From: noreply@feedback.planningportal.nsw.gov.au
To: DPE Energy and Resources Policy Mailbox
Subject: Webform submission from: Revised Large-Scale Solar Energy Guidelines
Date: Friday, 25 February 2022 6:11:55 PM
Attachments: cec-nsw-solar-guideline-submission_25feb22.pdf

Submitted on Fri, 25/02/2022 - 18:10

Submitted by: Anonymous

Submitted values are:

Submission Type
I am submitting on behalf of my organisation

Name

First name
Lucinda

Last name
Tonge

I would like my submission to remain confidential
No

Info

Email
[redacted]

Suburb/Town & Postcode
Melbourne

Please provide your view on the project
I am just providing comments

Submission file
cec-nsw-solar-guideline-submission_25feb22.pdf

Submission
Please see uploaded submission, thank you.

I agree to the above statement
Yes

25 February 2022

Matt Riley, Director – Energy and Resources Policy
Department of Planning and Environment
Locked Bag 5022 Parramatta NSW 2124
Via online submission

Dear Matt

Submission: Revised Large-Scale Solar Energy Guideline

The Clean Energy Council is pleased to provide a submission in response to the New South Wales Department of Planning and Energy's (**DPE**) Revised Large-Scale Solar Energy Guideline (Guideline).

The Clean Energy Council (**CEC**) is the peak body for the clean energy industry in Australia. We represent and work with over 950 of the leading businesses operating in renewable energy and energy storage. We are committed to accelerating Australia's clean energy transformation.

There are over 20 operational solar farms operating across New South Wales, and a further 16 large-scale projects currently under construction worth around $2.4billion in capital value. In all but the smaller projects, these developments are considered State Significant Development and they are subject to planning assessment by the State Government.

The large-scale solar industry is essential to the transition of NSW's electricity supply to clean energy. Significant levels of solar farm development will be required over the next decade in order to replace the state's retiring coal power stations, which are retiring increasingly early, as exemplified by the recent announcement about Eraring's 2025 closure. Indeed, the Australian Energy Market Operator's draft Integrated System Plan 2022 has indicated that coal generation is retiring 2-3 times faster than anticipated, with AEMO now expecting more than half of the remaining capacity retiring by 2030.[1] Transgrid's *Energy Vision* report similarly anticipates a rapid shift in the NSW electricity system away from coal generation.[2]

The NSW Government's Electricity Investment Roadmap and ambitious goal of 12 GW of renewable energy by 2030 relies heavily on new solar and wind farm development. While we recognise the importance of, and support, minimising the impacts of such developments, we note that imposing too many constraints and requirements on new projects risks deterring the scale of investment needed to both achieve the state government's targets and to manage the cost effectiveness of the energy transition.

With this in mind, the CEC welcomes the Guideline as an opportunity to provide more clarity for community and developers as what should be expected and appropriate in a large-scale solar project. However, in this submission we set out several strong recommendations to improve the Guideline.

[1] AEMO, *2022 Draft Integrated System Plan* (2021) https://aemo.com.au/en/energy-systems/major-publications/integrated-system-plan-isp/2022-integrated-system-plan-isp.
[2] Transgrid, *Energy Vision* (2021) https://www.transgrid.com.au/media/x4mbdody/transgrid_energy_vision.pdf.

Site selection (section 4.1)

While we appreciate that the Guideline is primarily a document for the proponents of large-scale solar projects, it will also prove to be an important resource for communities in helping them understand and form views about the appropriateness of site selection choices made by individual solar projects. To that end, the CEC submits that there is currently insufficient information for communities in the Guideline about the other constraints faced by solar proponents when it comes to site selection. Currently it focuses on why solar farms should not choose certain areas but doesn't articulate the challenges faced by solar project proponents in finding suitable sites and why some sites are more suitable than others.

Section 4.1 should therefore include a section targeted at the community audience, listing the multitude of factors solar farms must take into consideration when selecting a site, including restrictions such as:

- Proximity to the electricity grid, to minimise the need for additional infrastructure and associated impacts
- Distance from existing urban areas or designated urban growth areas (for example, the recently declared setbacks in the Infrastructure State Environment Planning Policy)
- Setbacks from the floodplain of a major water course or wetland, from waterways and drainage channels generally
- Access to main roads
- On land with topographical conditions that minimises visual amenity impacts and avoids the need for unnecessary or excessive earthworks
- Avoiding the loss (or minimising and/or offsetting) of native vegetation and biodiversity
- Accessing sufficient contiguous land that meets the above criteria, to enable a solar farm to be large enough to be cost-effective.

In addition to including a clearer articulation of the factors that make some sites undesirable from the perspective of solar farm proponents, we submit that this information should also be included in *Table 1. 'Key factors to be considered during site selection'* where they are not already included.

Agricultural land use (section 5.3)

The CEC understands that the use of prime agricultural land for uses such as solar farms is a highly complex issue. As the Department will be aware, renewable energy proponents actively avoid highly productive agricultural land wherever possible in planning for their projects. Under the CEC's Best Practice Charter, to which we have around 50 signatories, companies have committed to "minimising impacts on highly productive agricultural land and explore opportunities to integrate agricultural production". Practically, it is also more expensive for developers to buy or lease good agricultural land, and as such, there is no inherent incentive for proponents to seek out this acreage.

It is, however, becoming increasingly difficult to avoid land with sensitivities. The number of solar farms required to be built in NSW to achieve the Electricity Investment Roadmap, and the creation of concentrated areas of development through the Renewable Energy Zones (**REZs**), will mean that it is not always possible to avoid prime agricultural land when having to comply with the existing restrictions and constraints listed in the section above.

Furthermore, we note that the two practices are not mutually exclusive and that solar farming and agricultural practices can in fact produce positive outcomes by working and existing together. The two practices can be compatible and co-location is possible, as acknowledged by the Guideline. Additionally, we consider that a policy of avoiding Important Agricultural Land completely does not have regard for the post-development potential productive uses of the land at the end of life when the solar farm is decommissioned. With this in mind, we have outlined several recommendations below.

LSC Classification Step

Our main concern with this section is the land classifications suggested by the Guideline. The CEC submits there should be an option for proponents to adopt a conservative view and accept the designated land classification where the land is LSC 1-3, and follow the relevant assessment steps under the Guideline. This would allow the proponent to bypass the requirement for a soil test but still proceed under the "Level 3 detailed assessment" pathway.

One reason for suggesting the inclusion of such an option is that soil testing that reveals land to be in a lower class than previously thought can lead to unwanted community tensions about the quality of the land. If the site can be otherwise shown to be the most appropriate site in that section of the network, then confirmation of the LSC classification seems unnecessary.

Further, we submit that LSC 4 land that is adjacent to LSC 1-3 should not even require a detailed assessment.

Level 3 Assessment- detailed

Firstly, we agree with the position in the Guideline that applicants need to be able to justify the site of the project in light of alternatives and demonstrate that other project sites have been considered.

However, we consider that the requirement of "*a detailed economic assessment of project impacts on agricultural land, agricultural production and agricultural supply chains"* should instead be an assessment on whether the solar farm would have a ***material negative impact*** on the viability of the region's agricultural industry. This step was established in the case *Mirani Solar Farm vs Mackay Regional Council and Mackay Sugar* (2018).

In that case, the proponent was able to demonstrate that reasonable efforts had been made to find a land parcel of lower quality within the section of the network, and that none were readily available. The proponent had also been able to demonstrate that the use of the cane growing property for a large-scale solar development would not adversely affect the viability of the local sugar refinery. Judge Jones found that:

> "*Ensuring the protection of good quality agricultural land is a matter of significance as the evidence referred to identifies. That said, in performing the balancing act that I am required to do, I have reached the conclusion that I am satisfied that the proposed development ought to have been approved. To use the language of the Mackay Regional Planning Scheme, I am satisfied there is a need for this proposal that over-rides the need to protect good quality agricultural land and there is no alternative site. My conclusions might have been otherwise had there been evidence of the loss of this good quality agricultural land having an economic impact that might have affected the viability of the sugar mills in the region and otherwise involved a risk of material negative impact on the economy of the local government area, but that is not the case."*

Finally, we consider that the third requirement *"an analysis as to whether site design could be amended to reduce project impacts on agricultural land"* should be removed as this test will be addressed by conducting analysis for the previous requirement around site selection and is therefore unnecessary. To the extent that this dot point is intended to refer to the particular parcel of land hosting the prospective solar farm, we submit that these considerations are already addressed through land-owner consultation and decommissioning plans.

Further recommendations on agricultural land issues

Considering the difficulties in locating land without sensitives in the REZs (as outlined above) we submit that the first principle listed in section 5.3.2 should include the words "where possible". That is, *siting of solar energy projects on important agricultural land should be avoided* ***where possible.*** Currently, the wording of the Guideline may create a perception within the community that large-scale solar farms are no longer permitted on agricultural land, which may make community engagement more challenging.

The CEC also recommends that the word "conflict" be removed from the title of Section 5.3 as we consider this to be contentious language that sets an oppositional frame where the CEC believes there should be a greater focus on co-beneficial outcomes.

We further submit that the Guideline should also note that co-locating can result in real benefits for both the farmer and the solar farm, not simply ensuring the continued land use. Currently, the most common form of co-location (or 'agrisolar') is grazing sheep on site. The solar panels offer shade, protection from the elements and green pasture during droughts.[3] There is also emerging evidence on the potential to grow vegetables and crops underneath panels, as indicated by international research.[4] The CEC suggests that similar research could be encouraged and funded by the NSW Government, as has happened with Agriculture Victoria.[5,6]

Landholder consent (section 2.2.1)

The CEC submits that this section requires clarification to provide the proponent with more certainty around what documents to provide, specifically:

- What evidence/format is sufficient to confirm landholder consent, for example a signed letter from landholder or an email
- Confirm that the requirement for written landholder consent is in accordance with *Environmental Planning and Assessment Amendment (Planning Portal) Regulation 2020*.

Regarding the use of Crown land, the Crown Land landholder Consent form specifically requires the development application/environmental impact statement to be provided prior to consent application. However, this is not industry practice as Crown land consent can take several months which can cause significant delays to projects. The CEC therefore recommends that the process for Crown landholder consent should be updated and clarified.

It is also important to distinguish between Crown leasehold land (e.g. Western Plains Lease) and Crown/paper roads which are often found on rural properties. Crown/paper roads are either closed or a licence is required to utilise and construct infrastructure on the land. The process is timely and is completed after development consent has been granted. It is not practical to require Crown consent for lodging a development application, and these small parcels of land should not delay the development process.

Finally, other public (agency) landholder consents (TfNSW, ARTC, ETMHC etc.) can be costly and time consuming to obtain. These should not be required for lodgement of the development application.

---

[3] Clean Energy Council, *Australian Guide to Agrisolar for Large-scale Solar* (2021) https://assets.cleanenergycouncil.org.au/documents/resources/reports/agrisolar-guide/Australian-guide-to-agrisolar-for-large-scale-solar.pdf.

[4] Ibid.

Their consent should be obtained via the standard agency referral process during the assessment period.

Visual amenity (section 5.1)

The CEC is supportive of the prescriptive process and the supporting diagrams for the assessment of visual amenity. However, we are concerned about the timing and scope of the “First Stage: Preliminary visual assessment” and seek clarification that detailed community consultation is not required in the preliminary, scoping report, because the layout of the solar panels is too far from being finalised. Our view is that detailed community consultation makes most sense once the project layout has been informed by other constraints.

After conversations with DPE, the CEC understands that it is DPE’s intention that consultation at this first stage is simply to have community input to help identify key landscape features and viewpoints that the community consider important so this can be factored into the project. We recommend that the language in the Guideline is amended to clarify this position.

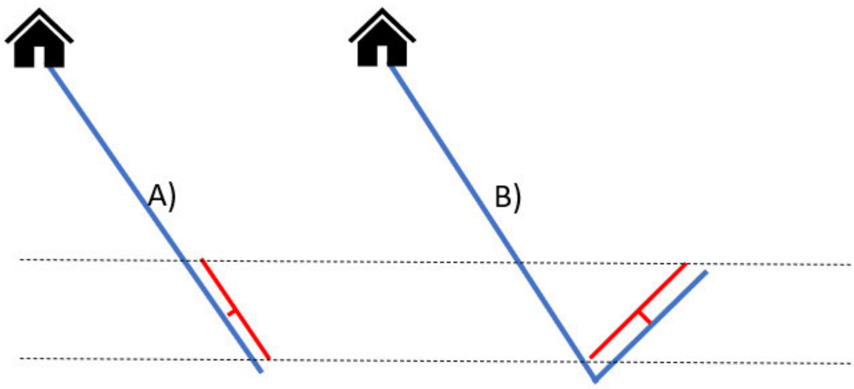
The CEC also recommends that section 5.1 could be more helpful for industry by making the following amendments:

- Clarify the sentence and provide an example of the following:

  > ‘*determine the height difference between the array and each viewpoint. This is calculated as the height difference between the project and the viewpoint plus the height difference from the lowest point on the project area to the highest point on the project area, including the height of the PV panels*’.

- Specify conditions for the viewshed analysis: relative viewpoint height, refraction, maximum/minimum angles, maximum radius.
- Specify if temporary infrastructure such as construction compounds must be included in the analysis.
- Provide the equations for *Figure 2. Preliminary Assessment Tool* and *Figure 4. Visual Magnitude Tool 1 – Vertical magnitude zones*.
- Specify the minimum elevation contour resolution required for the analysis.

The visual assessment does not consider the direction of the slope of the land and its influence on what proportion of the solar farm is visible from the receiver. The figure **below** shows an example of this. If the high and low points of the visible array and elevation and distance of the receiver are the same, the Preliminary Assessment Tool and the Vertical Magnitude Zone would provide the same result in both scenarios, while the real impact is significantly different.



Glint and glare (section 5.2)

While the CEC welcomes clarification around what is expected with glint and glare issues, we have several concerns with the guidance currently provided under the Guideline.

Definition of glare

Firstly, the main issue is that the brightness of glare is not considered in the Guideline, which will cause difficulty when predicting the *impact* of the glare. Experienced glare consultants that have conducted a large number of assessments for Australian solar farms have traditionally used the Sandia Labs SGHAT Ocular Plot criteria for Aviation Glare and the Threshold Increment (**TI**) value Road and Rail Disability Glare and Residential Nuisance Glare. The TI Value is calculated as the ratio of "veiling" luminance (e.g. from reflection) to the overall average background ("adaptation") luminance.

In Australia, a TI of 2-3 has been used at critical locations such as pedestrian crossings when conducting building reflective glare studies and this conservative value has been used as a useful benchmark for solar assessments of Residential Nuisance Glare by these consultants. If a threshold is not set for any of the relevant glare conditions of concern (aviation, road and rail, residential), this may result in *any* reflection being considered glare, no matter how low the brightness, which presumably is not the intended outcome of the Guideline.

We therefore submit that DPE should apply a brightness criterion threshold into its definition of glare, as appropriate for Aviation Glare, Road and Rail Disability Glare, and Residential Nuisance Glare, or alternatively, where no generally acceptable criterion is available (as in the case of Residential Nuisance Glare) to request proponents (or their consultants) to suggest one.

Furthermore, we submit that the criteria in Table 3 should clearly state "X mins per day **and** Y hours per year". Currently the criteria implies that **either/or** situation would classify as the corresponding level of glare. This outcome would result in an exceedingly low threshold, as it would not be difficult to exceed the 10 mins per day threshold at some dwellings, but it may only occur a few times per year. An alternative would be to replace the criteria table with a simple matrix where impact increases as a function of mins per day (x axis) vs hours per year (y axis), similar to a risk management matrix (likelihood vs consequence).

Finally, it is our understanding that internationally, and certainly in Australia, any reflection of the sun where the viewing angle of the sun is no greater than 10 degrees from the viewing angle of the object (in this case, the solar farm) is not considered to be glare – because the overwhelming effect will be the fact the view is almost directly into the sun. We submit that this convention should be recognised and adopted in the Guideline.

Location of receptors

The CEC considers that an assessment of impacts on dwellings within 4km is overly burdensome, when considering similar guidance in Victoria prescribes 1km. While it is possible that the solar farm and reflections can be viewed from 4km, any reflection would be low in brightness and not necessarily classed as glare. We submit that the distance should at least be amended to 3.25km, consistent with the visual amenity assessment requirements, and DPE's findings that glare impacts had been observed up to 3km away from the project.

The CEC understands that glint and glare assessments should only be undertaken on the receptor dwelling itself, not on any other part of the property, as the DPE confirmed in a meeting with the CEC on 10 February 2022. We submit that this should be clarified and made clearer in the Guideline. We also request that the Guideline confirms that the any glint and glare impacts during construction are only temporary and will not be assessed, for the benefit of both the developer and community expectations.

Waste (section 5.6) and other assessment issues (section 5.7)

Waste

The selection of manufacturers/distributors of PV panels and other infrastructure has often not been undertaken at the time of development application. Further, the construction contractor is responsible for waste management and will make decisions regarding suitable locations for recycling/disposal.

The CEC considers that it is premature at application stage to detail waste management arrangements as these can change considerably between the time of application and commencement of construction (which can be more than five years post application). We therefore submit that an estimation of the quantity and types of waste should be sufficient at the development stage. More details on waste management would be contained within the Construction Environmental Management Plan.

Furthermore, it is anticipated that reuse, refurbishment and recycling opportunities will develop rapidly over the next 20 years.

Transport

Engineering design drawings of proposed intersection and road upgrades would typically be required as a condition of consent and prepared during detailed design. However, the CEC considers that if this is going to be a standard requirement from DPE when assessing large-scale solar projects, this should be clearly stipulated as a requirement in the Guideline.

Heat Island

We acknowledge the Guideline specifies that there is only a setback to manage any potential heat island effect where that side of the solar farm is adjacent to land that is used for cropping or agricultural activity. While there is evidence of a small increase in ambient temperatures at 10-20m from the edge of a solar array (~1-1.5 degrees), it is not clear that this has any negative effect on cropping practices. We submit that the setback for sites adjacent to cropping should be reduced to 10 metres.

We also submit that the term “adjacent” should be clarified in the sentence “*Where a solar energy project is located adjacent to a horticultural or cropping activity”* (pg 31). The current wording is unclear as to where the cropping activity is located on the adjacent site and may lead to instances where a setback is enforced and the crops are not near the border of the property. We recommend that the Guideline be amended to so that the setback is in relation to where the cropping/horticultural activity is/has the potential to be located, rather than the property boundary.

Thank you again for this opportunity to provide feedback on the Guideline. We consider this piece of work very important for developers, communities and regulators and are very happy to provide any further assistance that may be needed in developing this Guideline. Please do not hesitate to contact me should you have any questions regarding our submission.

Yours sincerely

Dr Nicholas Aberle
Policy Director – Energy Generation & Storage
Clean Energy Council
naberle@cleanenergycouncil.org.au

[redacted]

From: noreply@feedback.planningportal.nsw.gov.au
Sent: Wednesday, 19 January 2022 8:39 PM
To: DPE Energy and Resources Policy Mailbox
Subject: Webform submission from: Revised Large-Scale Solar Energy Guidelines
Attachments: solar-photovoltaic-glint-and-glare-guidance---third-editionv3.1.pdf

Follow Up Flag: Follow up
Flag Status: Flagged

Submitted on Wed, 19/01/2022 - 20:34

Submitted by: Anonymous

Submitted values are:

Submission Type
I am submitting on behalf of my organisation

Name

First name
Danny

Last name
Scrivener

I would like my submission to remain confidential
No

Info

Email
[redacted]

Suburb/Town & Postcode
Sudbury, Suffolk, UK

Please provide your view on the project
I am just providing comments

Submission file
solar-photovoltaic-glint-and-glare-guidance---third-editionv3.1.pdf

Submission
The assessment boundary of 4km seems excessive for dwelling receptors considering glint and glare. Pager Power has deemed 1km to be an appropriate assessment boundary for dwellings. This is stated within the company's own glint and glare guidance (attached) which draws from the experience of over 800 glint and glare assessments. This has also been tested at a tribunal in Australia, whereby predicted impacts of glint and glare were found to be acceptable beyond 1km.

With respect to aviation, it is advised that consultation with an aerodrome is undertaken. Conservatively, 15km is an appropriate distance to assess out to. In reality significant effects are most likely for aviation receptors within 5km of a solar development.

The impact criteria within 5.2.4 seem reasonable however it appears to be replicating guidance used for shadow flicker from wind turbines. Shadow flicker is a much more intrusive effect compared to glare as you do not necessarily need to be able to see the wind turbine directly to experience the flicker effect, but with glare you need to have a clear view of the panels at the time glare is geometrically possible. This is much more unlikely. Pager Power recommends less restrictive criteria which have worked well. In general, these are: less than 3 months of the year = low impact, more than 6 months or more than 1 hour per day = moderate impact, more than 6 months and more than 1 hour per day = high impact. However this is a simplified approach, and the method for determining the impact significance should be determined based on the receptor type, i.e. road, dwelling or aviation (discussed below).

The assessment of different receptors should consider the specific requirements of each one when determining significance e.g. the duration of glare for a road user is not the main significance, it is where the glare originates from. Likewise for aviation, the main consideration is the intensity of glare, not duration. Therefore the impact of glare should be considered on a case-by-case basis for each receptor type based on varying significance criteria, with the significance not merely determined by the predicted duration.

Additional receptors may need to be referenced – this can include anything where safety or amenity may be compromised because of glint and glare. Railway lines are commonly assessed in the UK.

I attach our glint and glare guidance that we use to assess against all of the projects we work on for reference.

I agree to the above statement
Yes

PAGERPOWER
Urban & Renewables

Solar Photovoltaic and Building Development – Glint and Glare Guidance

PLANNING SOLUTIONS FOR:

- Solar
- Telecoms
- Railways
- Defence
- Buildings
- Wind
- Airports
- Radar
- Mitigation

www.pagerpower.com

April 2021 – Third edition

PAGERPOWER
Urban & Renewables

ADMINISTRATION PAGE

Reference:	Solar Photovoltaic Glint and Glare Guidance
Author and Reviewers:	Danny Scrivener, Kai Frolic and Mike Watson
Telephone:	+44 (0)1787 319001
Email:	danny@pagerpower.com, kai@pagerpower.com, mike@pagerpower.com

Revision History		
Issue	**Date**	**Detail of Changes**
1	April, 2017	First edition
2	October, 2018	Second edition This revision adds a methodology for the assessment of helipad operations whilst adding clarity to the previously presented methodologies through the experience gained in the time between edition 1 and 2. The methodologies have not changed significantly. High-level comments regarding the impact of building developments, particularly façades capable of producing specular reflections, is included within the foreword, which is also a new addition.
3	December, 2020	Third edition Updated Pager Power details. Updated Literature Review section Updated significance flow charts for determining the impact of solar reflections for road and dwelling receptors. Further comments on common considerations from railway stakeholders for glint and glare assessments including building and solar photovoltaic developments. Additional details regarding aviation assessments for building developments and the safeguarding of non-typical aviation receptors.
3.1	April, 2021	Update to the impact significance flow charts for road and dwelling receptors.

Stour Valley Business Centre, Sudbury, CO10 7GB

T:+44 (0)1787 319001 *E*:info@pagerpower.com *W*:www.pagerpower.com

FOREWORD

Introduction and Background

The number, size and scale of solar photovoltaic (PV) developments continues to rise, with glint and glare assessments often required within the UK, South Africa, Australia, India and elsewhere in the world. The requirement for a glint and glare assessment now extends to building developments with reflective façades. Rapid deployment of PV in the UK between 2010-2015 lead to a knowledge gap in the area of glint and glare, with assessments often required without definition of what constitutes a significant impact. Pager Power has been at the forefront of this planning issue, having now completed over 600 glint and glare assessments to date.

The original aim of the first edition of the glint and glare guidance was to produce a standardised methodology for PV developers, planners and stakeholders to follow. This was well received, adding clarity to a previously unfamiliar planning issue. The second edition, produced over a year and a half later, did not reinvent the assessment methodology for PV, it merely refined and added detail where required based on the experience gained subsequently. The requirement for glint and glare assessments of building developments, specifically those with large reflective façades, had also grown between the first and second edition and therefore further additional information regarding the methodology for assessment was provided.

The third edition now further refines the guidance and adds additional guidance for building developments, specifically in the vicinity of airports and railway infrastructure. The focus remains on the guidance for PV panels, however where required, additional information in presented for building developments.

The guidance presents the methodology recommended by Pager Power through assessment experience. It should be used for reference and ideally, the methodology should be agreed with the relevant stakeholder where an assessment is required. There may be cases where the assessment scenario does not match the guidance criteria, in this situation, a pragmatic approach is recommended.

It is understood that this guidance document has now been referred to internationally.

Guidance Basis

Prepared for:

Developers, planners and stakeholders.

Aim:

To provide guidance for assessing the impact of glint and glare from solar photovoltaic (PV) panels and building developments with large reflective façades upon surrounding receptors.

Receptors:

Dwellings (residential amenity), Roads (safety), Rail (safety) and Aviation (safety).

EXECUTIVE SUMMARY

Overview and Purpose

The purpose of this guidance document is to provide solar photovoltaic (PV) and building developers, planners and stakeholders with an assessment process for determining the effects of glint and glare (solar reflections) upon receptors surrounding a proposed solar PV and building development.

Throughout the document, the focus remains on the guidance for PV panels, however where required, additional information in presented for building developments. If a building development is not specifically mentioned, then assume the guidance is not applicable or relevant.

Formal guidance around glint and glare remains somewhat lacking in many cases. This guidance document has therefore been produced to bridge this knowledge gap pertaining to the assessment of glint and glare. The aim is to produce a standardised assessment process for developers, planners and stakeholders to reduce the element of risk associated with glint and glare.

The guidance presented is based on the following:

- Reviews of existing guidance in a variety of areas;
- Glint and glare assessment experience and industry knowledge;
- An overview of available solar reflection studies.

This guidance document is based on knowledge initially gained through analysis within the UK and Irish markets however the methodologies are deemed applicable, and have been used, for worldwide solar PV development and building development.

Key Receptors

Glint and glare can significantly affect nearby receptors under particular conditions. The key receptors with respect to glint and glare are residents in surrounding dwellings, road users, train infrastructure (including train drivers), and aviation infrastructure (including pilots and air traffic controllers). Other receptors do exist, however this guidance considers the four most common receptor types unless otherwise stated.

Modelling Requirements

A geometric glint and glare assessment model must include the following:

- The Earth's orbit around the Sun;
- The Earth's rotation;
- The Earth's orientation;

- The location of the solar PV development or building development including the reflector (solar panel or façade) area;
- The reflector's 3D orientation including azimuth angle of the solar panel or façade (the orientation of the reflectors relative to north and the reflector elevation angle;
- Local topography including receptor and panel or façade heights above mean sea level.

For increased accuracy, the model could account for the following:

- Terrain at the visible horizon;
- Local time zone and daylight savings times;
- Consideration of sunrise and sunset times;
- Determine which solar panels create the solar reflection within the solar PV development;
- Determine what area of the façade create the solar reflection from the building development;
- Azimuth range of the Sun[1] when a solar reflection is geometrically possible;
- Vertical elevation range of the Sun when a solar reflection is geometrically possible;
- High-resolution analysis i.e. undertaking multiple geometric calculations within the given solar PV development or façade area. For example, at intervals of between 1 and 20 metres;
- Consideration of the effect of non-specular reflective surfaces e.g. masonry between glass façades;
- The intensity[2] of any solar reflection produced.

Assessment Inputs – Receptors

The following paragraphs set out the key distances for identifying receptors and the height data which should be included.

Dwellings within approximately 1km of a proposed solar PV development that may have a view of the PV panels should be assessed. Terrain heights and an additional height to account for the solar panel and eye level within the relevant floor of the dwelling should also be considered. Dwellings are not typically assessed for building developments.

National roads, or those with greater significance, within approximately 1km of a proposed solar PV development that may have a view of the PV panels should be assessed. Terrain heights and

[1] The azimuth range is the angle between the Sun and North, measured clockwise around the receptor's horizon. The Sun azimuth range shows the location of the Sun when a geometric solar reflection is possible. Therefore, it is possible to determine whether the Sun and the solar reflection are both likely to be visible to a receptor.
[2] In W/cm^2 at the retina, for example.

an additional height to account for the solar panel and eye level of a road user should also be considered. Roads are not typically assessed for building developments.

Where railway infrastructure is located within approximately 100m of a proposed solar PV or building development that may have a view of the PV panels, an assessment should be undertaken. Train drivers out to 500m should be assessed. Any signals, crossings or vital railway infrastructure within 500m that could be affected by glare should be assessed especially where railway signal utilises incandescent bulb[3] technology and/or where no hood is attached. Terrain heights and an additional height to account for the solar panel/façade and eye level of a train driver or the height of a railway signal should also be considered.

Aviation receptors out to 30km[4] from a proposed PV development should be considered to determine the requirement for assessment, if any. A full technical assessment is usually undertaken for those developments located within 10km of an aerodrome or if specifically requested by the aerodrome safeguarding team. The typical receptors include the Air Traffic Control (ATC) tower and a 2-mile approach path for the relevant runway approaches. Additional receptors may be included where a solar reflection may be deemed a hazard to safety e.g. helipad approaches and the visual manoeuvring area (VMA). Aviation receptors for building developments are the same.

Assessment Significance

Determining the significance of a solar reflection varies for each receptor type. In general, the significance criteria for glint and glare effects are as follows:

- No Impact – A solar reflection is not geometrically possible or will not be visible from the assessed receptor. No mitigation required.
- Low – A solar reflection is geometrically possible however any impact is considered to be small such that mitigation is not required e.g. intervening screening will limit the view of the reflecting solar panels significantly or the glare time per year is considered negligible. No mitigation required.
- Moderate – A solar reflection is geometrically possible and visible however it occurs under conditions that do not represent a worst-case scenario e.g. a solar reflection originates from a less sensitive location. Mitigation may be required.
- High – A solar reflection is geometrically possible and visible under conditions that will produce a significant impact. Mitigation will be required if the proposed development is to proceed. Mitigation and consultation is recommended.

There may be instances where the solar reflection scenario does not fall accurately within the significance categories. Where this occurs, detailed consideration of the receptors and the modelling results should be undertaken.

---

[3] Non-LED.
[4] Aviation stakeholders can and have requested a glint and glare assessment beyond 30km.

See the following sections where the process for determining the significance of a solar reflection is described for each receptor type:

- Section 6 – Dwellings;
- Section 7 – Road infrastructure;
- Section 8 – Railway infrastructure;
- Section 9 – Aviation infrastructure.

In each section, the process for determining the significance of a solar reflection is described comprehensively.

Guidance Conclusions

This guidance should be followed to ensure comprehensive assessment of solar PV and building developments with respect to glint and glare. This guidance is applicable for solar PV and building development anywhere in the world.

LIST OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

GLOSSARY

Term	Definition
Aerodrome	A defined area on land or water (including any buildings, installations, and equipment) intended to be used either wholly or in part for the arrival, departure, and surface movement of aircraft[5].
Approach Path	The descent path of an aircraft as it comes in for landing.
ATC Tower	Air Traffic Control tower – used by air traffic controllers to observe and direct aviation activity at or near to an aerodrome.
Azimuth Angle	The angle the solar panel faces relative to north (0/360 degrees).
CAA	Civil Aviation Authority.
Diffuse Reflection	The reflection of light from a surface such that the incident light is reflected at many angles rather than at just one angle.
Elevation Angle	The angle of the solar panel relative to 0 degrees (the horizontal or flat).
FAA	Federal Aviation Administration.
Façade	The reflective surface of a building development
Glare	A continuous source of bright light.
Glint	A momentary flash of bright light.
Glint and Glare	As above. Interchangeably used with the term 'solar reflection' where the specific type of reflection is not necessary.
IAA	Irish Aviation Authority.
Incandescent Light Bulb	An incandescent light bulb is an electric light with a wire filament heated to a high temperature. An electric current is passed through it until it glows with visible light.

[5] International Civil Aviation Organization (ICAO) Documents, Aerodrome Standards, Aerodrome Design and Operations. Annex 14 to The Convention on International Civil Aviation (Chicago Convention), Volume I- Aerodrome Design and Operations under Definitions.

Term	Definition
Incident Solar Reflection	The solar reflection from the solar panel appears visible and close to the location of the Sun, such that both the solar reflection and the Sun originate and are visible from a receptor's viewpoint simultaneously. The angle between the reflected light and the perpendicular (or normal) to the surface (solar panel) is the angle of incidence.
LED	A light-emitting diode (LED). It is a semiconductor diode, which glows when a voltage is applied. LED signals are brighter and more efficient than incandescent bulbs and normally do not have a reflective mirror.
Level Crossing	A crossing where (typically) a road passes over a railway line.
Level Crossing Warning Lights (LCWL)	The system of lights located next to a level crossing on a railway line, used to warn road users from crossing.
National Roads: Typically A Roads (UK) or N Roads (Ireland)	Typically a road with a one or more carriageways with a maximum speed limit of up to 60mph or 70mph (UK A Road) or 100kph (Ireland N Road). These roads typically have fast moving vehicles with moderate to busy traffic density. Other road designations or maximum speed limits may apply internationally.
Major National Roads: Typically a motorway	Typically a road with a minimum of two carriageways with a maximum speed limit of up to 70mph (UK) or 120kph (Ireland). These roads typically have fast moving vehicles with busy traffic. Other road designation or maximum speed limits may apply internationally.
Local Roads	Typically roads and lanes with the lowest traffic densities. Speed limits vary.
Normal	The mathematical term used to define the line at right angles to a reflector i.e. a solar panel.
Potential for temporary after-image	The likelihood of a solar reflection continuing to appear in one's vision after the exposure to the original image has ceased.
Railway Signal	A light or physical signalling system located beside a railway line. Used to indicate to a train driver a particular order.

Term	Definition
Receptor	A potential viewer of glint and glare effects. They may be located in a dwelling, as a pilot in a plane, as a road user, train operator etc..
Regional Roads B Roads (UK) or R Roads (Ireland)	Typically a single carriageway with a maximum speed limit of up to 60mph (UK B Road) or 80kph (Ireland R Road). The speed of vehicles will vary with a typical traffic density of low to moderate. Other road designations or maximum speed limits may apply internationally.
Runway Threshold	The beginning of the physical runway surface.
SGHAT	Solar Glare Hazard Analysis Tool - solar glint and glare model designed by Sandia National Laboratory, specifically for aviation and recommended by the FAA.
Signal Hood	A signal hood is located on a lit railway signal to screen the light from direct sunlight.
Shadow Flicker	Refers to the sunlight flickering effect caused when rotating wind turbine blades periodically cast shadows over neighbouring properties through small openings such as windows.
Solar Reflection	Also referred to as glint or glare. Used interchangeably to describe glint or glare where the type of solar reflection is not necessary.
Specular Reflection	The mirror-like reflection of light from a surface, in which light from a single incoming direction is reflected into a single outgoing direction.

Glossary

PAGER POWER COMPANY PROFILE

Company Background

Pager Power is a dedicated consultancy company based in Suffolk, UK. The company has undertaken projects in 48 countries within Europe, Africa, America, Asia and Australia.

The company comprises a team of experts to provide technical expertise and guidance on a range of planning issues for large and small developments.

Pager Power was established in 1997. Initially the company focus was on modelling the impact of wind turbines on radar systems.

Over the years, the company has expanded into numerous fields including:

- Renewable energy projects.
- Building developments.
- Aviation and telecommunication systems.

Pager Power prides itself on providing comprehensive, understandable and accurate assessments of complex issues in line with national and international standards. This is underpinned by its custom software, longstanding relationships with stakeholders and active role in conferences and research efforts around the world.

Pager Power's assessments withstand legal scrutiny and the company can provide support for a project at any stage.

Pager Power's Experience

Pager Power has undertaken over 600 Glint and Glare Assessments in the United Kingdom and internationally.

The studies have included assessment of civil and military aerodromes, railway infrastructure and other ground-based receptors including roads and dwellings.

1 OVERVIEW

Introduction

1.1 Glint and glare is a planning consideration brought about through the rise and rapid deployment of solar photovoltaic (PV) development. There has been a lack of official guidance documents for developers, planners or stakeholders to follow and therefore Pager Power has produced this document to assist with this planning consideration.

1.2 The requirement for a glint and glare assessment has now extended to new building developments, or indeed any project which has the potential to produce significant glare through a specular solar reflection.

1.3 Whilst general planning guidance for solar PV development has been established, there is no specific planning guidance, in the UK and Ireland, for assessing the effects of glint and glare on surrounding receptors. There also remains no standardised guidance in regard to glare from building developments.

1.4 This guidance document has specific focus on the UK and Irish markets however the methodologies are deemed applicable for worldwide solar PV or building development.

Purpose

1.5 This guidance has been produced for developers, planners and stakeholders.

1.6 The aims of this guidance are as follows:

- To bridge the knowledge gap for all stakeholders regarding glint and glare (solar reflections) from solar PV and building developments;
- To produce a standardised and universally agreed methodology for assessing the impact of glint and glare upon receptors surrounding a proposed solar PV and building development;
- To ensure the proper and safe development of renewable energy schemes and building projects in the UK, Ireland and internationally with respect to glint and glare.

1.7 A standardised process will reduce risk for all stakeholders of a proposed solar PV or building development.

1.8 The guidance is based on industry knowledge, consultation and experience.

Scope

1.9 Glint and glare is referenced within guidance documents[6] throughout the UK and Ireland, however a specific methodology for assessing, contextualising and determining the impact of solar glint and glare are not provided for many receptor types. Aviation is covered within FAA guidance from the USA, however this is not strictly applicable within the UK and Ireland, nor is it currently endorsed by the CAA or IAA in the UK or Republic of Ireland respectively.

1.10 This guidance document aims to present a standardised methodology for assessing glint and glare for surrounding receptors, this includes:

- Residents in surrounding dwellings;
- Road users on surrounding roads;
- Railway infrastructure (including train drivers);
- Aviation infrastructure (including pilots and air traffic controllers).

Glint and Glare Definition

1.11 The reflective properties of solar PV panels vary from different manufacturers. Whilst solar panels vary in their reflectivity with some claiming 'anti-glare' properties, no solar panel absorbs 100% of the incoming light. Therefore, any solar PV panel has the potential to produce a solar reflection. The relative absorptive properties of a solar panel should be considered on a case-by-case basis.

1.12 The reflective properties of glass are similar to PV panels, with both producing reflections of similar intensities.

1.13 The definition of glint and glare can vary, however, the definition used for the purpose of this guidance is as follows:

- Glint – a momentary flash of bright light;
- Glare – a continuous source of bright light.

1.14 In context, glint will be witnessed by moderate to fast moving receptors whilst glare would be encountered by static or slow moving receptors with respect to a solar farm. The term 'solar reflection' is used to refer to both reflection types i.e. glint and glare.

[6] Overview of the associated guidance is presented in Section 3.

2 CONSULTATION

Consultation Overview

Consultation with key stakeholders is essential to ensure any concerns are suitably addressed. A list of some of the key stakeholders pertaining to safety related glint and glare issues is presented in Table 1 below.

Party	Comment
UK Civil Aviation Authority (CAA)	Key stakeholders pertaining to safety.
UK Ministry of Defence (MOD)	
Irish Department of Defence (DOD)	
Irish Aviation Authority (IAA)	
Network Rail	
Irish Rail	
Relevant Highways Agencies	

Table 1 *Stakeholder consultation*

3 LITERATURE REVIEW

3.1 A review of the available guidance and studies pertaining to solar PV developments and glint and glare is presented in this section.

Planning Guidance

UK Planning Practice Guidance

3.2 UK Planning Practice Guidance dictates that a glint and glare assessment is required in some instances. The guidance for 'Renewable and low carbon energy'[7] dictates the following with respect to glint and glare. Note only the relevant information is presented.

> *The deployment of large-scale solar farms can have a negative impact on the rural environment, particularly in undulating landscapes. However, the visual impact of a well-planned and well-screened solar farm can be properly addressed within the landscape if planned sensitively.*
>
> *Particular factors a local planning authority will need to consider include:*
>
> - *the proposal's visual impact, the effect on landscape of glint and glare (see guidance on landscape assessment) and on neighbouring uses and aircraft safety;*
> - *the extent to which there may be additional impacts if solar arrays follow the daily movement of the sun;*
> - *great care should be taken to ensure heritage assets are conserved in a manner appropriate to their significance, including the impact of proposals on views important to their setting. As the significance of a heritage asset derives not only from its physical presence, but also from its setting, careful consideration should be given to the impact of large scale solar farms on such assets. Depending on their scale, design and prominence, a large scale solar farm within the setting of a heritage asset may cause substantial harm to the significance of the asset;*
> - *the potential to mitigate landscape and visual impacts through, for example, screening with native hedges.*
> - *The approach to assessing cumulative landscape and visual impact of large scale solar farms is likely to be the same as assessing the impact of wind turbines. However, in the case of ground-mounted solar panels it should be noted that with effective screening and appropriate land topography the area of a zone of visual influence could be zero.*

[7] UK Planning Practice Guidance, 2015. Renewable and low carbon energy - What are the particular planning considerations that relate to large scale ground-mounted solar photovoltaic Farms? Last accessed 01.07.2020.

3.3 The UK planning guidance does not provide a specific methodology for assessing the impact of glint and glare.

Road Safety Guidance

UK Highway Code

3.4 Information relating to solar glare and general guidelines for safer driving is presented in the UK's Highway Code8. Each country will have their own guidance with respect to road safety. The relevant information is presented below for reference. Note only the relevant information is presented.

93 Slow down, and if necessary stop, if you are dazzled by bright sunlight.

125 The speed limit is the absolute maximum and does not mean it is safe to drive at that speed irrespective of conditions. Driving at speeds too fast for the road and traffic conditions is dangerous. You should always reduce your speed when:

- *the road layout or condition presents hazards, such as bends;*
- *sharing the road with pedestrians, cyclists and horse riders, particularly children, and motorcyclists;*
- *weather conditions make it safer to do so;*
- *driving at night as it is more difficult to see other road users.*

146 Adapt your driving to the appropriate type and condition of road you are on. In particular:

- *do not treat speed limits as a target. It is often not appropriate or safe to drive at the maximum speed limit;*
- *take the road and traffic conditions into account. Be prepared for unexpected or difficult situations, for example, the road being blocked beyond a blind bend. Be prepared to adjust your speed as a precaution;*
- *where there are junctions, be prepared for road users emerging;*
- *in side roads and country lanes look out for unmarked junctions where nobody has priority;*
- *be prepared to stop at traffic control systems, road works, pedestrian crossings or traffic lights as necessary;*
- *try to anticipate what pedestrians and cyclists might do. If pedestrians, particularly children, are looking the other way, they may step out into the road without seeing you.*

[8] The Highway Code, 2016. Department of Transport, UK Government. Last accessed 01.07.2020.

3.5 Different countries have various highway standards that must be followed. The UK Highway Code states that a driver should be aware of particular hazards such as glare from the Sun, and should adjust their driving style appropriately. Solar panels reflect sunlight producing solar reflections under specific conditions, therefore it is advised that this guidance is considered.

Railway Guidance

3.6 It is understood that that railway guidance with respect to signalling has changed[9]. The following historical guidance is therefore presented for reference only.

UK Network Rail Guidance

3.7 This section provides an overview of the relevant railway guidance with respect to the siting of signals on railway lines. Network Rail is the stakeholder of the UK's railway infrastructure[10]. Generally, a railway operator's concerns would likely to relate to the following:

- The development producing a solar reflection that affects train drivers;
- The development producing a solar reflection towards level crossing warning lights (LCWL) or level crossings; and
- The development producing a solar reflection that affects railway signals.

3.8 The railway guidelines are presented below. The extract is taken from section 3.2 of the 'Guidance on Signal Positioning and Visibility' which details the visibility of signals, train drivers' field of vision and the implications with regard to signal positioning. Note only the relevant information is presented.

> ***3.2 The visibility of signals***
>
> ***3.2.1 Overview***
>
> *The effectiveness of an observer's visual system in detecting the existence of a target will depend upon the object's position in the observer's visual field, its contrast with its background, its luminance properties, and the observer's adaptation to the illumination level of the environment. It is also influenced by the processes relating to colour vision, visual accommodation, and visual acuity. Each of these issues is described below.*
>
> ***3.2.2 Field of vision***
>
> *The field of vision, or visual field, is the area of the visual environment that is registered by the eyes when both eyes and head are held still. The normal extent of the visual field is approximately 135 degrees in the vertical plane and 200 degrees in the horizontal plane.*
> *The visual field is normally divided into central and peripheral regions: the central field being the area that provides detailed information. This extends from the central point (0 degrees) to approximately 30 degrees at each eye. The peripheral field extends from 30 degrees out to the edge of the visual field.*

---

[9] Known to Pager Power as of August 2020.

[10] Guidance on Signal Positioning and Visibility, December 2003. Railway Group Guidance Note. Last accessed 28.03.2017.

Objects are seen more quickly and identified more accurately if they are positioned towards the centre of the observer's field of vision, as this is where our sensitivity to contrast is highest. Peripheral vision is particularly sensitive to movement and light.

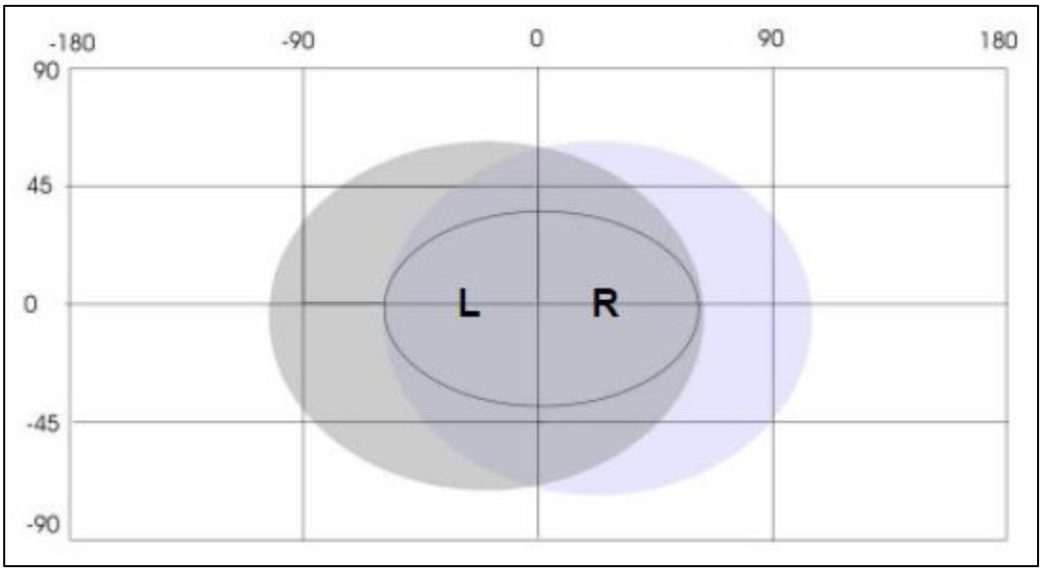


Figure 1 *Field of view*

In the diagram above, the two shaded regions represent the view from the left eye (L) and the right eye (R) respectively. The darker shaded region represents the region of binocular overlap. The oval in the centre represents the central field of vision.

Research has shown that vehicle drivers search for signs/signals towards the centre of the field of vision. As approach speed increases, drivers demonstrate a tunnel vision effect and focus only on objects in a field of + 8° from the direction of travel

3.2.2.1 Field of vision

*Drivers become increasingly dependent on central vision for signal detection at increasing train speeds, and even minor distractions can reduce the visibility of the signal if it is viewed towards the peripheral field of vision. (**D I**)*

*Because of our sensitivity to movement in the peripheral field, the presence of clutter to the sides of the running line, for example, fence posts, lamp-posts, traffic, or non-signal lights, such as house, factory or security lights, can be highly distracting. (**D I**)*

3.2.2.2 Implications

*Signals should be at a height and distance from the running line that permits them to be viewed towards the centre of the field of vision. (**D**)*

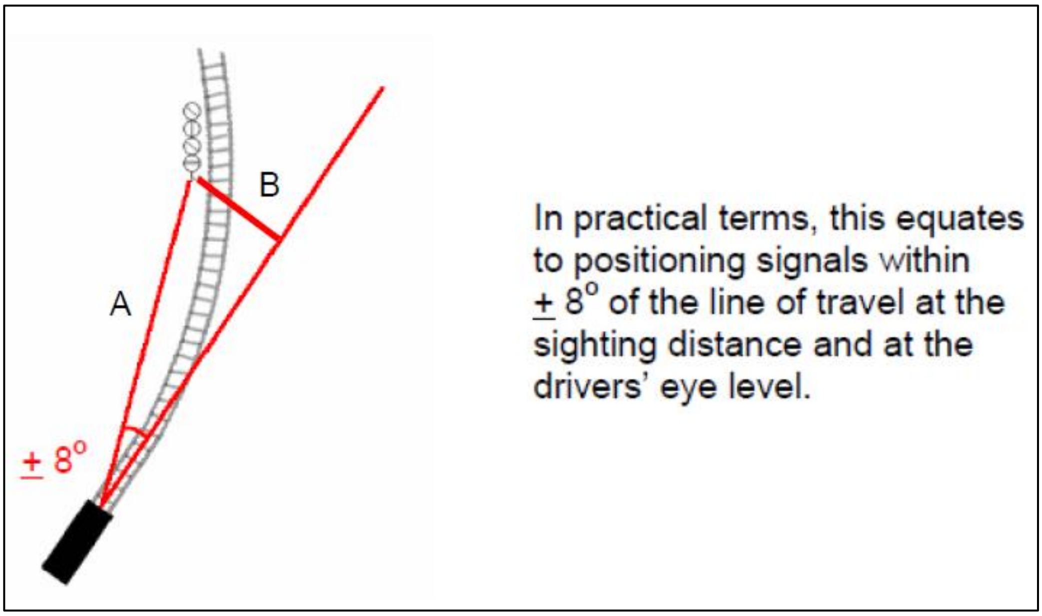


Figure 2 *Signal positioning*

*'Car stop' signs should be positioned such that, if practicable, platform starting signals and 'OFF' indicators can be seen in the driver's central field of vision. (**D**)*

*If possible, clutter and non-signal lights in a driver's field of view should be screened off or removed so that they do not cause distraction. (**D I**)*

The distance at which the 8° cone along the track is initiated is dependent on the minimum reading time and distance which is associated to the speed of trains along the track. The extract below is taken from section B5 (pages 8-9) of the guidance which details the required minimum reading time for a train driver when approaching a signal. Note only the relevant information is presented.

'B5.2.2 Determining the assessed minimum reading time

GE/RT8037

The assessed minimum reading time shall be no less than eight seconds travelling time before the signal.

The assessed minimum reading time shall be greater than eight seconds where there is an increased likelihood of misread or failure to observe. Circumstances where this applies include, but are not necessarily limited to, the following:

a) the time taken to identify the signal is longer (for example, because the signal being viewed is one of a number of signals on a gantry, or because the signal is viewed against a complex background)

b) the time taken to interpret the information presented by the signal is longer (for example, because the signal is capable of presenting route information for a complex layout ahead) *c) there is a risk that the need to perform other duties could cause distraction from viewing the signal correctly (for example, the observance of lineside signs, a station stop between the caution and stop signals, or DOO (P) duties)*

d) the control of the train speed is influenced by other factors (for example, anticipation of the signal aspect changing).

The assessed minimum reading time shall be determined using a structured format approved by the infrastructure controller.

3.9 Network Rail guidance does not specifically reference the effect of glint and glare from solar PV developments on railway infrastructure. Nonetheless, the guidance references the importance of signal visibility and driver awareness, hence the guidance has merit when determining whether glint and glare will have a significant impact on railway safety.

Aviation Guidance

UK CAA Guidance

3.10 The UK Civil Aviation Authority (CAA) issued interim guidance relating to Solar Photovoltaic Systems (SPV) on 17 December 2010 and was subject to a CAA information alert 2010/53. The formal policy was cancelled on September 7th, 2012[11] however it remains the most recent and comprehensive CAA guidance produced to date. The CAA guidance is presented in the section below. Note only the relevant information is presented.

> **Interim CAA Guidance - Solar Photovoltaic Systems**
>
> *BACKGROUND*
>
> *1 Airport interest in solar energy is growing rapidly as a way to reduce operating costs and to demonstrate a commitment to renewable energy and sustainable development. In response, the CAA is seeking to develop its policy on the installation of Solar Photovoltaic (SPV) Systems and their impact on aviation. In doing so, it is reviewing the results of research having been carried out in the United States by the Federal Aviation Administration (FAA) culminating in the publication of Technical Guidance for Evaluating Solar Technologies on Airports[12] and also reviewing guidance issued by other National Aviation Safety Administrations and Authorities on this subject.*
>
> *2 On completion of the review, the CAA, together with the assistance of other aviation stakeholders, will develop a policy and provide formal guidance material on the installation of SPV, principally on or in the vicinity[13] of licensed aerodromes but will also include guidance on installations away from aerodromes (or 'en-route'[14]). This document therefore constitutes interim CAA guidance until a formal policy has been developed.*
>
> *DISCUSSION*
>
> *3 At present the key safety issue is perceived to be the potential for reflection from SPV to cause glare, dazzling pilots or leading them to confuse reflections with aeronautical lights. Whilst permission is not required from the CAA for any individual or group to shine or reflect a light or lights into the sky, SPV developers should be aware of the requirements to comply with the Air Navigation Order (ANO) 2009. In particular, developers and Local Planning Authorities (LPA) should be cognisant of the following articles of the ANO with respect to any SPV development regardless of location:*
>
> - *Article 137 – Endangering safety of an aircraft.*

[11] CAA, 2010. Interim CAA Guidance - Solar Photovoltaic Systems. Last accessed 28.03.2017.
[12] Discussed in the following section.
[13] *'In this context, the term "in the vicinity" refers to officially safeguarded aerodromes noted in the Planning Circulars (see Paragraph 10) and a distance of up to 15km from the 'Aerodrome Reference Point' or the centre of the longest runway.'*
[14] *'SPV installations proposed further than 15km from an aerodrome are considered "en-route" developments, and may still require consultation with the CAA for an assessment on the impact, if any, to CNS equipment.'*

- *Article 221 – Lights liable to endanger.*
- *Article 222 – Lights which dazzle or distract.*

4 The potential for SPV installations to cause electromagnetic or other interference with aeronautical Communications Navigational and Surveillance equipment (CNS) must be considered by the SPV developer, in coordination with the CAA, the aerodrome Air Traffic Service provider (ATS), the Air Navigation Service Provider (ANSP) and/or NATS and the MoD, as required.

5 Where SPV systems are installed on structures that, for example, extend above the roofline of tall buildings (either on, or 'off-aerodrome'), or where they are installed in the vertical plane (on plinths or towers), then there may be the potential for creating an obstacle hazard to aircraft and - in addition to the potential for creating turbulence hazard to aircraft - any infringement of the aerodrome Obstacle Limitation Surfaces (OLS) shall also need to be considered by the Aerodrome Licence Holder (ALH).

6 For all planned SPV installations it is best practice for the developer to consult with the operators of nearby aerodromes before any construction is initiated.

7 An ALH, in agreement with their LPA, may wish to initiate procedures so that it is only consulted on SPV planning applications at shorter distances from the aerodrome (for example within a 5 km radius), or at distances that would limit SPV development from within the aircraft operating visual circuit; however, this is at the discretion of the ALH and no CAA approval or endorsement of this decision is necessary.

RECOMMENDATIONS

8. It is recommended that, as part of a planning application, the SPV developer provide safety assurance documentation (including risk assessment) regarding the full potential impact of the SPV installation on aviation interests.

9. Guidance on safeguarding procedures at CAA licensed aerodromes is published within CAP 738 Safeguarding of Aerodromes and advice for unlicensed aerodromes is contained within CAP 793 Safe Operating Practices at Unlicensed Aerodromes.

10. Where proposed developments in the vicinity of aerodromes require an application for planning permission the relevant LPA normally consults aerodrome operators or NATS when aeronautical interests might be affected. This consultation procedure is a statutory obligation in the case of certain major airports, and may include military establishments and certain air traffic surveillance technical sites. These arrangements are explained in Department for Transport Circular 1/2003 and for Scotland, Scottish Government Circular 2/2003.

11. In the event of SPV developments proposed under the Electricity Act, the relevant government department should routinely consult with the CAA. There is therefore no requirement for the CAA to be separately consulted for such proposed SPV installations or developments.

12. If an installation of SPV systems is planned on-aerodrome (i.e. within its licensed boundary) then it is recommended that data on the reflectivity of the solar panel material should be included in any assessment before installation approval can be granted. Although approval for installation is the responsibility of the ALH, as part of a condition of a CAA Aerodrome Licence, the ALH is required to obtain prior consent from CAA Aerodrome Standards Department before any work is begun or approval to the developer or LPA is granted, in accordance with the procedures set out in CAP 791 Procedures for Changes to Aerodrome Infrastructure.

13. During the installation and associated construction of SPV systems there may also be a need to liaise with nearby aerodromes if cranes are to be used; CAA notification and permission is not required.

14. The CAA aims to replace this informal guidance with formal policy in due course and reserves the right to cancel, amend or alter the guidance provided in this document at its discretion upon receipt of new information.

15. Further guidance may be obtained from CAA's Aerodrome Standards Department via aerodromes@caa.co.uk.

3.11 The CAA Guidance does not provide a methodology for assessing the effects of glint and glare on aviation infrastructure. Many aviation stakeholders under the umbrella of the CAA in the UK utilise the US FAA guidance presented on the following page. It is known that other countries internationally recommend the FAA guidance and it remains the most detailed methodology for assessing glint and glare internationally. The FAA guidance is presented in the following subsection.

US FAA Guidance

3.12 The most comprehensive guidelines available for the assessment of solar PV developments near aerodromes were produced initially in November 2010 by the United States Federal Aviation Administration (FAA) and updated in 2013.

3.13 The 2010 document is entitled 'Technical Guidance for Evaluating Selected Solar Technologies on Airports'[15].

3.14 The 2013 version is entitled 'Interim Policy, FAA Review of Solar Energy System Projects on Federally Obligated Airports'[16].

3.15 The 2018 version is entitled 'Technical Guidance for Evaluating Selected Solar Technologies on Airports'[17] and is version 1.1 of the 2013 edition. The key changes are as follows:

Version 1.1 (April 2018):

o Updated Section 3.1.2, Reflectivity, to incorporate the latest information about evaluating solar glint and glare.

o Updated corresponding references to glare throughout the document.

o Clarified the relationship between solar energy and the FAA's Voluntary Airport Low Emissions (VALE) program in Section 5.3.2.

o Added information about the FAA's Airport Energy Efficiency Program to Section 5.3.3.

o Updated FAA Contact information on Appendix A (where appropriate).

3.16 Key points[18] from the latest FAA guidance produced in 2018 are presented in the following section.

16. Abstract

Airport interest in solar energy is growing rapidly as a way to reduce airport operating costs and to demonstrate a commitment to sustainable development. In response, the Federal Aviation Administration (FAA) has prepared Technical Guidance for Evaluating Selected Solar Technologies on Airports to meet the regulatory and informational needs of the FAA Airports organization and airport sponsors.

For airports with favorable solar access and economics, this report provides a checklist of FAA procedures to ensure that proposed photovoltaic or solar thermal hot water systems are safe and pose no risk to pilots, air traffic controllers, or airport operations. Case studies of operating

---

[15] FAA, 2010. Technical Guidance for Evaluating Selected Solar Technologies on Airports. Last accessed 28.03.2017.
[16] FAA, 2013. Interim Policy, FAA Review of Solar Energy System Projects on Federally Obligated Airports. Last accessed 28.03.2017.
[17] FAA, 2018. Technical Guidance for Evaluating Selected Solar Technologies on Airports. Last accessed 06.07.2020.
[18] Edited to include only key information with respect to assessing glint and glare from solar PV developments.

airport solar facilities are provided, including Denver International, Fresno Yosemite International, and Albuquerque International Sunport.

…

Preface

Over 15 airports around the country are operating solar facilities and airport interest in solar energy is growing rapidly. In response, the Federal Aviation Administration (FAA) has prepared this report, Technical Guidance for Evaluating Selected Solar Technologies on Airports, to meet the regulatory and information needs of FAA personnel and airport sponsors in evaluating airport solar projects.

The guidance is intended to provide a readily usable reference for FAA technical staff who review proposed airport solar projects and for airport sponsors that may be considering a solar installation. It addresses a wide range of topics including solar technology, electric grid infrastructure, FAA safety regulations, financing alternatives, and incentives.

Airport sponsors are interested in solar energy for many reasons. Solar technology has matured and is now a reliable way to reduce airport operating costs. Environmentally, solar energy shows a commitment to environmental stewardship, especially when the panels are visible to the traveling public. Among the environmental benefits are cleaner air and fewer greenhouse gases that contribute to climate change. Solar use also facilitates small business development and U.S. energy independence.

While offering benefits, solar energy introduces some new and unforeseen issues, like possible reflectivity and communication systems interference. The guidance discusses these issues and offers new information that can facilitate FAA project reviews, including a flow chart of FAA procedures to ensure that proposed systems are safe and pose no risks to pilots, air traffic controllers, or airport operations.

The guidance includes case studies of operating solar projects at Denver International, Fresno Yosemite International, Metropolitan Oakland International, Meadows Field (Bakersfield), and Albuquerque International Sunport. Each case study highlights a particular area of interest such as the selected technology, siting considerations, financing, and regulatory requirements.

…

1 AIRPORTS AND SOLAR ENERGY: CHARTING A COURSE

Though solar energy has been evolving since the early 1990's as a mainstream form of renewable energy generation, the expansion in the industry over the past 10 years and corresponding decrease in prices has only recently made it a practical consideration for airports. Solar energy presents itself as an opportunity for FAA and airports to produce on-site electricity and to reduce long-term electricity use and energy costs. While solar energy has many benefits, it does introduce some new and unforeseen issues, like possible glare (also referred to as reflectivity) and communication systems interference, which have complicated FAA review and *approval of this technology. This guide discusses such issues and how FAA reviews for solar projects can be streamlined and standardized to a greater extent.*

…

3.1.2 Reflectivity

Reflectivity refers to light that is reflected off surfaces. The potential effects of reflectivity are glint (a momentary flash of bright light) and glare (a continuous source of bright light). These two effects are referred to hereinafter as "glare," which can cause a brief loss of vision, also known as flash blindness.

FAA Order 7400.2, Procedures for Handling Airspace Matters, defines flash blindness as "generally, a temporary visual interference effect that persists after the source of illumination has ceased."

The amount of light reflected off a solar panel surface depends on the amount of sunlight hitting the surface, its surface reflectivity, geographic location, time of year, cloud cover, and solar panel orientation. As illustrated on Figure 16[19], flat, smooth surfaces reflect a more concentrated amount of sunlight back to the receiver, which is referred to as specular reflection. The more a surface is polished, the more it shines. Rough or uneven surfaces reflect light in a diffused or scattered manner and, therefore, the light will not be received as bright.

CSP systems use mirrors to maximize reflection and focus the reflected sunlight and associated heat on a design point to produce steam, which generates electricity. About 90 percent of sunlight is reflected. However, because the reflected sunlight is controlled and focused on the heat collecting element (HCE) of the system, it generally does not reflect back to other sensitive receptors. Another source of reflection in a CSP system is the light that contacts the back of the HCE and never reaches the mirror. Parts of the metal frame can also reflect sunlight. In central receiver (or power tower) applications, the receiver can receive concentrated sunlight that is up to a thousand times the sun's normal irradiance. Reflections from a central receiver, although approximately 90% absorptive, can still reflect a great deal of sunlight.

Solar PV and SHW panels are constructed of dark, light-absorbing materials and covered with an anti-reflective coating designed to maximize absorption and minimize reflection. However, the glass surfaces of solar PV and SHW systems also reflect sunlight to varying degrees throughout the day and year. The amount of reflected sunlight is based on the incidence angle of the sun relative to the light-sensitive receptor (e.g., a pilot or air traffic tower controller). The amount of reflection increases with lower incidence angles. In some situations, 100% of the sun's energy can be reflected from solar PV and SHW panels.

Because solar energy systems introduce new visual surfaces to an airport setting where reflectivity could result in glare that can cause flash blindness to those that require clear,

[19] Shown as figure 3 in this report.

unobstructed vision, project proponents should evaluate reflectivity during project siting and design.

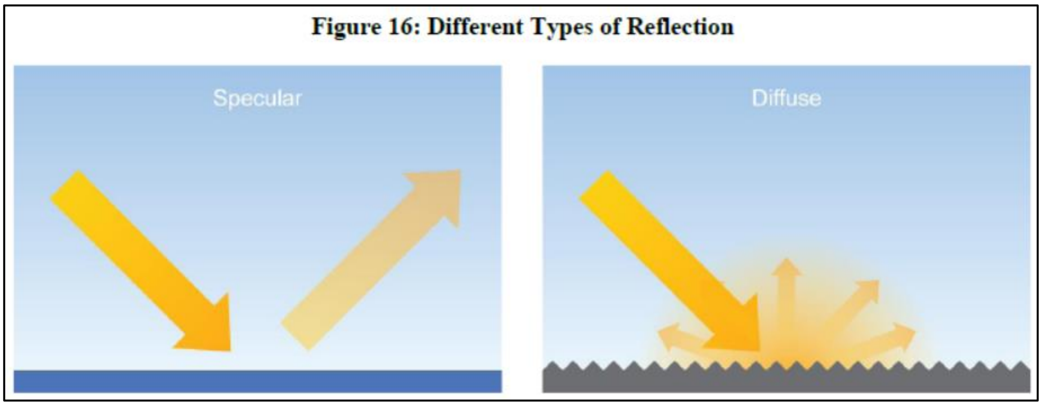


Figure 3 *Specular versus diffuse reflections*

Completing an Individual Glare Analysis

Evaluating glare for a specific project should be an iterative process that looks at one or more of the methodologies described below. Airport sponsors should coordinate closely with the FAA's Office of Airports to evaluate the potential for glint and glare for solar projects on airport property. These data should include a review of existing airport conditions and a comparison with existing sources of glare, as well as related information obtained from other airports with experience operating solar projects.

Because the FAA has no specific standards for airport solar facilities and potential glare, the type of glare analysis may vary. Depending on site specifics (e.g., existing land uses, location and size of the project) an acceptable evaluation could involve one or more of the following levels of assessment:

(1) A qualitative analysis of potential impact in consultation with the Air Traffic Control Tower, pilots, and airport officials

(2) A demonstration field test with solar panels at the proposed site in coordination with Air Traffic Control Tower personnel

(3) A geometric analysis to determine days and times when there may be an ocular impact.

The FAA should be consulted after completing each of the following steps to determine if potential reflectivity issues have been adequately considered and addressed.

The extent of reflectivity analysis required to assess potential impacts will depend on the specific project site and system design.

1. Assessing Baseline Reflectivity Conditions

Reflection in the form of glare is present in current aviation operations. The existing sources of glare come from glass windows, auto surface parking, rooftops, and water bodies. At airports, existing reflecting surfaces may include hangar roofs, surface parking, and glassy office buildings. To minimize unexpected glare, windows of air traffic control towers and airplane *cockpits are coated with anti-reflective glazing. Operators also wear polarized eye wear. Potential glare from solar panels should be viewed in this context. Any airport considering a solar PV project should first review existing sources of glare at the airport and the effectiveness of measures used to mitigate that glare.*

2. Tests in the Field

Potential glare from solar panels can easily be viewed at the airport through a field test. A few airports have coordinated these tests with FAA Air Traffic Controllers to assess the significance of glare impacts. To conduct such a test, a sponsor can take a solar panel out to proposed location of the solar project, and tilt the panel in different directions to evaluate the potential for glare onto the air traffic control tower. For the two known cases where a field test was conducted, tower personnel determined the glare was not significant. If there is a significant glare impact, the project can be modified by ensuring panels are not directed in that direction.

3. Geometric Analysis

Geometric studies are the most technical approach for reflectivity issues. They are conducted when glare is difficult to assess through other methods. Studies of glare can employ geometry and the known path of the sun to predict when sunlight will reflect off of a fixed surface (like a solar panel) and contact a fixed receptor (e.g., control tower). At any given site, the sun moves across the sky every day and its path in the sky changes throughout year. This in turn alters the destination of the resultant reflections since the angle of reflection for the solar panels will be the same as the angle at which the sun hits the panels. The larger the reflective surface, the greater the likelihood of glare impacts. Figure 17 provides an example of such a geometric analysis (not shown).

Facilities placed in remote locations, like the desert, will be far from receptors and therefore potential impacts are limited to passing aircraft. Because the intensity of the light reflected from the solar panel decreases with increasing distance, an appropriate question is how far you need to be from a solar reflected surface to avoid flash blindness. It is known that this distance is directly proportional to the size of the array in question23 but still requires further research to definitively answer.

The FAA Airport Facilities Terminal Integration Laboratory (AFTIL), located at the William J. Hughes Technical Center at Atlantic City International Airport, provides system capabilities to evaluate control tower interior design and layout, site selection and orientation, height determination studies, and the transition of equipment into the airport traffic control tower environment. AFTIL regularly conducts computer assessments of potential penetrations of airspace for proposed airport design projects and has modeled the potential characteristics of glare sources, though not for solar projects. AFTIL may be a resource for regional FAA officials and sponsors who seek to evaluate the potential effects of glare from proposed solar projects.

Experiences of Existing Airport Solar Projects

Solar installations are presently operating at a number of airports, including megawatt-sized solar facilities covering multiple acres. Air traffic control towers have expressed concern about *glint and glare from a small number of solar installations. These were often instances when solar installations were sited between the tower and airfield, or for installations with inadequate or no reflectivity analysis. Adequate reflectivity analysis and alternative siting addressed initial issues at those installations*

3.17 The previous 2013 guidance stated that any proposed solar PV development should not produce glint and glare towards the ATC Tower (existing or proposed). 'No glint and glare' or glare with a 'low potential for temporary after-image' is acceptable towards any existing or proposed 2-mile runway approach path[20]. Glare of greater intensity is not acceptable towards a 2-mile runway approach. Most aerodromes[21] still apply the 2013 guidance. The 2018 update offers three assessment options however where a proposed solar development is located where a risk to aviation safety is possible, geometric analysis, as per the 2013 guidance, will likely be the only option available to alleviate concerns.

[20] As per the Solar Glare Hazard Analysis Tool (SGHAT), developed by Sandia National Laboratories – discussed in the 2013 guidance.

[21] Based on Pager Power's assessment experience.

The Air Navigation Order

3.18 The Air Navigation Order (ANO) from 2009[22] contains general aviation legislation with respect to aviation safety. Key points relating to general safety and light as a hazard are presented below. Note only the relevant information is presented.

> **The Air Navigation Order 2009**
>
> ***'Endangering safety of an aircraft***
>
> *137. A person must not recklessly or negligently act in a manner likely to endanger an aircraft, or any person in an aircraft.*
>
> ***Lights liable to endanger***
>
> *221.—(1) A person must not exhibit in the United Kingdom any light which—*
>
> *(a) by reason of its glare is liable to endanger aircraft taking off from or landing at an aerodrome; or*
>
> *(b) by reason of its liability to be mistaken for an aeronautical ground light is liable to endanger aircraft.*
>
> *(2) If any light which appears to the CAA to be a light described in paragraph (1) is exhibited, the CAA may direct the person who is the occupier of the place where the light is exhibited or who has charge of the light, to take such steps within a reasonable time as are specified in the direction—*
>
> *(a) to extinguish or screen the light; and*
>
> *(b) to prevent in the future the exhibition of any other light which may similarly endanger aircraft.*
>
> *(3) The direction may be served either personally or by post, or by affixing it in some conspicuous place near to the light to which it relates.*
>
> *(4) In the case of a light which is or may be visible from any waters within the area of a general lighthouse authority, the power of the CAA under this article must not be exercised except with the consent of that authority.*
>
> ***Lights which dazzle or distract***
>
> *222. A person must not in the United Kingdom direct or shine any light at any aircraft in flight so as to dazzle or distract the pilot of the aircraft.'*

[22] The Air Navigation Order, 2009. No. 3015. Last accessed 01.07.2020.

3.19 The document states that no ‘light’, ‘dazzle’ or ‘glare’ should be produced which would produce a detrimental impact to aircraft safety. This guidance is referenced within the CAA guidance.

4 MODELLING PARAMETER REQUIREMENTS

4.1 A glint and glare assessment requires a geometric model to accurately predict whether a solar reflection is geometrically possible towards a receptor.

Geometric Modelling Requirements

4.2 The requirements for a geometric model are presented below. Failure to include the parameters below is likely to result an over-simplified output that would not be considered reliable in the context of predicted impact. The calculations are three dimensional and complex, and must account for the following:

- The Earth’s orbit around the Sun;
- The Earth’s rotation;
- The Earth’s orientation;
- The location of the solar PV development or building development including the reflector (solar panel or façade) area;
- The reflector’s 3D orientation including azimuth angle of the solar panel or façade (the orientation of the reflectors relative to north and the reflector elevation angle;
- Local topography including receptor and reflector (panel or façade) heights above mean sea level.

For increased accuracy, the model could account for the following:

- Terrain at the visible horizon;
- Local time zone and daylight savings times;
- Consideration of sunrise and sunset times;
- Determine which solar panels create the solar reflection within the solar PV development;
- Determine what area of the façade create the solar reflection from the building development;
- Azimuth range of the Sun[23] when a solar reflection is geometrically possible;
- Vertical elevation range of the Sun when a solar reflection is geometrically possible;
- High-resolution analysis i.e. undertaking multiple geometric calculations within the given solar PV development or façade area. For example, at intervals of between 1 and 20 metres;

[23] The azimuth range is the angle between the Sun and North, measured clockwise around the receptor's horizon. The Sun azimuth range shows the location of the Sun when a geometric solar reflection is possible. Therefore, it is possible to determine whether the Sun and the solar reflection are both likely to be visible to a receptor.

- Consideration of the effect of non-specular reflective surfaces e.g. masonry between glass façades;
- The intensity[24] of any solar reflection produced.

Geometric Modelling Overview

4.3 Solar reflections from a solar panel or a façade made of glass are specular meaning that a high percentage of incoming light is reflected in a particular direction. The direction of a specular solar reflection from a flat reflector is calculated by considering the normal. The normal is an imaginary line perpendicular to the reflective surface and originates from the point the incoming light intercepts the face of the reflector. Figure 4 and Figure 5 below may be used to aid understanding of the reflection calculation process.

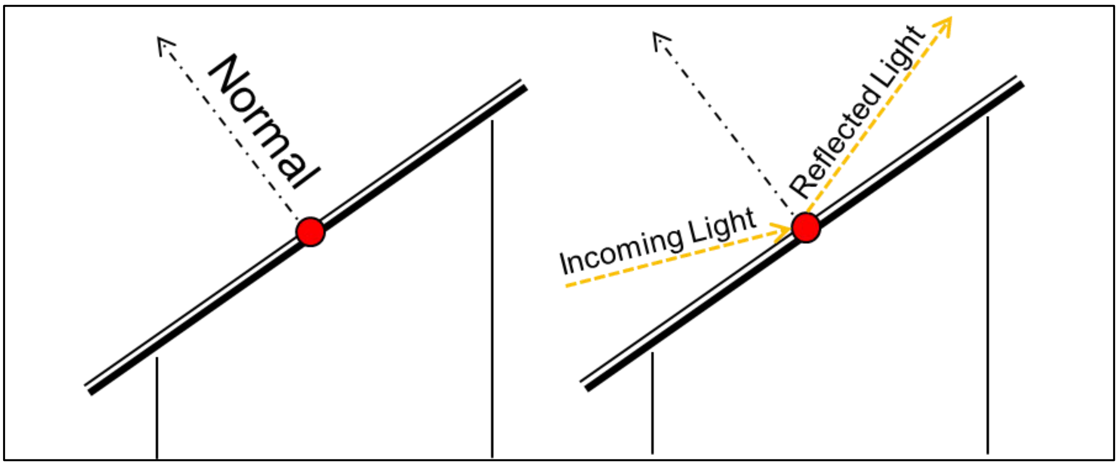


Figure 4 *Illustration showing normal and solar reflection from a solar panel (side on).*

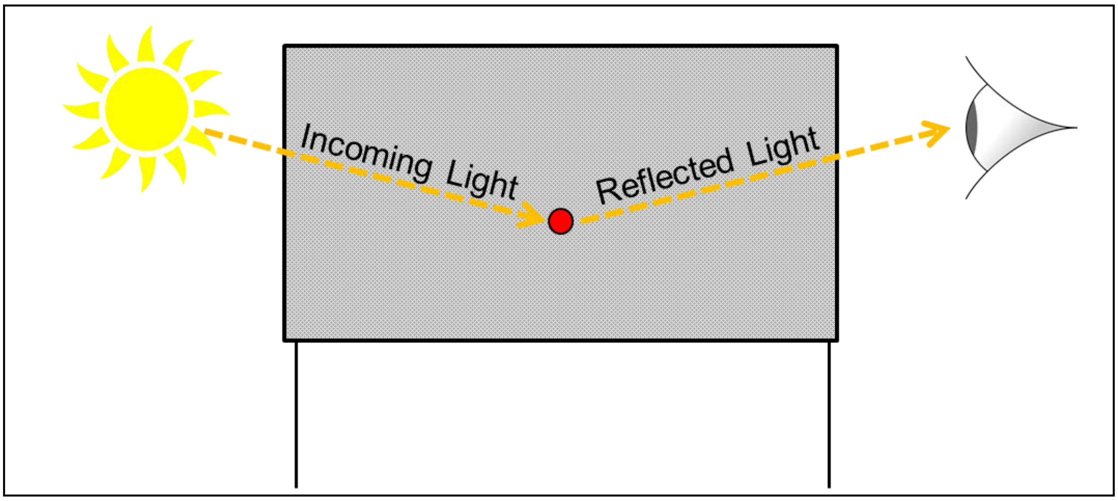


Figure 5 *Illustration showing solar reflection from a solar panel (top down).*

[24] In W/cm^2 at the retina, for example.

4.4 The direction of a solar reflection is also dependent on the elevation angle and the azimuth angle of a solar panel. The solar panel elevation angle and azimuth angle are illustrated in Figure 6 below.

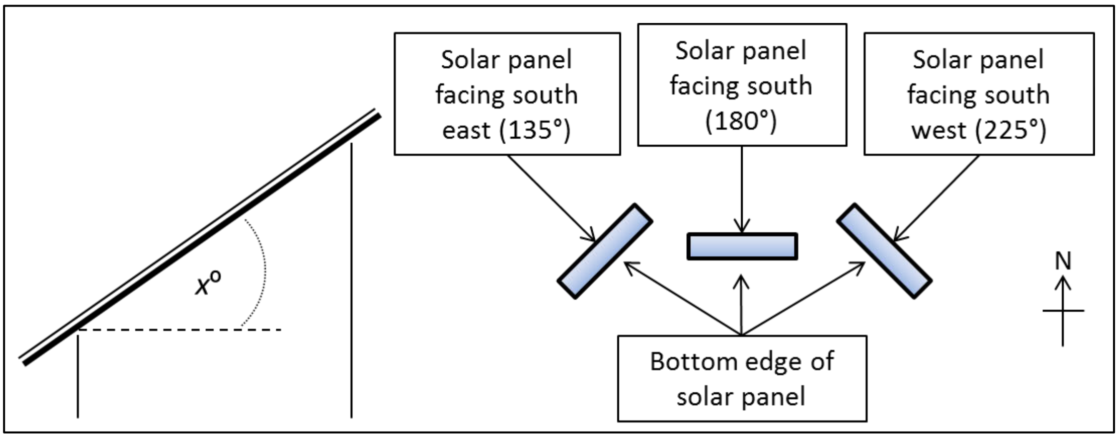


Figure 6 *Illustration showing panel elevation angle (side-on) and panel azimuth angle (top down)*

4.5 The left image in Figure 6 shows the panel elevation angle. A typical panel elevation angle value for x in the UK and Ireland is 15°-35°. The right image shows the panel azimuth angle viewed from a top down perspective. A typical panel azimuth angle in the UK and Ireland is 180° (facing south towards the equator). Building façades are typically at 90 degrees to the horizontal, however some buildings, such as the Shard in London (UK), do not have façades that are perpendicular to the ground.

Geometric Modelling Methodology Overview

4.6 A geometric solar reflection model needs to consider a number of factors when determining whether a solar refection is geometrically possible towards a surrounding receptors, and if so, the duration throughout the year. The following information is required for a complete geometric solar reflection model:

- A model of the Sun's path throughout the sky for an entire selected year;
- For calculating a solar reflection:
  - The 3D angle between the source and the normal;
  - The azimuth and elevation of the solar reflection, by verifying the following:
    - That the angle between source (the Sun) and normal (relative to ther reflector, considering its elevation and azimuth angle) is equal to the angle between the normal and solar reflection;
    - That the source, normal and solar reflection are in the same plane;
    - A model of the path of the Sun relative to the reflector area based on the reflector's latitude and longitude;
    - The assessed receptor location's latitude and longitude relative to the above.

- The model must then be run to determine whether the Sun is ever in a position within the sky to create a solar reflection from the reflectors towards the assessed receptor. This must consider the relative heights of the reflectors and receptors. Where a solar reflection is geometrically possible, a date time graph is a suitable representational format.

4.7 The process outlined above does not describe the full methodology for undertaking a detailed geometric glint and glare assessment however, it presents the key criteria that must be considered within a model.

Modelling Parameter Requirement Conclusions

4.8 Various modelling methodologies can be used to model solar reflections from the Sun. The process outlined provides general guidance for the parameters that should be built into a geometric solar reflection model.

5 GLINT AND GLARE IMPACT SIGNIFICANCE

Overview

5.1 The significance of glint and glare will vary for different receptors. This section presents a general overview of the significance criteria with respect to experiencing a solar reflection.

Impact Significance Definition

5.2 For each glint and glare assessment, an overall conclusion should be made with reference to the requirement for mitigation for each assessed receptor. Table 2 below presents the recommended definition of 'impact significance' in glint and glare terms and the requirement for mitigation under each.

Impact Significance	Definition	Mitigation Requirement
No Impact	A solar reflection is not geometrically possible or will not be visible from the assessed receptor.	No mitigation required.
Low	A solar reflection is geometrically possible however any impact is considered to be small such that mitigation is not required e.g. intervening screening will limit the view of the reflecting solar panels significantly.	No mitigation required.
Moderate	A solar reflection is geometrically possible and visible however it occurs under conditions that do not represent a worst-case.	Whilst the impact may be acceptable, consultation and/or further analysis should be undertaken to determine the requirement for mitigation and/or recommendations for or against mitigation should be made by an expert on a case by case basis with suitable reasoning.

Impact Significance	Definition	Mitigation Requirement
High	A solar reflection is geometrically possible and visible under conditions that will produce a significant impact. Mitigation and consultation is recommended.	Mitigation will be required if the proposed development is to proceed.

Table 2 *Impact significance definition*

5.3 Figure 7 on the following page highlights the general conditions under which a solar reflection may be possible. These are key considerations when determining whether a solar reflection is to be considered significant and whether mitigation should be implemented.

General Overview – Determining Significant Glint and Glare Effects

5.4 The following six conditions should be considered when determining whether a predicted solar reflection will produce an impact (low to high) for the assessed receptors. These conditions are illustrated in Figure 7 to the right. Each one is explained further below.

1. The reflector can be seen by the receptor i.e. there is line of sight between the observer (receptor) and the reflector;
2. The location of the receptor relative to the solar reflection. The significance of a solar reflection may be dependent on its location of origin relative to the location of the receptor;
3. The time of day when the Sun is in the position to produce a solar reflection from a reflector towards an assessed receptor[25]. Some times of day may be more significant than others for some receptors;
4. The path between the Sun and reflector is clear of obstruction i.e. there is a line of sight between the Sun and the reflector when the Sun is at a location in the sky where it can produce a solar reflection;
5. The solar reflection is not coming from the same direction as the Sun. A solar reflection is less significant when a receptor is already facing directly at the Sun;
6. A momentary exposure is less significant than a prolonged one. Therefore, the duration of the solar reflection should be considered for static receptors i.e. dwellings or ATC Towers.

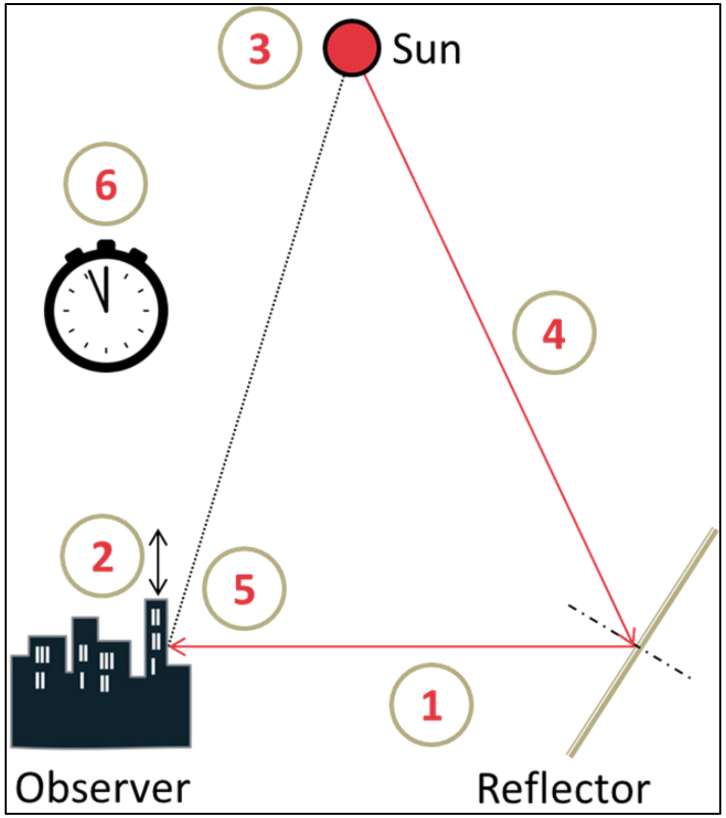


Figure 7 *Conditions for determining significant glint and glare*

[25] Not specifically referenced within the significance criteria for each assessed receptor (dwellings, road, rail and aviation) however in some instance the time of day may warrant consideration.

5.5 Figure 8 below shows the general process for determining the significance of glint and glare.

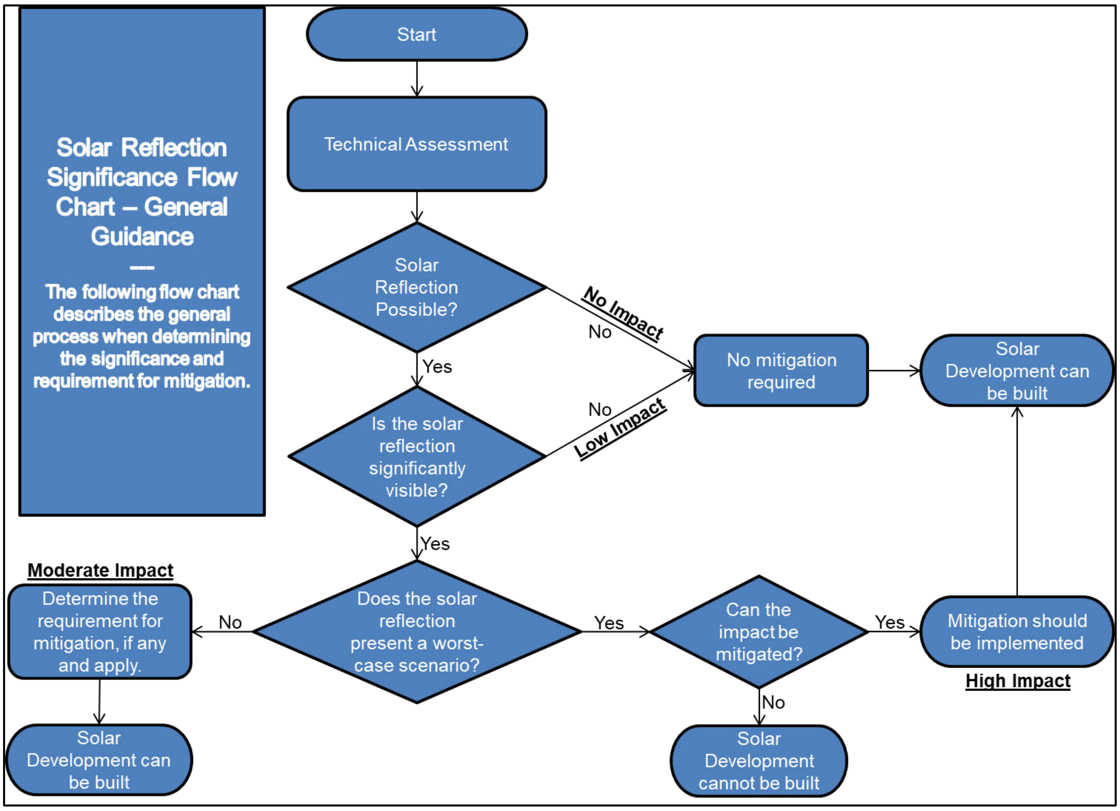


Figure 8 *General process for determining the significance of glint and glare*

5.6 The specific methodologies for each receptor (dwellings, road, railway and aviation) are presented in Sections 6-9.

6 ASSESSING THE IMPACT UPON SURROUNDING DWELLINGS

Overview

6.1 Local residents are a key stakeholder within the local environment when proposing a solar PV development. This is because residents will be living in close proximity to the solar PV development whilst also potentially having views of the solar panels for its lifetime. Where a view of the solar panel exists, a solar reflection may be possible which may impact upon residential amenity. The following guidance has therefore been produced to determine in what instances, a solar reflection becomes significant and mitigation should be implemented. The effects of glint and glare from building developments is not typically considered however, if required, the general methodology can be applied.

Key Considerations

6.2 A list of key considerations for assessing glint and glare with respect to surrounding dwellings and residential amenity is presented below:

- Surrounding dwellings may have views of a solar PV development. Where a view of the solar panel exists, a solar reflection may be possible;
- A view of a solar panel however does not guarantee that a solar reflection is possible;
- There is no technical limit (distance) within which solar reflections is possible for a surrounding dwelling receptor however, the significance of a reflection decreases with distance. This is because the proportion of an observer's field of vision that is taken up by the reflecting area diminishes as the separation distance increases;
- Seasonal variations or additional developments may change the view from a dwelling towards the solar panels over time;
- Terrain and shielding by vegetation are also more likely to obstruct an observer's view at longer distances;
- In general, the geometry of the relationship between typical ground mounted solar panels and the movement of the Sun in the northern hemisphere means that dwellings due east and west of the panels are most likely to view a solar reflection for south facing arrays panels. Dwellings that are north or south of the panels are unlikely to experience a solar reflection in this instance;
- For solar PV developments that have solar panels orientated at an azimuth angle other than south, solar reflections may be directed in alternate directions.

6.3 The following subsections present the recommended methodology for assessing the impact upon residential amenity.

Identifying Receptors

6.4 The following process should be used for identifying dwelling receptors:

1. Identify dwellings in the immediate surrounding area (out to approximately 1km from the solar PV development boundary) that may have visual line of sight to the solar panels. Figure 9 below shows the receptor identification process;
2. If visual line of sight exists between the proposed solar PV development and a dwelling, then a solar reflection could be experienced if it is geometrically possible. If there is no line of sight, then a reflection cannot be experienced;
3. An additional height should be added to the ground level at a dwelling to represent a viewing height;
4. For dwellings, a recommended additional height of 1.8 metres above ground level should be added to account for eye level on the ground floor. A height of 3.8 metres is recommended for a first floor. Additional heights should be considered where a receptor is higher than a first floor. Modelling is recommended for ground floor receptors because it is typically occupied during daylight hours;
5. Use the height and location data within the geometric solar reflection model.

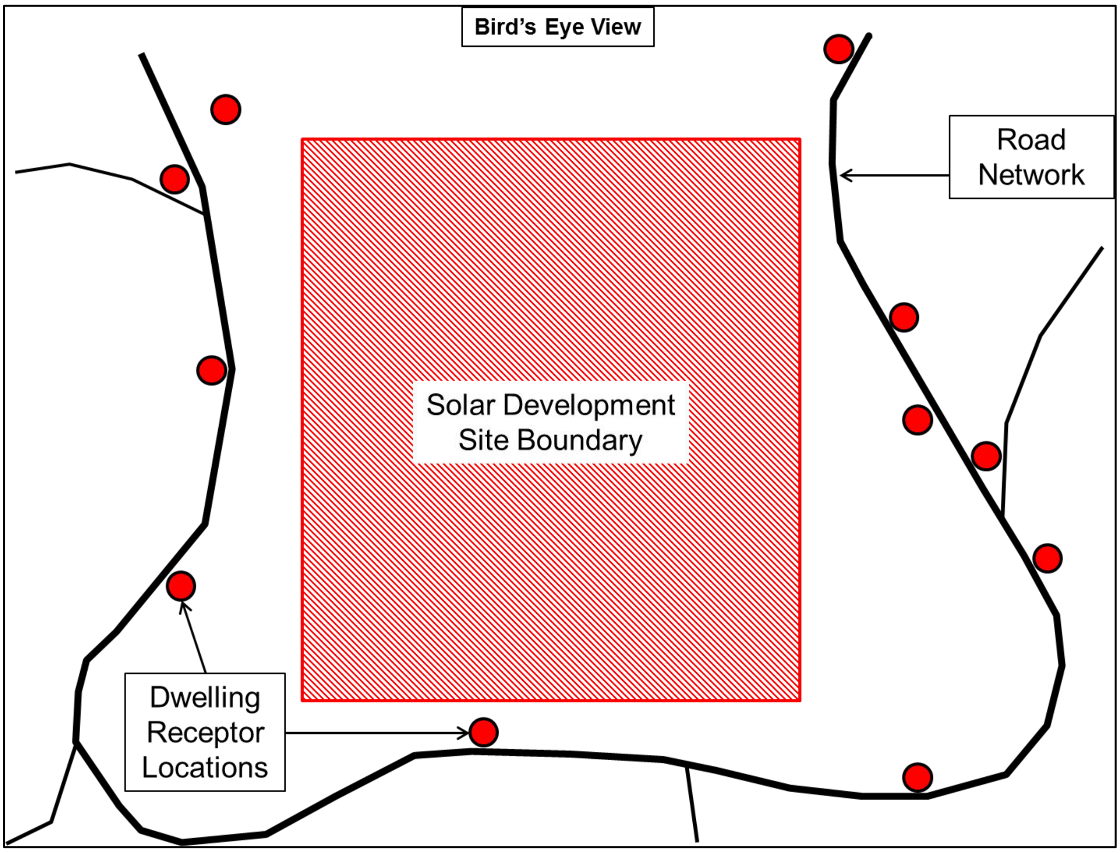


Figure 9 *Illustration showing receptor identification process – dwellings*

Assessment Process

6.5 The following process should be used for modelling glint and glare for the identified dwelling receptors:

1. Define the solar PV development panel area;
2. Undertake geometric calculations, as outlined within Section 4 of this guidance;
3. Produce a solar reflection chart to determine whether a solar reflection is geometrically possible, and if so at what time/duration;
4. Assess the results of the geometric glint and glare assessment in the context of the following:
   a. Sun location relative to the solar panels;
   b. Location of the reflecting solar panels relative to the dwelling;
   c. Existing screening;
   d. Proposed screening;
5. Determine whether a solar reflection is significant;
6. Consider mitigation, if required.

Discussion of Significant Effects

6.6 There are many solar PV developments where solar reflections are geometrically possible and visible from surrounding dwellings. Experiencing a solar reflection does not, however, guarantee a significant effect requiring mitigation will occur. Assuming the solar PV development is visible from a window of a room occupied during daylight hours, the duration of time for which a solar reflection could last is the most significant characteristic.

6.7 Other factors that could be considered when determining whether a solar reflection is significant include:

- Whether the solar reflection is incident to direct sunlight and the location;
- Whether the dwelling has a window facing the solar PV development;
- The room within the dwellings from which a solar reflection may be visible i.e. is it occupied for a long period during daylight hours e.g. a living room;
- The time of day/year when a solar reflection is geometrically possible.

6.8 The duration of time for which a solar reflection is possible is the main defining characteristic when determining whether mitigation is required. Defining a minimum duration for effects to become significant is, however, subjective. For static receptors, the length of time for which a solar reflection is geometrically possible and visible will determine its significance upon residential amenity. Therefore, it is appropriate to choose a duration beyond which solar reflections become significant and where mitigation is required. Applying a strictly scientific approach is difficult however because:

- Most models generally show a worst-case scenario of glint and glare, often predicting solar reflections for a much greater length of time than will be experienced in reality;
- The scenario in which glint and glare occurs will vary for each dwelling;
- The effects of glint and glare are subjective and the significance will vary from person to person.

6.9 To quantify and determine where a significant impact is expected, previous glint and glare assessment experience has been drawn upon as well as a review of existing guidance with respect to light based environmental impacts, these include:

- Previous glint and glare assessment experience;
- Shadow flicker guidance for wind turbines[26]. Guidance has been produced which sets durations beyond which a significant impact on residential amenity is expected and mitigation is required.

Previous Experience of Glint and Glare Dwelling Assessments

6.10 It is common for dwellings to be located within 1km of a proposed solar PV development. Assessment experience means that typical results for proposed ground mounted solar PV developments[27] are known. It is common for solar reflections to be possible in the mid-morning (~06:00-08:00 GMT) and again in the early evening (~17:00-19:00 GMT). There are many examples of dwellings located where a solar reflection is geometrically possible however, a solar reflection could only ever be significant where the solar reflection is visible from the dwelling. Assuming a solar reflection is geometrically possible, and the reflecting solar panels are visible, a solar reflection would be experienced when the following conditions are met:

1. An observer is located at a point within the dwelling where a solar reflection is possible e.g. located at a kitchen window at the time of the day when a solar reflection is geometrically possible;
2. The weather at the particular time of the day when a solar reflection is geometrically possible is clear and sunny;
3. There are clear unobstructed views from this window towards the reflecting solar panel area

6.11 The likelihood of these conditions being met varies both person to person and geographically based on local climate conditions. However, it illustrates that a predicted geometric solar reflection does not guarantee a visible solar reflection when considering real world conditions.

[26] Shadow flicker, like glint and glare, is considered a detrimental effect created through the manipulation of sunlight. Therefore the guidance has been used for comparative purposes.
[27] At typical solar panel azimuth and inclinations. Defined as panel elevation angle 15-30 degrees and south facing in the UK and Ireland.

Shadow Flicker Guidance

6.12 "Shadow flicker" refers to the sunlight flickering effect caused when rotating wind turbine blades periodically cast shadows over neighbouring dwellings through small openings such as windows. This can cause a significant detrimental impact upon residential amenity under certain conditions.

6.13 A review of the shadow flicker guidance has been undertaken, with specific reference to the guidance where time limits have been stated for the maximum acceptable duration of shadow flicker, beyond which mitigation is required. The guidance states the following:

1. Shadow flicker is possible at dwellings within 10 rotor diameters[28]. A typical rotor diameter for a large-scale wind turbine is 90m, making the potential shadow flicker zone out to 900m from the wind turbine location[29];
2. The following must all apply:
    a. Shadow flicker is only possible when the wind turbine is rotating; and
    b. Shadow flicker is only possible where the Sun passes behind the rotating wind turbine relative to the assessed dwelling; and
    c. Shadow flicker is possible within rooms where windows have a clear view of the rotating wind turbine.
3. Shadow flicker is deemed significant where it lasts for longer than 30 minutes per day and for more than 30 hours of the year within 500m of the turbine[30] in some European countries. Beyond this distance no maximum acceptable time is stated;
4. Mitigation is required if all of the above are satisfied.

Determination of Significant Effects

6.14 The effects of glint and glare differ to shadow flicker for a number of reasons, and could be considered less significant because:

- A solar panel produces a solar reflection and therefore the light reflected is less intense than direct sunlight because a percentage of the light is absorbed by the solar panel. Shadow flicker is the effect of the varying light levels directly from the Sun;
- Shadow flicker produces significant variations to light levels within a room. An observer does not have to be looking at the wind turbine directly to observe the

[28] Onshore Wind Energy Planning Conditions Guidance Note, Renewables Advisory Board and BERR (2007). Last accessed 02/11/2016.

[29] The search radius for dwellings is within 1km from a proposed solar development for glint and glare effects. This search area is for glint and glare effects is therefore expected to be larger than the area for shadow flicker for the majority of large-scale onshore wind turbines.

[30] Draft PPS18: Renewable Energy Annex 1 Wind Energy Planning Issues: Shadow Flicker and Reflected Light, Planning Portal Northern Ireland (the shadow flicker recommendations are based on research by Predac, a European Union sponsored organisation promoting best practice in energy use and supply which draws on experience from Belgium, Denmark, France, the Netherlands and Germany). Last accessed 02/11/2016.

effect. For glint and glare effects to be experienced, an observer has to view the solar panels directly;

- A solar reflection from a solar panel will appear static, whereas the effect of shadow flicker will inherently flicker in time with 1/3 the frequency of the rotating blades (assuming three blades);
- The presence of shadow flicker would be a new effect experienced at a dwelling. Solar panels produce solar reflections of similar intensity to those from still water or glass for example, both common reflective sources next to dwellings.

6.15 Shadow flicker guidance states that effects for more than 30 minutes per day, over 30 hours of the year, is significant and requires mitigation. Considering the information presented within Section 6.5 and the above, it is deemed appropriate to consider the effects of glint and glare less significant than shadow flicker. Therefore, the duration beyond which mitigation should be required for glint and glare is longer than for shadow flicker.

6.16 Therefore the recommendation within this guidance is:

- If visible glint and glare is predicted for a surrounding dwelling for longer than 60 minutes per day, for three or more months of the year, then the impact should be considered significant with respect to residential amenity. In this scenario, mitigation should be implemented.

6.17 The process outlined in the following flow chart (Figure 10 below) is recommended when determining whether a solar reflection should be deemed significant and mitigation implemented.

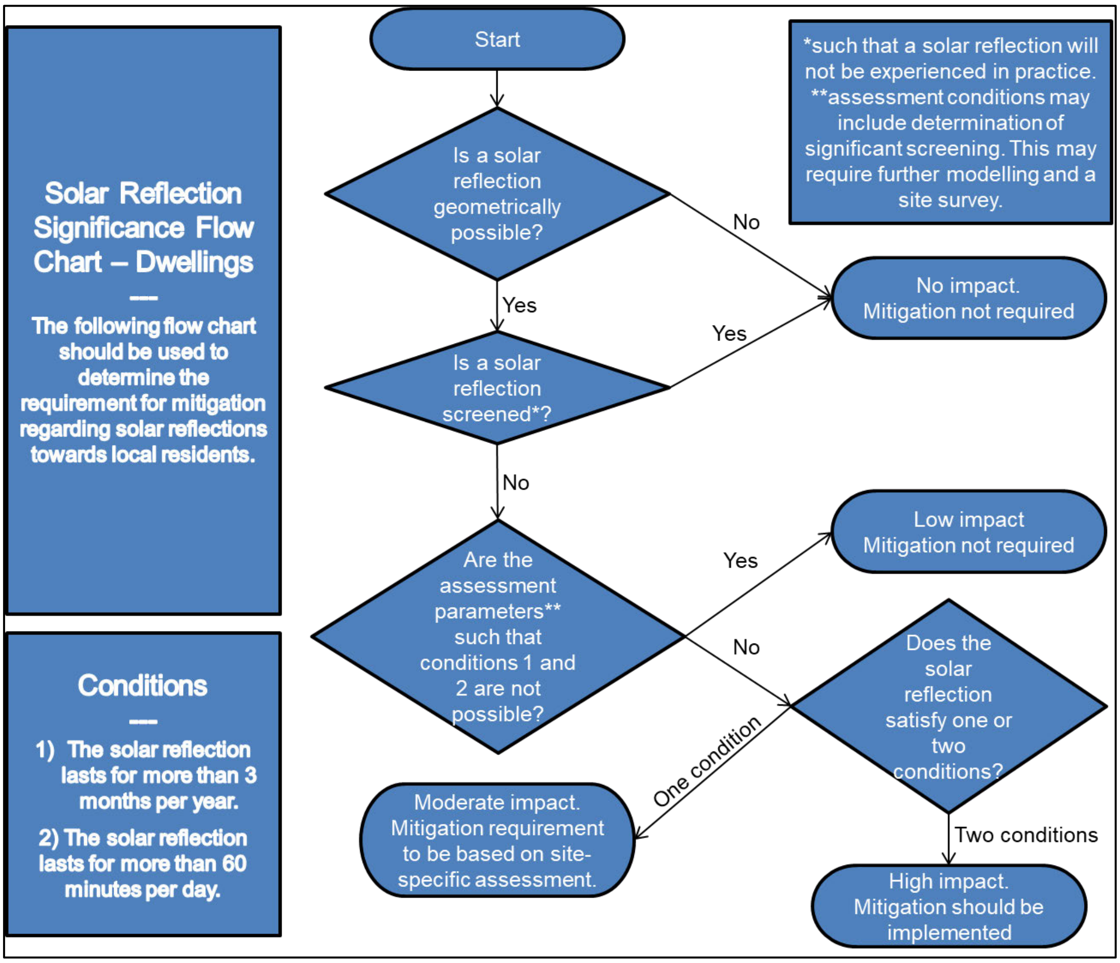


Figure 10 *Dwelling impact significance flow chart*

6.18 'Significant screening' with respect to visibility of reflecting solar panels implies that the observer's view is impeded to the extent that the presence of the solar panels cannot be easily discerned at first glance. For example, a hedgerow that contains small gaps that facilitate partial visibility of the panel face(s) would provide 'significant screening'. Figure 11 on the following page illustrates this.

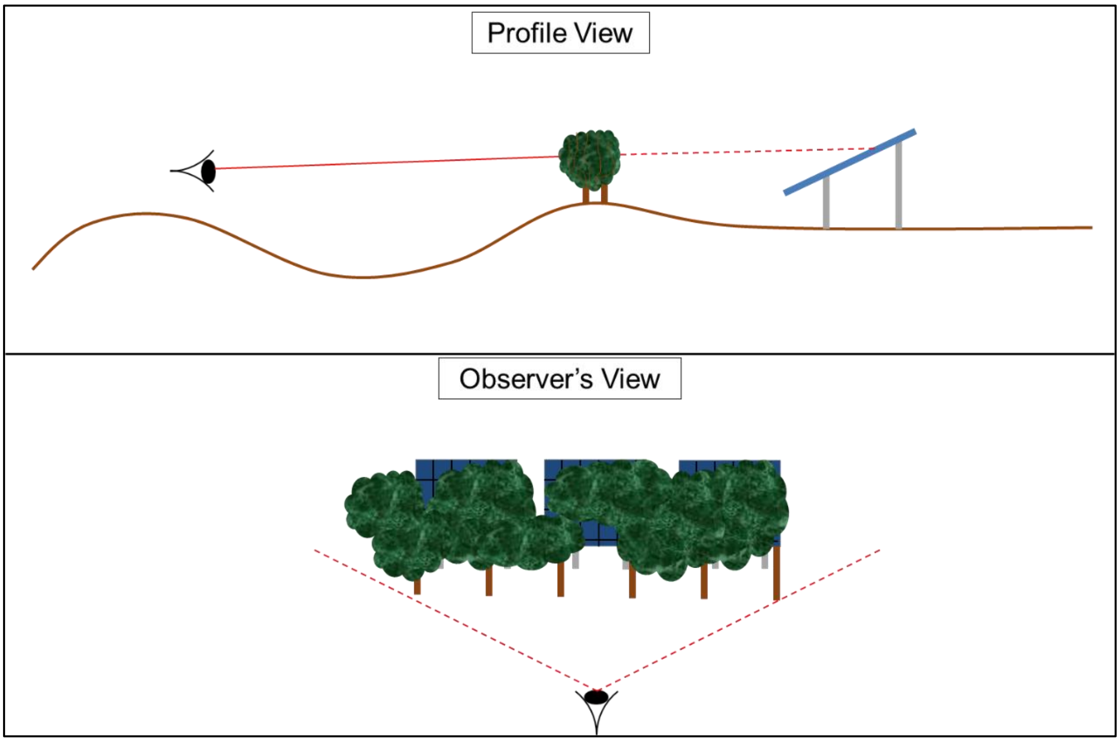


Figure 11 *Illustration of 'significant screening'*

Conclusions

6.19 The size of the solar panel area and visibility of the reflecting solar panels relative to the assessed dwelling will determine the duration of the solar reflection. Where solar reflections persist beyond 60 minutes per day for three or more months per year, solar reflections are considered significant and mitigation should be implemented. Consultation is recommended where there is a requirement for mitigation.

7 ASSESSING THE IMPACT UPON ROAD USERS

Overview

7.1 Locating a solar PV development next to a road is often essential due to access requirements. The possibility of glint and glare effects from the proposed solar PV development can however lead to concerns with respect to the possible impact upon road safety especially if the solar PV development is to be located next to a road with fast moving and/ or busy traffic. Therefore, a glint and glare assessment may be requested by the relevant stakeholders so that the possible effects can be understood. The effects of glint and glare from building developments is not typically considered however, if required, the general methodology can be applied.

Key Considerations

7.2 A list of key considerations for assessing glint and glare with respect to road safety is presented below:

- A road user may have views of a solar PV development. Where a view of the solar panel exists, a solar reflection may be possible;
- A view of a solar panel does not however guarantee that a solar reflection is possible;
- There is no technical limit (distance) within which a solar reflection is possible for a surrounding road user however, the significance of a reflection decreases with distance. This is because the proportion of an observer's field of vision that is taken up by the reflecting area diminishes as the separation distance increases;
- Seasonal variations to vegetation or new additional development may change the view from a road user towards the solar panels over time;
- Terrain and shielding by vegetation are also more likely to obstruct an observer's view over longer distances;
- In general, the geometry of the relationship between typical ground mounted solar panels and the movement of the Sun in the northern hemisphere means that roads due east and west of the panels are most likely to view a solar reflection for south facing arrays panels. Roads that are north or south of the panels are very unlikely to experience a solar reflection;
- For solar PV developments that have solar panels orientated at an azimuth angle other than south, solar reflections may be directed in alternate directions.

7.3 The following subsections present the recommended methodology for assessing the impact upon road safety.

Identifying Receptors

7.4 The following process should be used for identifying road receptors:

1. Identify roads in the immediate surrounding area (out to approximately 1km from the solar PV development boundary) that may have visual line of sight to the solar panels;
2. If visual line of sight exists between the proposed solar PV development and the road, then a solar reflection could be experienced if it is geometrically possible;
3. If there is no line of sight, then a reflection cannot be experienced;
4. Assess a length of road, choosing individual receptor locations no more than 200 metres apart. This is shown in Figure 12 on the following page;
5. An additional height should be added to the ground level height to represent the typical viewing height from a road user. For road users, a height of 1.5 metres is recommended;
6. Use the height and location data within the geometric solar reflection model.

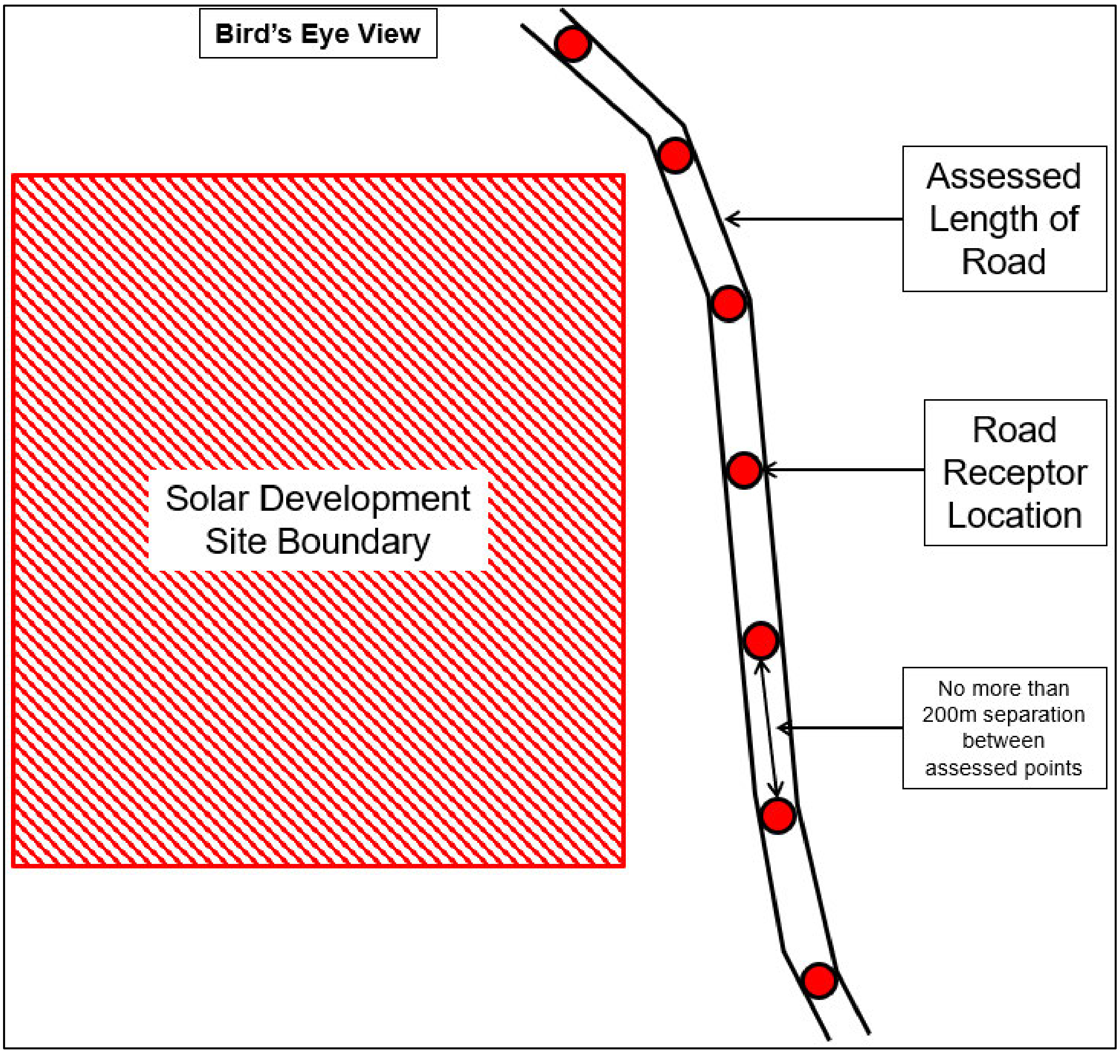


Figure 12 Illustration showing receptor identification process – roads

Assessment Process

7.5 The following process should be used for modelling glint and glare for the identified road user receptors:

1. Define the solar PV development solar panel area;
2. Undertake geometric calculations, as outlined within Section 4 of this guidance;
3. Produce a solar reflection chart to determine whether a solar reflection is geometrically possible;
4. Assess the results of the geometric glint and glare assessment in the context of the following:
   a. Sun location relative to the solar panels;
   b. Location of the reflecting solar panels relative to the road and direction of traffic;

c. Consideration of existing screening;

d. Consideration of proposed screening;

5. Determine whether a solar reflection is significant;

6. Consider mitigation, if required.

Determination of Significant Effects

7.6 A road user travelling on surrounding roads where a solar reflection is geometrically possible would experience a solar reflection that is fleeting in nature. This is because the road user is typically moving at speeds anywhere up to 70mph or 120kph. This means that the duration of a predicted solar reflection is mostly dependent on the speed of the road user travelling past the solar farm at the time when a solar reflection is geometrically possible. Therefore, the location of origin of the solar reflection is more significant than its duration because the receptor is moving.

7.7 There are many solar PV developments where solar reflections are geometrically possible towards roads. Experiencing a solar reflection does not guarantee a significant effect requiring mitigation and there are criteria that should be considered when determining the significance of a solar reflection, these are:

- Is the solar reflection incident to direct sunlight?
- What type of road is affected? Major National, National, Regional or Local roads?
- Does the solar reflection appear in-line with, or close to, the direction of travel?
- What is the length of road that may experience a solar reflection?

7.8 For south facing solar panels at standard inclinations[31] it is likely that the Sun will be incident to the solar reflections in the UK and Ireland. Whether the solar reflection appears in-line with, or close to, the direction of travel depends on the geographic location of the surrounding road relative to the solar PV development. This, along with the size of the proposed solar PV development, determines the length of road that may be affected.

7.9 Because the length of time a solar reflection can last is mostly dependent on the road user's speed rather than the solar PV development, the length of time that a solar reflection is not considered when determining its significance. Instead, the location of origination of the solar reflection and road type are considered.

7.10 The process outlined in the flow chart on the following page (Figure 13) is recommended when determining whether a solar reflection should be deemed significant and mitigation implemented.

[31] Defined as 15-35 degrees in the UK and Ireland.

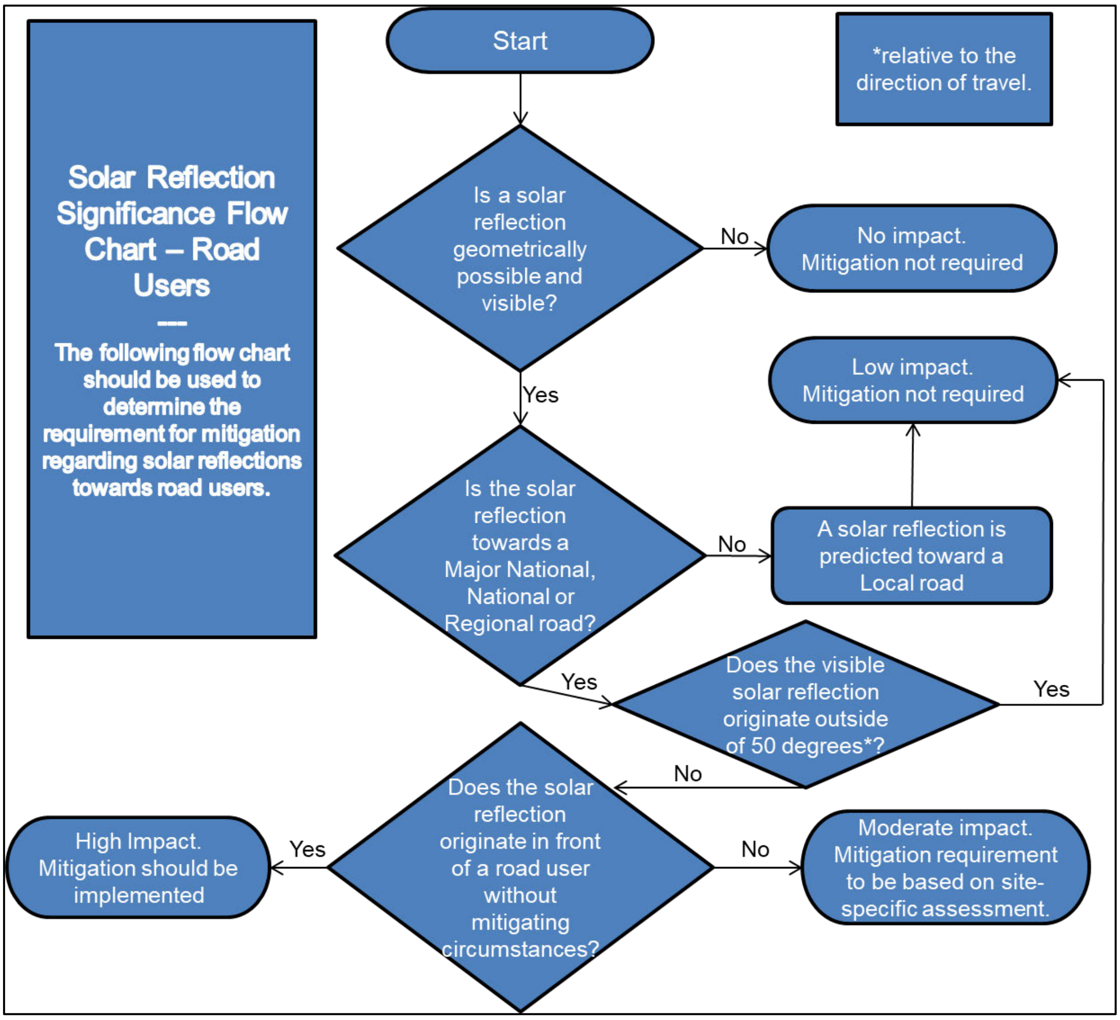


Figure 13 *Road user impact significance flow chart*

7.11 Regional, National and Major National roads are the most important in the majority of instances. Local roads may, under particular conditions, prove to be vital to the surrounding road network. Therefore, consultation with the local highways authority is recommended to ascertain the significance of a surrounding road where it is unknown.

7.12 The road classifications are based on typical UK roads, however what constitutes a regional road (for example) may vary in different countries. Therefore, alongside road classification, the road size, speed limit, surface, traffic volume and traffic speed should also be considered when applying impact significance with road classification.

Conclusions

7.13 The visibility and size of the reflecting solar panel area from an assessed road will in part, determine the duration of a solar reflection. In most scenarios, the speed of the vehicle will be the overall determining factor which determines the duration of the solar reflection. The type of road affected and location of origin of the solar reflection with respect to the direction of road travel will determine the requirement for mitigation. Consultation with the local highway authority is recommended where mitigation is required.

8 ASSESSING THE IMPACT UPON RAILWAY OPERATIONS

Overview

8.1 Solar PV and building developments can be located adjacent to railway lines. Indeed there are already a number of operational solar PV developments in these locations present in the UK[32,33]. A consideration of a railway stakeholder may be the safety implications of glint and glare effects from a proposed solar PV or building development. It is therefore important to set a specific and standardised assessment methodology so that all proposals are assessed in the same way.

Key Considerations

8.2 A list of key considerations for assessing glint and glare with respect to rail safety is presented below:

- A train driver may have views of a solar PV or building development. Where a view of the solar panel or façade exists, a solar reflection may be possible;
- A view of the reflector does not however guarantee that a solar reflection is possible;
- There is no technical limit (distance) to which a solar reflection is possible towards a surrounding railway line however, the significance of a reflection decreases with distance. This is because the proportion of an observer's field of vision that is taken up by the reflecting area diminishes as the separation distance increases;
- Seasonal variations or additional development may change the view from a receptor location towards the solar panels or building development over time;
- Terrain and shielding by vegetation are also more likely to obstruct an observer's view at longer distances;
- In general, the geometry of the relationship between typical ground mounted solar panels and the movement of the Sun in the northern hemisphere means that railways due east and west of the panels are most likely to view a solar reflection for traditional south facing arrays panels. Railways that are north or south of the panels are very unlikely to experience a solar reflection;
- For building developments and for solar developments that have solar panels orientated at azimuth angles other than south, solar reflections may be directed in alternate directions

.

[32] Hadlow Solar Farm, Off Sherenden Road, Tudeley, Kent, England.
[33] Tower Hayes Solar Farm, near Stanton under Bardon, Leicestershire, England.

8.3 The following subsections present the recommended methodology for assessing the impact upon railway safety.

Identifying Receptors – Railway Infrastructure

8.4 The following process should be used for identifying receptors[34]:

1. Identify whether a railway line or railway infrastructure is present within 100m of the solar or building development ;
2. If visual line of sight exists between the proposed solar or building development and the railway line, then a solar reflection could be experienced if it is geometrically possible. If there is no line of sight, then a reflection cannot be experienced;
3. Assess a length of railway line, choosing individual receptor locations no more than 200 metres apart out to up to 500m from the development location. This is shown in Figure 14 on the following page with reference to a solar development;
4. An additional height should be added to the ground level height to represent the typical viewing height of a train driver. For train drivers, a height of 2.75 metres is recommended;
5. Identify any other railway infrastructure that may be present within 500m of the proposed development. This includes railway signals and crossings;
6. Use the height and location data for feeding into the geometric solar reflection model.

[34] Railway signals are discussed separately, beginning paragraph 8.11.

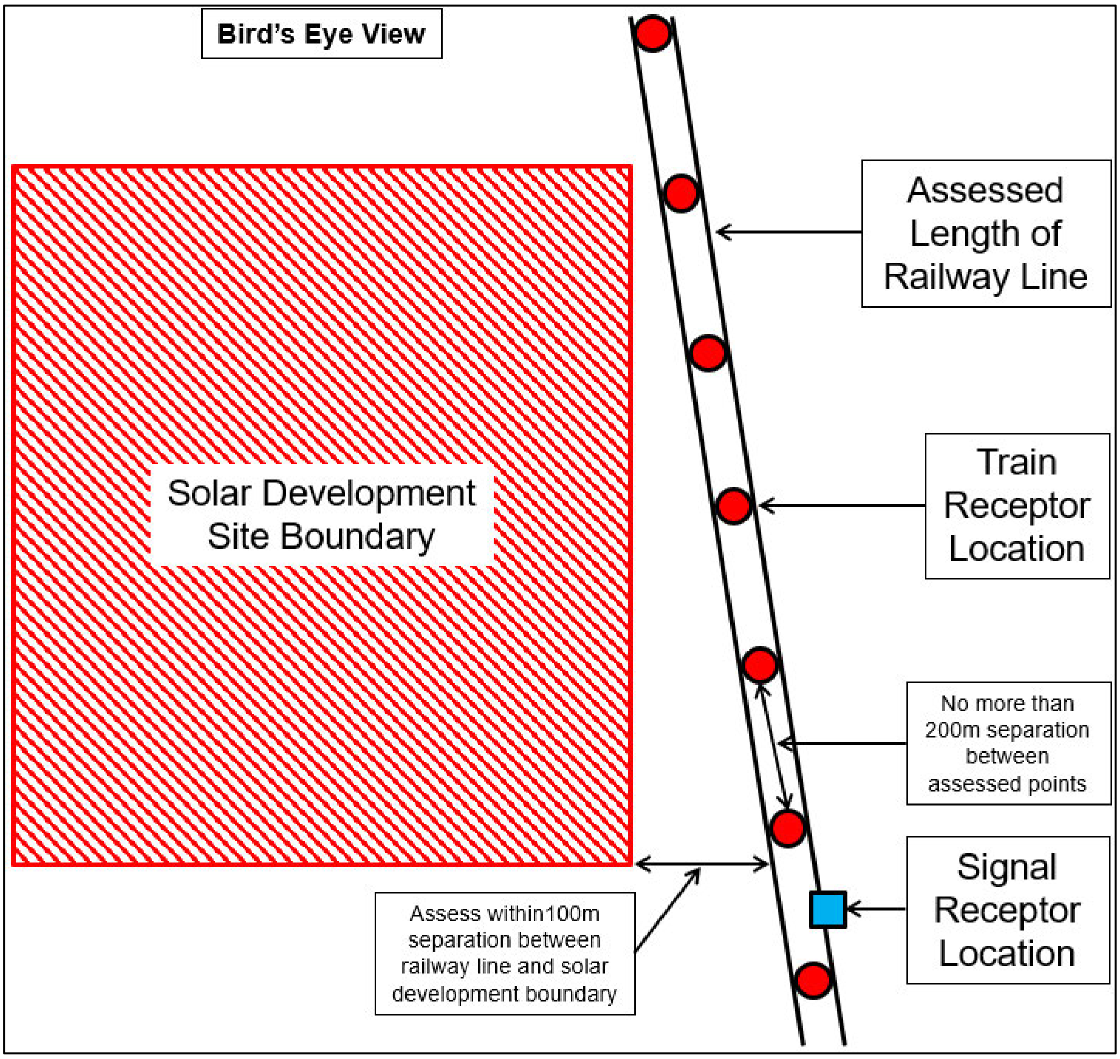


Figure 14 *Illustration showing receptor identification process – train drivers and signals*

Assessment Process

8.5 The following process should be used for modelling glint and glare for a railway line:

1. Define the solar PV development solar panel area or building façade;
2. Undertake geometric calculations for train drivers and any other railway infrastructure, as outlined within Section 4 of this guidance;
3. Produce a solar reflection chart to determine whether a solar reflection is geometrically possible;
4. Assess the results of the geometric glint and glare assessment in the context of the following:
   a. Sun location relative to the solar panels or façade;
   b. Location of the reflecting solar panels or façade relative to the railway line, direction of trains and key infrastructure, such as railway signals;

   c. Existing screening;
   d. Proposed screening;
5. Consider train driver workload;
6. Assess the intensity of the solar reflection, if appropriate;
7. Determine whether a solar reflection is significant;
8. Consider mitigation, if required.

Determination of Significant Effects

8.6 A train driver travelling on a section of railway line where a solar reflection is geometrically possible would experience a solar reflection that is fleeting in nature. This is because a train will typically be moving at speeds anywhere up to 120mph (~190kph). This means that the duration of a predicted solar reflection is mostly dependent on the speed of the train travelling past the solar PV or building development at the time when a solar reflection is geometrically possible. Therefore, the location of origin of the solar reflection is more significant than its duration because the receptor is moving.

8.7 There are examples of solar PV and building developments where solar reflections are geometrically possible towards an adjacent railway line. Experiencing a solar reflection does not necessarily mean there is a significant effect requiring mitigation. The following criteria should be considered when determining the significance of a solar reflection towards a train driver or train infrastructure:

- Is the solar reflection incident to direct sunlight?
- Does the affected length of railway have a signal, crossing or switch/set of points?
- Does the solar reflection appear in line with, or close to, the direction of travel?
- What is the length of railway that may experience a solar reflection?
- What is the intensity of the solar reflection?[35]

8.8 For south facing solar panels at standard inclinations[36] it is likely that the Sun will be incident to the solar reflections in the UK and Ireland. Whether the solar reflection appears in line with, or close to, the direction of travel depends on the geographic location of the surrounding railway relative to the solar PV development. This, along with the size of the proposed solar PV development, determines the length of railway line that may be affected.

8.9 For building developments, the scenarios in which solar reflections can occur can vary significantly.

---

[35] The intensity of any calculated solar reflection may be requested by the railway stakeholder. An assessment methodology aligned with the methodology produced for aviation receptors can be utilised (Section 9).
[36] Typically 15-35 degrees in the UK and Ireland

8.10 Because the length of time a solar reflection can last is mostly dependent on a train's speed rather than the solar PV or building development, the length of time that a solar reflection can last is not considered when determining its significance. Instead, the location of origination of the solar reflection, length of railway and infrastructure present on the assessed railway line are considered.

8.11 The process outlined in the flow chart below (Figure 15) is recommended when determining whether a solar reflection should be deemed significant and mitigation implemented.

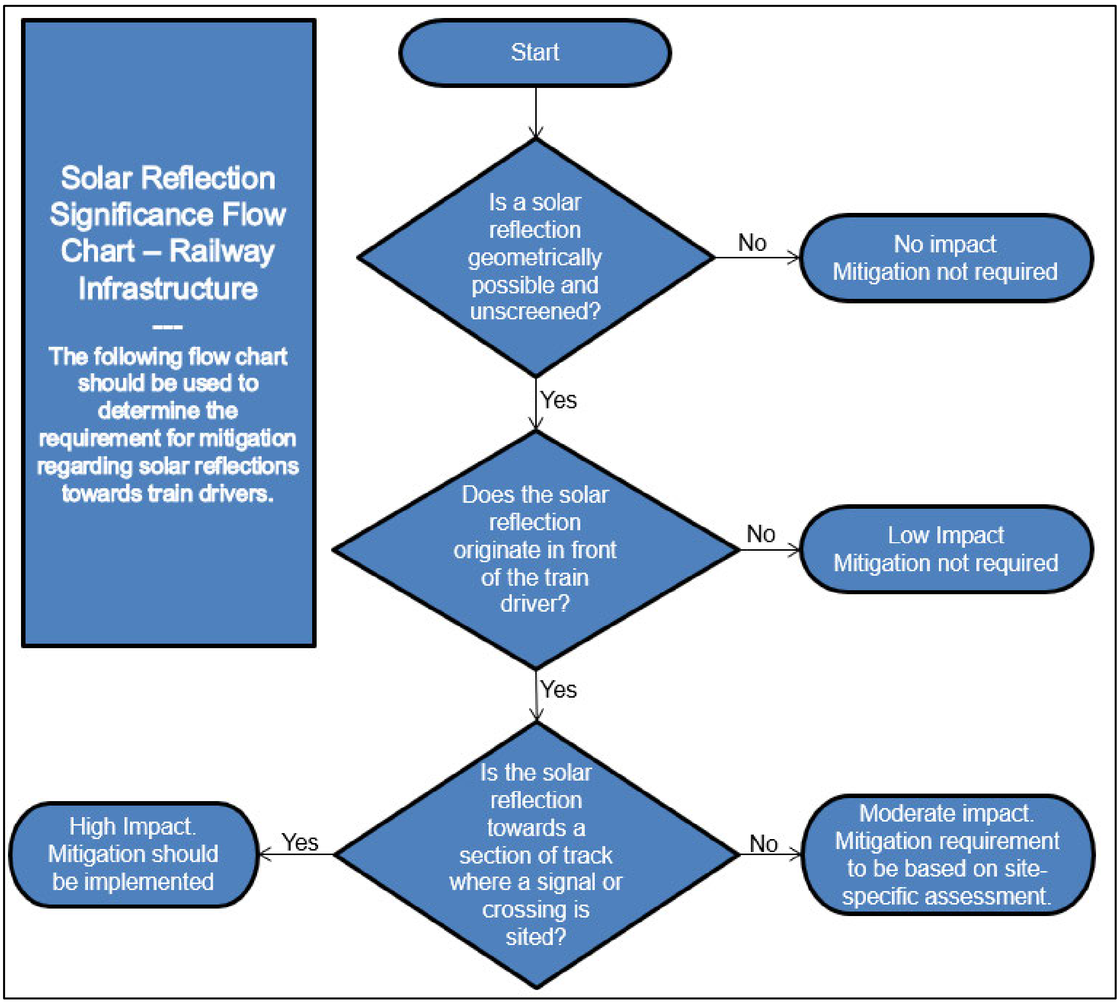


Figure 15 *Train driver impact significance flow chart*

Other considerations

Railway Signals

8.12 Railway signal lights are located immediately adjacent to or above a railway line and are used to direct trains on the lines. In some instances, signals may be difficult to identify and therefore consultation with the railway stakeholder may be beneficial to identify their location and specification. An assessment may be required because of the potential for a phantom aspect illusion occurring. The definition of phantom aspect is presented below.

8.13 'Light emitted from a Signal lens assembly that has originated from an external source (usually the Sun) and has been internally reflected within the Signal Head in such a way that the lens assembly gives the appearance of being lit[37].'

8.14 A phantom aspect is caused when the incoming light is of an intensity which causes a light signal to appear illuminated when it is not switched on. This is a particular problem for filament bulbs with a reflective mirror incorporated into the bulb design.

8.15 No known studies have shown that a phantom aspect illusion is possible due to a solar reflection from a solar panel or glass. Furthermore, modern LED signals are designed to reduce or completely eliminate the likelihood of a phantom aspect illusion occurring and many have hoods attached to reduce the risk of incoming direct light illuminating the signal lens directly. Nevertheless, following consultation with railway operators, it is recommended that an assessment of all signal lights be undertaken. A railway signal location should also be considered where there may be solar reflections towards a train driver on the railway line where the signal is present. This is because a train driver's workload may be higher where signals are present, increasing the potential impact as a result of the solar reflection. If the assessed reflectors are not in line of sight to the signal lens, then no phantom aspect illusion is possible.

Level Crossings and Level Crossing Warning Lights (LCWL)

8.16 For determining the impact of glint and glare upon level crossings with respect to road users, follow the 'road users' assessment methodology presented in Section 7. For LCWLs, follow the assessment of railway signals as presented in Section 8.11. In both instances, consultation with the railway and/or road stakeholder is advised.

Switches/Set of Points

8.17 Switches and sets of points are present on sections of track where a train may cross from one section of a railway line to another. Where this occurs, a train driver's workload may be increased, and the effect of a solar reflection may increase the significance of a solar reflection.

---

[37] Glossary of Signalling Terms, Railway Group Guidance Note GK/GN0802. Issue One. Date April 2004.

Conclusions

8.18 The size of the reflector area and visibility of the reflectors relative to static infrastructure (such as signals) will determine the duration of the solar reflection. For moving trains, their speed will be the overall determining factor with regard to the duration of the solar reflection. Consultation with the railway stakeholder is recommended to determine the requirement for assessment, identify particular receptors and determine whether mitigation is required.

9 ASSESSING THE IMPACT UPON AVIATION OPERATIONS

Overview

9.1 Solar PV developments and aviation activity can safely co-exist. There are many examples of solar PV developments being sited on or near to an aerodrome[38]. Safeguarding an aerodrome and its aviation activity is essential, and glint and glare effects may cause a safety concern under certain conditions. Therefore a glint and glare assessment of a proposed solar PV development is essential when it is to be sited in the vicinity of an aerodrome.

9.2 More recently, the effect of solar reflections from building developments with surfaces capable of producing specular solar reflections has been raised as a potential concern at a number of UK airports.

9.3 This section presents a recommended assessment approach, based on previous guidance and experience within the UK, Ireland and internationally.

Key Considerations

9.4 The two main receptors that require consideration within an aviation glint and glare assessment are pilots in aircraft and air traffic controllers in the Air Traffic Control (ATC) Tower. Helipads and alternate aviation receptors are considered separately within this sector.

9.5 Whilst a proposed solar PV development may be located such that air traffic controllers have no view of the solar panels, pilots navigating the airspace above will almost certainly have a view of the solar panels. Where a view of the solar panel exists, a solar reflection may be possible. A view of a solar panel does not however guarantee that a solar reflection is possible.

9.6 There is no technical limit (distance) within which a solar reflection is possible towards the ATC Tower or pilots, however the significance of a reflection decreases with distance. This is because the proportion of an observer's field of vision that is taken up by the reflecting area diminishes as the separation distance increases.

9.7 Seasonal variations or additional development may change the view from the ATC tower towards the solar panels over time.

9.8 Terrain and shielding by vegetation are also more likely to obstruct an air traffic controller's view at longer distances.

9.9 In general, the geometry of the relationship between typical ground mounted solar panels and the movement of the Sun in the northern hemisphere means that ATC towers due east and west of the panels are most likely to view a solar reflection for south facing arrays panels. ATC

[38] Gatwick Airport and Athens Airport for example.

towers north or south of the panels are very unlikely to experience a solar reflection unless the solar PV development and ATC Tower are in close proximity i.e. an on-aerodrome development. Pilots may experience solar reflection from a greater number of locations because of the changing location and altitude of the aircraft.

9.10 For building developments and for solar developments that have solar panels orientated at azimuth angles other than south, solar reflections may be directed in alternate directions.

9.11 The key considerations listed in the sections above are broadly the same for both solar and building developments.

Identifying Receptors – Aerodromes

9.12 The following process should be used for identifying the requirement for assessment:

1. Identify aerodromes within 30km of the proposed solar PV development. Complete the following depending on proximity;
    a. Within 5km: consult with the aerodrome, complete a glint and glare assessment;
    b. Within 5-10km: consult with the aerodrome, the aerodrome is likely to request a glint and glare assessment;
    c. 10km-30km: consider consultation with certified and licensed aerodromes, the aerodrome may request a glint and glare assessment;
    d. 30km+: consultation and assessment not considered a requirement, however requests for assessment have been requested beyond 30km.

9.13 If a glint and glare assessment is to be completed, follow the process outlined below for identifying receptors:

1. Identify any existing or proposed ATC Towers (if there is one) and approach routes for all existing or proposed runways;
2. If visual line of sight exists between the proposed solar PV development and the ATC Tower, then a solar reflection could be experienced if it is geometrically possible;
3. If there is no line of sight, then a reflection cannot be experienced;
4. Assess a 2-mile[39] approach path towards the runways using the following criteria;
    a. Starting point taken at 50 feet (15.2m) above the runway threshold;
    b. Measure out to 2 miles from the runway threshold using a 3 degree descent path (unless requested otherwise or as per the published aeronautical approach procedures);

---

[39] A statute mile (1.61km).

c. Take reference aircraft locations at no more than ¼ mile intervals (minimum of nine points over 2-miles);

5. An additional height should be added to the ground level height to represent the viewing height of an air traffic controller within the ATC Tower;

6. Use the height and location data for feeding into the geometric solar reflection model. Figure 16 below shows the process for identifying aviation receptors.

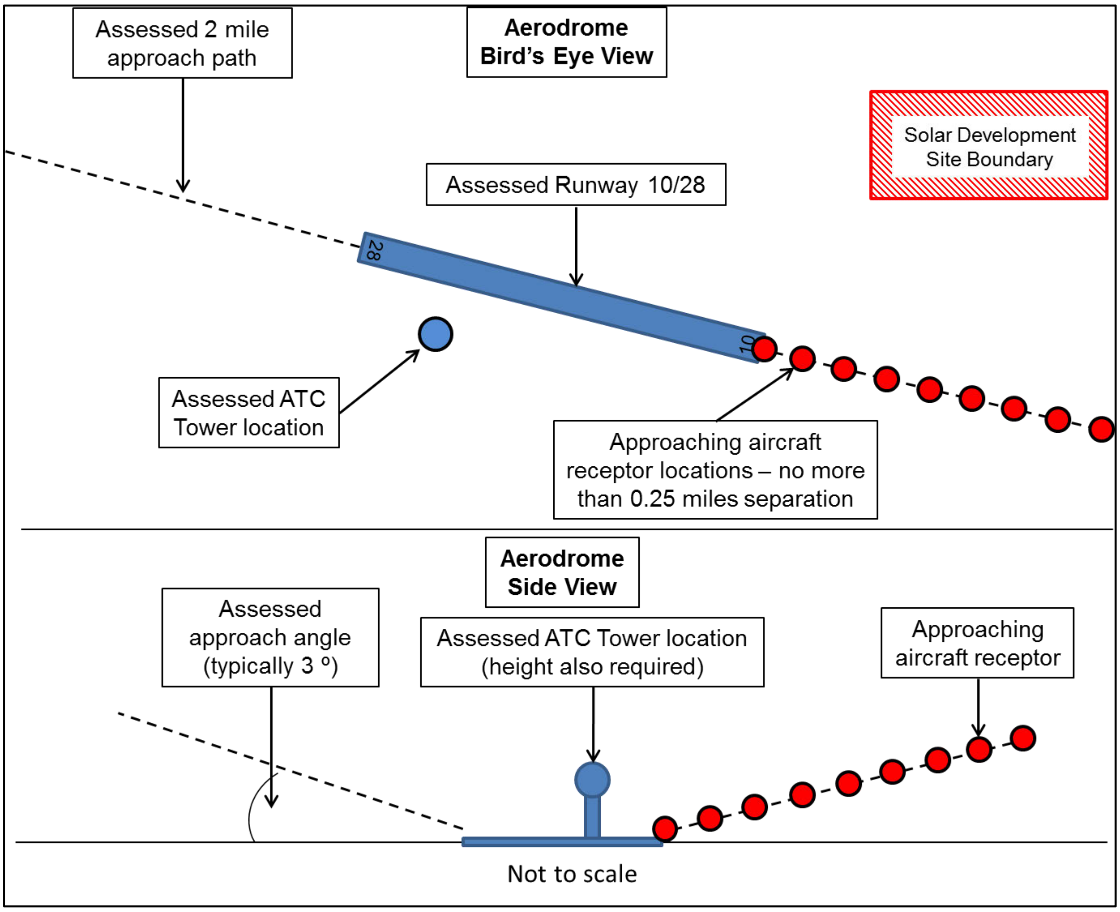


Figure 16 *Illustration showing receptor identification process – aviation*

Assessment Process

9.14 The following process should be used for modelling glint and glare effect for aviation activity:

1. Define the solar PV development solar panel area;
2. Undertake geometric calculations, as outlined within Section 4 of this guidance;
3. Produce a solar reflection chart to determine whether a solar reflection is geometrically possible;
4. Assess the results of the geometric glint and glare assessment in the context of the following:

   a. Sun location relative to the solar panels;
   b. Location of the reflecting solar panels relative to the ATC Tower and/or aircraft location;
   c. Consideration of existing screening (ATC Tower only);
   d. Consideration of proposed screening (ATC Tower only);
5. Determine whether a solar reflection is significant;
6. Consider mitigation, if required.

Building Developments

9.15 The process for assessing reflective façades on building developments is similar to those for solar panels however the FAA guidance does not apply to reflective surfaces other than solar panels and therefore the significance of a reflection, as per the sections below, can be considered for reference from a technical perspective but should not be the sole determining factor in assigning an impact significance.

Determination of significant effects

Air Traffic Control

9.16 An air traffic controller uses the visual control room to monitor and direct aircraft on the ground, approaching and departing the aerodrome. It is essential that air traffic controllers have a clear unobstructed view of the aviation activity. The key areas on an aerodrome are the views toward the runway thresholds, taxiways and aircraft bays.

9.17 The FAA guidance states that no solar reflection towards the ATC tower should be produced by a proposed solar PV development:

> '*1. No potential for glint or glare in the existing or planned Airport Traffic Control Tower (ATCT) cab…*'

9.18 However, it is recommended that any predicted solar reflection should be assessed pragmatically. Therefore, the following should be considered when determining whether a solar reflection is significant:

1. The predicted intensity of the solar reflection;
2. Location of origin of the solar reflection relative to the ATC Tower;
3. Solar reflection duration per day;
4. Number of days a solar reflection is geometrically possible per year;
5. The time of day when a solar reflection is geometrically possible.

9.19 Determining a period of time and location from which a predicted solar reflection is considered significant will depend on the operations at a particular aerodrome.

9.20 The process outlined within the flow chart on the following page (Figure *17*) is recommended when determining whether a solar reflection should be deemed significant and mitigation implemented.

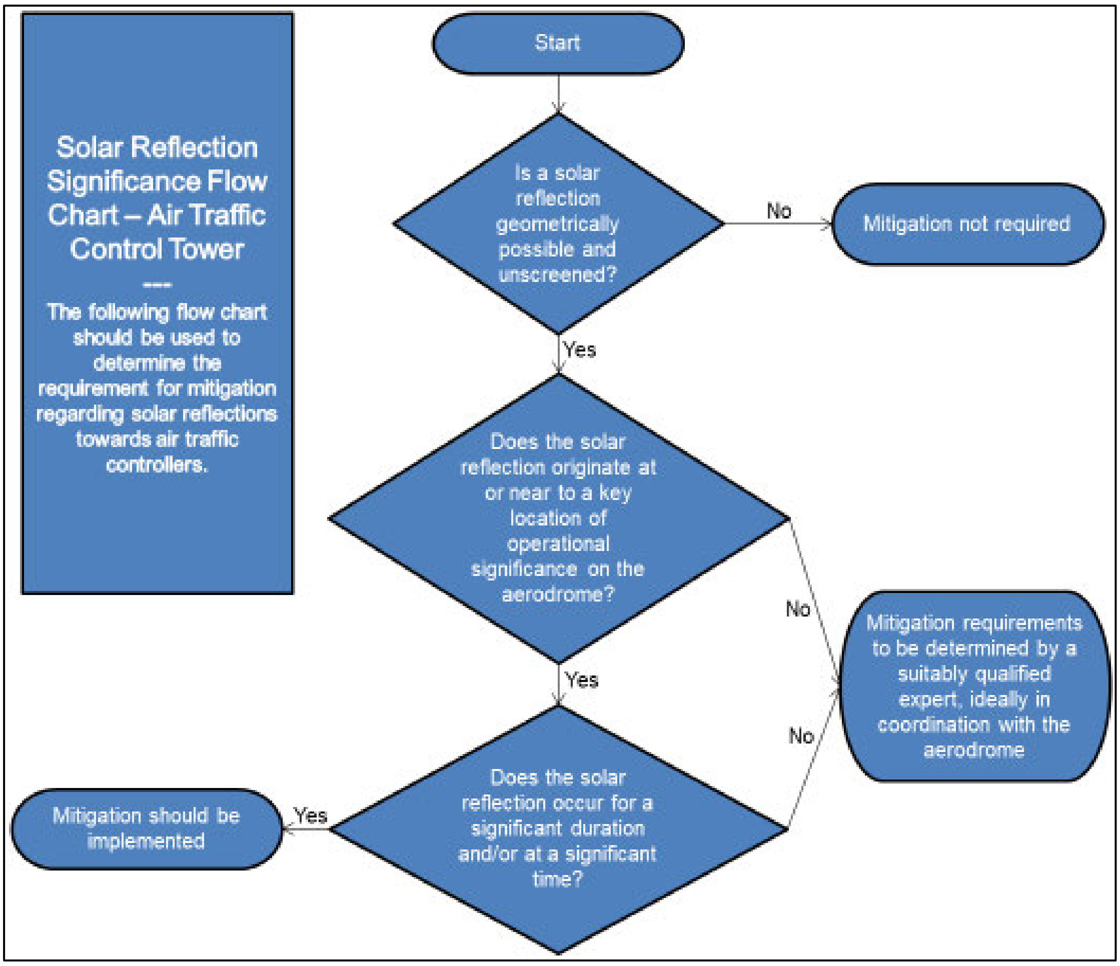


Figure 17 *ATC tower impact significance flow chart*

Approaching Aircraft

9.21 A pilot flying a 2-mile final approach path where a solar reflection is geometrically possible would experience a fleeting solar reflection as the aircraft travels through the solar reflection zone. This means that the duration of a predicted solar reflection is dependent on the speed of the aircraft above the solar PV development at the time when a solar reflection is geometrically possible. Therefore, the location of origin of the solar reflection is more significant than its duration because it is a fast-moving receptor. The time at which the solar reflection may occur should however be considered.

9.22 There are examples of solar PV developments where solar reflections are geometrically possible towards approaching aircraft. Experiencing a solar reflection does not guarantee a significant effect requiring mitigation, however there are criteria that should be considered when determining the significance of a solar reflection and mitigation requirements, these are:

- Is the solar reflection incident to direct sunlight?
- Does the solar reflection originate from near to a runway threshold?
- What is the length of approach path that can experience a solar reflection?
- Does the solar reflection occur at a significant time?
- Does the solar reflection occur for a significant period of time?
- What is the intensity of the solar reflection?

9.23 Further comments regarding the solar reflection intensity and its effect on the significance is presented in the following sub-section.

Solar Reflection Intensity

9.24 Many UK and Irish aviation stakeholders have adopted the FAA guidance with respect to glint glare. Along with the guidance, the Sandia Solar Glare Hazard Analysis Tool (SGHAT) model was also created. This model can be used to determine the intensity of a solar reflection which is significant when determining the impact upon approaching aircraft.

9.25 The FAA guidance states:

> *2. No potential for glare or "low potential for after-image" (shown in green in Figure 1) along the final approach path for any existing landing threshold or future landing thresholds (including any planned interim phases of the landing thresholds) as shown on the current FAA-approved Airport Layout Plan (ALP). The final approach path is defined as two (2) miles from fifty (50) feet above the landing threshold using a standard three (3) degree glide path.*

9.26 It is recommended that the FAA guidance is used as a basis for assessment, however it is advised that a pragmatic approach is followed when determining whether a predicted solar reflection may indeed by a hazard to aviation safety.

9.27 The process outlined within the flow chart (Figure 18) on the following page is recommended when determining whether a solar reflection should be deemed significant and mitigation implemented.

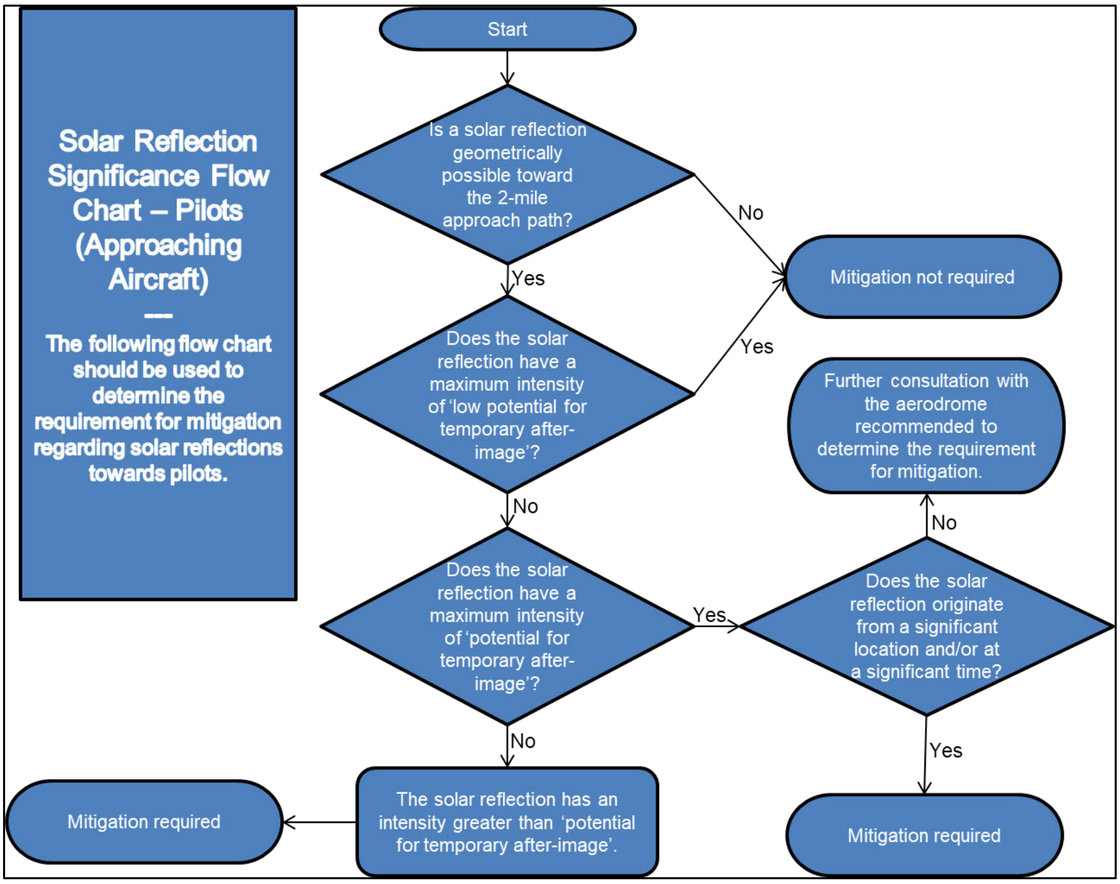


Figure 18 *Pilots (approaching aircraft) impact significance flow chart*

Helipads

9.28 Where helipads are present, a glint and glare assessment may be required. Therefore, Pager Power's has developed a standard methodology to determine the significance of a solar reflection towards a helicopter pilot on approach towards a helipad. The approach paths are assessed within the glint and glare assessment because they are considered to be the most critical stage of the flight.

9.29 The approach for determining receptor (helicopter) locations on the approach paths is to select locations along each bearing (spaced at maximum of 10 degrees) based on the centre point of the helipad out to a distance of 2 miles, spaced every ¼ mile. All possible approach paths are assessed unless specified or requested otherwise. The altitude of the aircraft is based on a 10 degree descent[40] path referenced to 2m above the helipad centre point (approximate eye level of a helicopter pilot).

[40] Normal helicopter descent angle on approach.

9.30 Similarly, to the assessment for fixed wing aircraft on approach, the location, duration, time and intensity of the solar reflection are considered to determine whether an impact may be significant. The flow chart presented in Figure 17 can therefore be followed to determine the impact significance. Results should be considered on a case-by-case basis.

Other Considerations

Circling Aircraft, Visual Manoeuvring Areas, Visual Circuits and En-Route Aircraft

9.31 Some aerodromes may request that circling aircraft, visual manoeuvring areas, visual circuits and en-route aircraft be assessed. If requested, the requirements of the assessment should be considered on a case-by-case basis and through consultation with the aerodrome. A typical assessment for aircraft in the Visual Manoeuvring Area (VMA) is as follows:

- Glint and glare calculations are undertaken for points spaced at regular intervals across a 10km radius circle centred above the airport at an altitude of 1500 feet above mean sea level[41];
- For each point where glint and glare is possible, the glare is classified in accordance with FAA standards;
- Where glint and glare is predicted to have 'potential for temporary after-image' or greater, the following should be completed:
  - The results will be overlaid on the published ICAO[42] Visual Approach Chart for the airport or similar;
  - An operational assessment should be undertaken using the overlaid Visual Approach Chart, considering the following:
    - Visual Holding Patterns;
    - Visual Reporting Points;
    - Aircraft joining approach from Visual Hold;
    - Other Visual Approach Chart features.
- Considering all of the above, it should be determined whether a significant impact is expected;
- Where glint and glare is not predicted or predicted to have a 'low-potential for temporary after-image', there will be no significant impact.

[41] Specific request may vary from an aerodrome depending on its operations.
[42] International Civil Aviation Organisation – ICAO. Chart usually available from the relevant national aviation stakeholder or aerodrome.

Conclusions

9.32 The size of the solar panel area and visibility of the reflecting solar panels relative to static infrastructure (such as the ATC Tower) will determine the duration of the solar reflection. The same is true for a reflective façade on a building development. For moving aircraft, its speed will be the overall determining factor with regard to the duration of the solar reflection. Consultation with the aviation stakeholder is essential to determine the requirement for assessment. It is recommended to consider aerodromes within 30km, though a detailed assessment may not be required.

10 OVERALL CONCLUSIONS

Overview

10.1 The purpose of this guidance document is to provide solar PV and building developers, planners and stakeholders with an assessment process for determining the effect of glint and glare (solar reflections) upon receptors surrounding a proposed solar PV or building development.

10.2 Formal guidance around glint and glare remains somewhat lacking in many cases. This guidance document has been produced to bridge this knowledge gap pertaining to the assessment of glint and glare from solar PV panels and reflective façades on building developments. The aim is to standardise an assessment process for developers, planners or stakeholders to follow.

10.3 The guidance presented within this document is based on the following:

- Reviews of existing guidance in a variety of areas;
- Glint and glare assessment experience and industry knowledge;
- Overview of available solar reflection studies.

10.4 The methodologies presented are deemed applicable for worldwide solar PV and building development.

Modelling Requirements

10.5 A geometric glint and glare assessment model must include the following:

- The Earth's orbit around the Sun;
- The Earth's rotation;
- The Earth's orientation;
- The location of the solar PV development or building development including the reflector (solar panel or façade) area;
- The reflector's 3D orientation including azimuth angle of the solar panel or façade (the orientation of the reflectors relative to north and the reflector elevation angle;
- Local topography including receptor and panel or façade heights above mean sea level.

10.6 For increased accuracy, the model could account for the following:

- Terrain at the visible horizon;
- Local time zone and daylight savings times;
- Consideration of sunrise and sunset times;
- Determine which solar panels create the solar reflection within the solar PV development;

- Determine what area of the façade create the solar reflection from the building development;
- Azimuth range of the Sun[43] when a solar reflection is geometrically possible;
- Vertical elevation range of the Sun when a solar reflection is geometrically possible;
- High-resolution analysis i.e. undertaking multiple geometric calculations within the given solar PV development or façade area. For example, at intervals of between 1 and 20 metres;
- Consideration of the effect of non-specular reflective surfaces e.g. masonry between glass façades;
- The intensity[44] of any solar reflection produced.

Assessment Inputs – Receptors

10.7 The following paragraphs set out the key distances for identifying receptors and the height data which should be included.

10.8 Dwellings within approximately 1km of a proposed solar PV development that may have a view of the PV panels should be assessed. Terrain heights and an additional height to account for the solar panel and eye level within the relevant floor of the dwelling should also be considered. Dwellings are not typically assessed for building developments.

10.9 Roads within approximately 1km of a proposed solar PV development that may have a view of the PV panels should be assessed. Terrain heights and an additional height to account for the solar panel and eye level of a road user should also be considered. Roads are not typically assessed for building developments.

10.10 Where railway infrastructure is located within approximately 100m of a proposed solar PV or building development that may have a view of the PV panels, an assessment should be undertaken. Train drivers out to 500m should be assessed. Any signals, crossings or vital railway infrastructure within 500m that could be affected by glare should be assessed especially where railway signal utilises incandescent bulb[45] technology and/or where no hood is attached. Terrain heights and an additional height to account for the solar panel/façade and eye level of a train driver or the height of a railway signal should also be considered.

---

[43] The azimuth range is the angle between the Sun and North, measured clockwise around the receptor's horizon. The Sun azimuth range shows the location of the Sun when a geometric solar reflection is possible. Therefore, it is possible to determine whether the Sun and the solar reflection are both likely to be visible to a receptor.
[44] In W/cm^2 at the retina, for example.
[45] Non-LED.

10.11 Aviation receptors out to 30km[46] from a proposed PV development should be considered to determine the requirement for assessment, if any. The typical receptors include the Air Traffic Control (ATC) tower and a 2-mile approach path for the relevant runway approaches. Additional receptors may be included where a solar reflection may be deemed a hazard to safety e.g. helipad approaches and the visual manoeuvring area (VMA). Aviation infrastructure is similarly assessed for building developments.

Assessment Significance

10.12 Determining the significance of a solar reflection varies for each receptor type. In general, the significance criteria for glint and glare effects are as follows:

- No Impact – A solar reflection is not geometrically possible or will not be visible from the assessed receptor. No mitigation required.
- Low – A solar reflection is geometrically possible however any impact is considered to be small such that mitigation is not required e.g. intervening screening will limit the view of the reflecting solar panels significantly or the glare time per year is considered negligible. No mitigation required.
- Moderate – A solar reflection is geometrically possible and visible however it occurs under conditions that do not represent a worst-case scenario e.g. a solar reflection originates from a less sensitive location . Mitigation may be required.
- High – A solar reflection is geometrically possible and visible under conditions that will produce a significant impact. Mitigation will be required if the proposed development is to proceed. Mitigation and consultation is recommended.

10.13 There may be instances where the solar reflection scenario does not fall accurately within the significance categories. Where this occurs, detailed consideration of the receptors and the modelling results should be undertaken.

10.14 See the following sections where the process for determining the significance of a solar reflection is described for each receptor type:

- Section 6 – Dwellings;
- Section 7 – Road infrastructure;
- Section 8 – Railway infrastructure;
- Section 9 – Aviation infrastructure.

10.15 In each section, the process for determining the significance of a solar reflection is described comprehensively.

[46] Aviation stakeholders can and have requested a glint and glare assessment beyond 30km.

Guidance Conclusions

10.16 This guidance should be followed to ensure comprehensive assessment of solar PV and building developments with respect to glint and glare. This guidance is applicable for solar PV and building development anywhere in the world.

PAGERPOWER
Urban & Renewables

Pager Power Limited
Stour Valley Business Centre
Sudbury
Suffolk
CO10 7GB

Tel: +44 1787 319001 **Email:** info@pagerpower.com **Web:** www.pagerpower.com

DOC22/69654-1

Mr Matthew Riley
Director – Energy and Resources Policy
Department of Planning and Environment
Locked Bag 5022
PARRAMATTA NSW 2124
Email: energy.resourcespolicy@dpie.nsw.gov.au

Dear Matthew,

Thank you for providing the NSW Environment Protection Authority (EPA) with the opportunity to present feedback on the draft Revised Large-Scale Solar Energy Guideline. We value the Department of Planning and Environment's commitment to review the Guideline to give clearer guidance on planning considerations.

The EPA supports the revised draft Guideline as it focuses on ensuring consistency in assessments of development issues such as environmental impacts for this renewable energy source and what measures are to be considered to minimise impacts. We are pleased to be able to share with you our feedback specifically in managing the waste produced by solar panels so that waste generation is reduced, recycling opportunities are considered early and environmental impact is minimised in the longer-term.

As you may know, in June 2021 the NSW Government released the NSW Waste and Sustainable Materials Strategy 2041 Stage 1: 2021 - 2027. The Strategy aims to reduce waste and change how the NSW economy produces, consumes and recycles products and materials. Consistent with the Strategy, the EPA is supporting projects that improve options for recovering solar panels at end-of-life to help NSW transition to renewable energy sources within a circular economy framework and reduce the landfilling of solar panels.

Recognising the need to address the management of end-of-life solar panels and to future-proof this growing waste stream, the EPA created the $10 million Circular Solar grant program. The first phase of grant projects were announced in August 2021 and are expected to improve the options in NSW for reuse and recycling of solar panels in the near future. The details on funded projects under the Circular Solar program are available on the EPA website:
https://www.epa.nsw.gov.au/working-together/grants/infrastructure-fund/circular-solar-trials

We are pleased the Guideline reflects that waste reduction and its management are considered important components when assessing large-scale solar energy projects, supporting NSW's transition to a circular economy. To strengthen item 5.6 waste management section of the Guideline, the EPA suggests:

- reviewing the data used for the projected waste volumes of solar panels to reflect the importance of addressing waste management for this quickly growing waste stream
- highlighting the responsibility of waste management for solar panels at end-of-life by ensuring projects consider long-term resource recovery requirements
- supporting the implementation of the upcoming product stewardship scheme for solar panels to ensure industry uptake and national consistency for end-of-life management.

The EPA would like to ensure that waste volume projections reflect how rapidly waste from solar panels is growing and how solar panel waste management is a significant concern. We would like to let you know of a scoping study on solar panels and battery system reuse and recycling commissioned in 2020 by the Department of Planning, Industry and Environment commissioned and prepared by UTS Institute of Sustainable futures and Equilibrium Consulting.

In this study, the waste generation of solar panels in NSW were projected using installation capacity. It was forecasted that NSW will generate 3,000-10,000 tonnes per year by 2025, and 34,000-63,000 tonnes per year by 2035. There may be opportunity to update the lower figures reported in item '5.6.1 Introduction' with those from this recent research to inform the growing need for waste management solutions.

The EPA supports the emphasis on minimising waste through the lifecycle of solar energy projects in the waste management section of the Guidelines. In addition, the EPA would support the use of stronger language in this section to address the ownership of waste generated during construction, operation, and decommissioning so there is increased commitment to minimising waste generation as well as reusing or recycling waste. A particular emphasis on managing intact solar panels would also align to EPA programs to reduce modules ending up in landfill when component parts can be recovered.

To achieve this, it might be considered that the proponent (or relevant party) address the responsibility of waste generated across the life of the project. For example:

- Item '5.6.2 Principles' could also include '*End-markets for waste materials generated by the project, including intact solar panels, are to be identified to ensure a recoverable pathway and avoid landfilling.*'
- Additions to Item '5.6.3 Assessment', could include asking proponents to:
  a) prepare a waste management plan that includes detail on how waste, including intact solar panels, is to be sorted, stored and removed for reuse, recycling, or disposal and the relevant party responsible for each stage in the project
  b) provide evidence from local council or facilities that will accept the volume and type of waste generated by the project
  c) include a strategy or draft agreement that addresses waste responsibility following the possible occurrence of a change of ownership during the project's life or loss of business operation.

To be effective in waste management of solar panels, the EPA also considers it important that the Guideline incentivise participation in the upcoming national solar panel product stewardship scheme. This could be achieved by requesting proponents, or the relevant party, be a member of the scheme once it is implemented. This will ensure a nationally consistent system is supported and industry participates in the scheme to manage solar panels at end-of-life. As you may know, solar panels have been on the Australian Government's National Product List since 2016-17, which identifies the products and materials considered to be most in need of a product stewardship approach. The Australian Government has committed to the nationwide scheme being operational by June 2023, which will include an approach to deal with legacy panels.

Thank you once again for the opportunity to provide feedback and to contribute to the future direction of managing solar panels through their lifecycle. If you have any questions on the feedback provided in this letter, please contact Emma Maxwell, A/Unit Head, Waste & Recycling Infrastructure on (02) 9995 5415 or by email at Emma.Maxwell@epa.nsw.gov.au

Yours sincerely

LIESBET SPANJAARD
Executive Director, Engagement, Education & Programs

riverina
agriconsultants

P 02 6964 9911
E admin@rivagri.com.au
Level 1, 84 Yambil Street
PO Box 1458
Griffith NSW 2680

22 February, 2022

Mr M Reilly
Director – Energy and Resources Policy
Department of Planning, Industry and Environment
Locked Bag 5022
PARRAMATTA NSW 2124

Dear Sir

Re: Draft Large-Scale Solar Energy Guideline

I have reviewed the Draft Large-Scale Solar Energy Guideline, dated December 2021, and wish to provide the following comments in relation to agricultural land use and impact assessment requirements.

I have prepared Agricultural Impact Statements for three large-scale solar projects in the Greater Hume LGA and am familiar with the potential impacts and mitigants of such developments.

The Draft Guideline indicates a policy has been adopted of avoiding Important Agricultural Land for future large-scale solar farms. As such, in my opinion, the Draft Guideline will create a perception within communities that large-scale solar projects are no longer permitted on Important Agricultural Land. As a result of this I believe meaningful community consultation is unlikely to be achieved. A policy of avoiding Important Agricultural Land does not have regard for mitigants such as post development productive uses, for example as a high performing sheep grazing enterprise. In my opinion, instead of a reliance on avoiding Important Agricultural Land, a requirement for proponents to assess the pre and post development productive potential would be more appropriate. Approval conditions could address expectations for post development productive agricultural use.

In my opinion, the requirement for soil surveys in some circumstances as part of the assessment process is inappropriate. In my experience, existing land capability mapping often does not reflect the actual potential productivity of the land nor a land manager's capacity to mitigate or ameliorate soil constraints. The focus on soil type and soil surveys overlooks other factors that influence agricultural productive capacity. Soil quality is not static but is influenced by a range of factors including management and ameliorants.

I would be happy to discuss any of the points raised here with you in more detail.

Yours sincerely

Michael Ryan
Principal Consultant

From:	noreply@feedback.planningportal nsw.gov au
To:	DPE Energy and Resources Policy Mailbox
Subject:	Webform submission from: Revised Large-Scale Solar Energy Guidelines
Date:	Friday, 25 February 2022 9:55:41 AM
Attachments:	ltr-to-dpie---large-scale-solar-energy-guidelines---25.2 22.pdf

Submitted on Fri, 25/02/2022 - 09:53

Submitted by: Anonymous

Submitted values are:

Submission Type
I am submitting on behalf of my organisation

Name

First name
Liza

Last name
Booth

I would like my submission to remain confidential
No

Info

Email
[redacted]

Suburb/Town & Postcode
Sydney

Please provide your view on the project
I am just providing comments

Submission file
ltr-to-dpie---large-scale-solar-energy-guidelines---25.2.22.pdf

Submission
Attached is submission from the Law Society of NSW.

I agree to the above statement
Yes

THE LAW SOCIETY
OF NEW SOUTH WALES

Our ref: EP&D:JvdPlb250222

25 February 2022

Mr Matthew Riley
Director, Energy and Resources Policy
Department of Planning, Industry and Environment
Locked Bag 5022
PARRAMATTA NSW 2124

Dear Mr Riley,

Large-Scale Solar Energy Guidelines

The Law Society appreciates the opportunity to comment on the Draft Large-Scale Solar Energy Guideline. The Law Society's Environmental Planning and Development Committee contributed to this submission.

Our comments on the sections discussed below adopt the subheadings used in the draft Guideline.

Application of the guideline
Section 1.2 states:

> Although large-scale solar energy projects are the focus of this Guideline, applicants, Councils and planning panels that are responsible for local and regional solar development applications are encouraged to consider the site selection and impact assessment matters in the Guideline when assessing and determining local and regional solar development applications.

We suggest that it is unlikely that Council planners would consider the Guideline in assessing local and regional solar development applications, unless the Guideline is referenced in the Council's development control plan. We also note that the suggestion to consider the Guideline would be more helpful if it gave some guidance as to the weight that Councils should apply to the Guideline in assessments, other than for State Significant Development (SSD).

When is a solar energy project 'State significant development'?
Under the existing planning framework, a solar energy project is SSD if (among other things):

> it is not permissible without consent and has a:
> • capital investment value of more than $30 million
> • capital investment value of more than $10 million and is in an environmentally sensitive area[1] of State significance.[2]

[1] As defined in 4(1) of Part 1 of the *State Environmental Planning Policy (State and Regional Development) 2011*
[2] Schedule 1, Clause 20, *State Environmental Planning Policy (State and Regional Development) 2011*

Although beyond the scope of the Guideline, in our view, it is not appropriate to site large-scale developments for the type of solar farming proposed on environmentally sensitive areas of State significance.

Community and stakeholder engagement
The statement on page 25 that 'Applicants are expected to engage' should be amended to make clear whether applicants 'must' or 'may' engage. 'Expected to' is ambiguous and its use risks uncertainty by applicants and in the community about what is required and what is optional.

Agricultural land use conflicts
Visual assessment requires the proponent to prepare a visual impact assessment as part of the Environmental Impact Statement (section 5.3.1). Figure 2 on page 32 demonstrates the visual assessment of impacts. Impacts that are greater than low impact should be avoided. Moderate or high impacts not only impact residential premises in rural areas but also impact agricultural activities, tourism activities and may impact cropping activities where aircraft are used.

The principles listed in 5.3.2 require that land categorised as being of high agricultural significance should be avoided. Unfortunately lands that are classified as being of either low soil or agricultural quality are usually environmental lands or lands set aside for nature conservation. This may lead to unfortunate consequences of further substantial land clearing in regional areas. While this approach is objectively designed to encourage sustainability, the assessment process needs to ensure that any development, particularly through land clearing, does not result in significant detriment to adjoining local areas.

Benefit Sharing and Agreements
Benefit Sharing Agreements are encouraged where identified land holders are significantly affected:

> Where impacts are more specific to identifiable landholders, and those impacts cannot be mitigated by other measures, it would be appropriate for an applicant and landholders to negotiate agreements regarding the management of impacts. It is up to applicants and landholders to agree on what is appropriate to manage impacts (including at different stages of the project's life) in their particular circumstances.[3]

Impacted landholders have only one recourse, and that is to enter into an agreement with the developer. While the applicant must pay the cost of the landholder obtaining independent legal advice, in many cases it may be that the applicant has significantly more resources than the landholder, akin to the situation some regional communities face in their interactions with mining projects. We suggest that sufficient resources are allocated to support engagement with, and other support services for, landowners needing to navigate this process.

Decommissioning
Decommissioning requires that the land be returned to its pre-existing use. This is often not possible, especially where the land was formerly classified as of environmental significance or as environmentally sensitive. We also note that where no bond is required, failure to decommission in accordance with conditions of consent leaves only enforcement options.

[3] NSW Government, Department of Planning, Industry and Environment, *Draft Large Scale Solar Energy Guideline*, 38.

At 5.3.3:

> The consent authority should impose conditions of consent to ensure that the above principles are met. Because the decommissioning and rehabilitation of solar farms is relatively straightforward, these conditions should be outcomes-based and not include post approval requirements such as management plans.

As stated above, it is not always possible to achieve outcome-based solutions, and in such circumstances plans of management are helpful, particularly if parts of the development come on and offline in differing cycles.

Other assessment issues (section 5.7)
There should be a requirement for detailed assessment of bushfire risks to be undertaken, both during construction and once the project is operative. Although this risk is noted under the heading "Hazards", a greater emphasis would serve to reflect the scale of risk represented by the operation of large solar farms.

Appendix B, 3 Content of Assessment
The list of requirements for a Level 1 assessment should include 'and any avoidance or mitigation measures proposed by the Applicant and/or neighbouring landholders' after the words 'on immediately adjacent land' in the second dot point. It is observed that objector appeals of solar projects are often resolved once the objecting neighbouring landholder has provided their proposed avoidance and mitigation measures. Opening a two-way discussion before a development application is even lodged has the potential for mutually acceptable resolutions without the need for court proceedings.

Appendix C
Negotiated agreements may fail to consider other industries in proximity to the project, including tourism and the equine industry.

We suggest removing the statement "remain in force for at least the duration of any predicted exceedance of the relevant assessment criteria" and insert, "remain in force until the project is fully decommissioned and can be modified if additional exceedances occur throughout the duration of the project."

It is often the case that after an initial approval is obtained, the applicant seeks modifications or extensions to the consent, which in turn lead to further exceedances. This should be a factor for consideration in any landholder agreement.

The Law Society appreciates the opportunity to participate in the reform process. If you have any questions about this submission, please contact Liza Booth, Principal Policy Lawyer, at liza.booth@lawsociety.com.au or on (02) 9926 0202.

Yours sincerely,

Joanne van der Plaat
President

From:	noreply@feedback.planningportal nsw.gov au
To:	DPE Energy and Resources Policy Mailbox
Subject:	Webform submission from: Revised Large-Scale Solar Energy Guidelines
Date:	Friday, 25 February 2022 11:43:52 AM

Submitted on Fri, 25/02/2022 - 11:43

Submitted by: Anonymous

Submitted values are:

Submission Type
I am submitting on behalf of my organisation

Name

First name
Dennis

Last name
Armstrong

I would like my submission to remain confidential
No

Info

Email
[redacted]

Suburb/Town & Postcode
Gulgong 2852

Please provide your view on the project
I object to it

Submission
The proliferation of renewables projects hroughout rural Australia is causing many communi ies harm. Save Our Surroundings (SOS) speaks for many of these communities. Industrial wind, solar and now Battery Energy Storage Systems (lithium-ion batteries) have been around long enough, especially in Europe and the USA, for the adverse effects they have on communities and the environment to be well documented.

The attached research paper, 'Wind and Solar Electricity Generation are the Answer. Seriously? February 2022', explore many of these negatives, which should be taken into account by the Department when finalising its guidelines, which in itself is an issue, They should be requirements and enforceable conditions, not just guidelines hat developers will find ways of only appearing to comply with he guidelines.

The guidelines still do not adequately address what the Developers do not tell communities about their product and make all sorts of output, jobs and "mitigation" promises, often not met because there is little to no oversight during construction or after commissioning.

A sensible Energy Policy that works from he consumer back, focused upon availability, affordability & reliability 24/7. An energy Policy that:

1. Is technology agnostic;
2. Eliminates all subsidies and discriminatory legislation which favours one, or operates against one, technology over another;
3. Requires contractual obligations via AEMO auction to meet guaranteed power outputs in accord wi h clearly defined Quality of Service standards;
4. Imposes substan ial financial penalties upon any electricity generator who fail to meet contractual commitments;
5. Requires a bond in advance to meet restoration of environmental Terms & Conditions (for decommissioning, removal of all infrastructure, land rehabilita ion and/or disposal/recycling costs for the infrastructure e. g. solar-PV panels, wind turbine blades, etc);
6. Repeals legislation, such as the RET, Safeguard Mechanism etc. and he prohibition of nuclear power.

Thank you for allowing us to make a submission.
SOS

I agree to the above statement
Yes

From:	Dennis Armstrong
To:	DPE Energy and Resources Policy Mailbox
Subject:	FW: Revised Large-Scale Solar Energy Guidelines: Our SOS submission
Date:	Friday, 25 February 2022 12:08:44 PM
Attachments:	SOS Research Paper February 2022 v1.pdf

Resent due to fault in original email address

Regards
Dennis Armstrong
Save Our Surroundings (SOS)

From: Dennis Armstrong
Sent: Friday, 25 February 2022 12:02 PM
To: energy.resourcespolicy@dpie.nsw.gov.au <energy.resourcespolicy@dpie.nsw.gov.au>; eplanning.exhibitions@planning.nsw.gov.au
Subject: Revised Large-Scale Solar Energy Guidelines: Our SOS submission

Dear Sir/Ms
Save Our Surroundings (SOS) today lodged online our submission as shown below. However, despite waiting over thirty minutes for our pdf to be uploaded it appears not to have been. On each of several submission attempts we received a notification that said: *"File upload in progress. Upload may be lost. Do you want to continue? OK Cancel".* After several attempts of hitting cancel we had to hit OK as considerable time had elapsed.
The 4.44 MB document we tried to upload is attached and we will appreciate you adding it to our online lodged submission if in fact it was not uploaded the first time.

The proliferation of renewables projects throughout rural Australia is causing many communities harm. Save Our Surroundings (SOS) speaks for many of these communities. Industrial wind, solar and now Battery Energy Storage Systems (lithium-ion batteries) have been around long enough, especially in Europe and the USA, for the adverse effects they have on communities and the environment to be well documented.

The attached research paper, 'Wind and Solar Electricity Generation are the Answer. Seriously? February 2022', explore many of these negatives, which should be taken into account by the Department when finalising its guidelines, which in itself is an issue, They should be requirements and enforceable conditions, not just guidelines that developers will find ways of only appearing to comply with the guidelines.

The guidelines still do not adequately address what the Developers do not tell communities about their product and make all sorts of output, jobs and "mitigation" promises, often not met because there is little to no oversight during construction or after commissioning.

A sensible Energy Policy that works from the consumer back, focused upon availability, affordability & reliability 24/7. An energy Policy that:

1. Is technology agnostic;

2. *Eliminates all subsidies and discriminatory legislation which favours one, or operates against one, technology over another;*
3. *Requires contractual obligations via AEMO auction to meet guaranteed power outputs in accord with clearly defined Quality of Service standards;*
4. *Imposes substantial financial penalties upon any electricity generator who fail to meet contractual commitments;*
5. *Requires a bond in advance to meet restoration of environmental Terms & Conditions (for decommissioning, removal of all infrastructure, land rehabilitation and/or disposal/recycling costs for the infrastructure e.g. solar-PV panels, wind turbine blades, etc);*
6. *Repeals legislation, such as the RET, Safeguard Mechanism etc. and the prohibition of nuclear power.*

Thank you for allowing us to make a submission.
SOS

Regards
Dennis Armstrong
Save Our Surroundings (SOS)
Save Our Surroundings (SOS) is an umbrella group for like-minded concerned and impacted citizens that oppose the proliferation of industrial scale weather-dependent “renewables” and their negative impacts on local and global environments and communities. The independently run SOS groups share and distribute information and are currently: SOS Central West NSW, SOS-Gulgong, SOS-Mudgee, SOS-Wellington, SOS-Orange, SOS-Greater Hume, SOS-Riverina, SOS-Clarence Valley and SOS-Qld.

Wind and Solar Electricity Generation Are The Answer. Seriously?

February 2022












Contents

Wind and Solar Electricity Generation are the answer. Seriously? September 2021

Prepared by Save Our Surroundings (SOS) and updates the original November 2020 paper and the updated May 2021 and October 2021 papers as a result of more current events supporting the evidence we provide.

SOS is an umbrella group for like-minded concerned and impacted citizens that oppose the proliferation of industrial scale weather-dependent "renewables" and their negative impacts on local and global environments and communities. The independently run SOS groups share and distribute information and are currently: SOS Central West NSW, SOS-Gulgong, SOS-Mudgee, SOS-Wellington, SOS-Orange, SOS-Greater Hume, SOS-Riverina, SOS-Clarence Valley and SOS-Qld.

Introduction

Why SOS prepared this paper

Residents of rural Australia are, and continue to be, directly and negatively impacted by mega industrial wind and solar proposals and constructions and the decisions of our policy makers that facilitate the destruction of their local environments and limit their rights. This destruction is long-lasting. Concerned citizens volunteer their time and energy to providing the collective knowledge gained so far to anyone who wants to learn about the negatives of weather-dependent "renewables" and know what questions to ask of our governments, organisations, media and developers. Rural regional Australians want to be heard and their issues appropriately addressed.

"The public and the news media, who should be asking probing questions, have become convinced that they cannot understand science. They are reduced to asking scientists to spoon feed them sound bites. With a little work, most lay people can understand scientific papers and they should try. Relying on politicians, scientists, and the media to tell us what is happening is not acceptable."

Quote by Andy May "Politics and Climate Change: A History"; wattsupwiththat.com/2020/11/15/the-government-corruption-of-science/

The significant conclusions drawn from our nearly three years of research and input from dozens of affected communities into weather-dependent wind and solar electricity generation, including the required backup using batteries, pumped hydro and biomass, are that:

- Australian governments cannot achieve their stated objectives of reducing global temperatures, significantly reducing electricity prices and creating substantial numbers of jobs. No state or country with a large proportion of renewables, including wind and solar plants, in their electricity generation mix has achieved these objectives.

- The risks to the safety of people and the damages to many domestic and overseas environments are substantial and are being ignored. The risks include life-cycle toxicity, causing serious bush and grass fires, loss of productive farmland, pollution of the environments and abuses of people in developing countries, including children. Globally, 82% of mining areas, including wilderness areas, are now targeted to extract raw materials for "renewables".

- Resources are being misallocated: up to ten times more resources (land and materials) are needed for intermittent weather-dependent and weather impacted renewables than for alternatives, such as reliable base-load modern coal, gas or nuclear generators. Subsidies and favourable policies for renewables distort the market place for energy generation.

- The public are not being told about the many negative aspects of weather-dependent electricity generation or are being mislead about the benefits, the costs and the viability of proposed solutions, such as green hydrogen. Even so, the general public and impacted community groups have already rejected the case for excessive renewables several times, but our politicians continue to ignore the majority decisions by the voters.

This paper presents many of our research findings that highlight the folly of the Federal and State governments' policies in promoting and subsidising solar and wind electricity generating plants and setting net zero targets at the expense of much better modern alternatives, such as High Efficiency Low Emissions (HELE) coal-fired power plants, combined closed cycle natural/hydrogen gas turbines and nuclear reactor electricity generation, which are all much less harmful to the global environment and still reduce emissions in comparison to Australia's old coal-fired electricity generation plants.

The two policy drivers promoted by governments and others to extensively and radically change the methods of electricity production in Australia are:
(1) to lower carbon dioxide equivalent emissions to reduce Earth's projected temperature increases, and
(2) to provide a very low cost electricity supply so as to, in Australia:
 a) increase economic activity, especially manufacturing;
 b) create sufficient jobs for an increasing population;
 c) mitigate the impacts of the COVID-19 on Australia's economy, which resulted in an unacceptable unemployment levels and created astronomical states' and national debts.

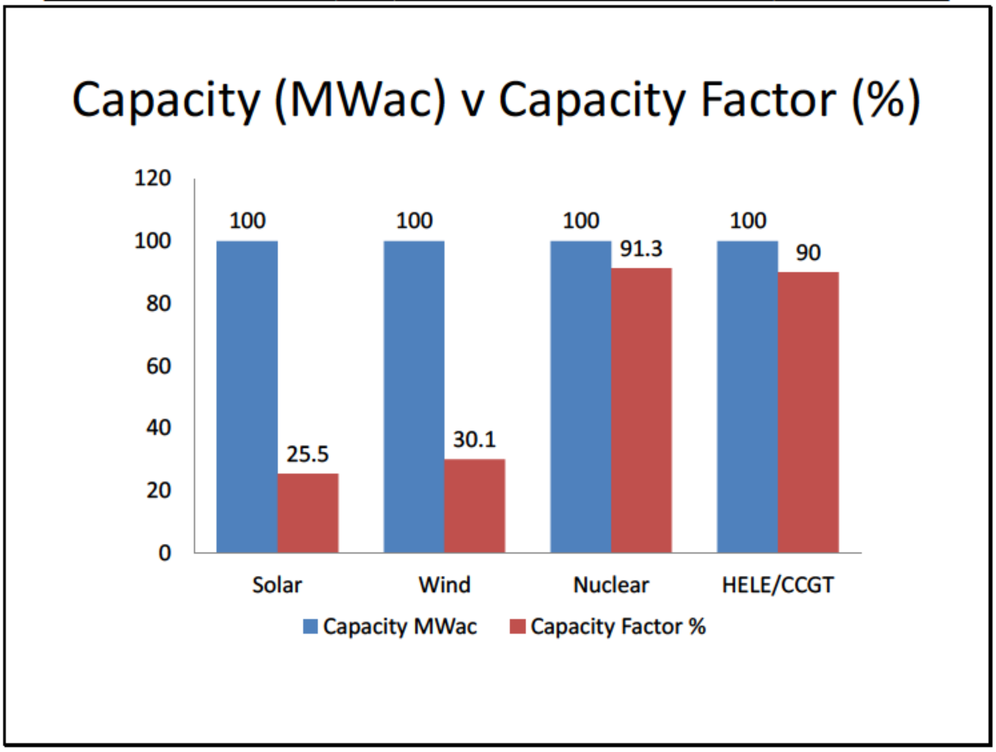
Therefore, the question to be answered is: "To what extent should weather-dependent renewables, and their necessary additional costs, infrastructure and negative impacts on all environments and people, play in achieving these policies?". The NSW State and Federal LNP, Labor and Greens parties and many of the other ill-informed public bodies, companies and main stream media promote, without supporting facts, net-zero emissions and claim that much cheaper electricity will result from higher proportions of weather-dependent renewables. However, our research demonstrates that the verifiable facts and the actual experiences to date do not support such claims. Therefore, renewables must play a very small part if Australia is to recover economically and continue to provide and improve the services of a developed country for the current and future generations of Australians.

Our justification for concluding that wind turbines and solar industrial electricity generating plants (IEGP) should play a small part in Australia's total electricity generation mix derives from examination of the available evidence, which does not support any of the usually unsupported claims made by those that advocate wind and solar electricity generation, including the necessary backup of battery, pumped hydro and biomass plants. This research paper examines the claims by proponents of weather-dependent renewables, which are that renewables will:

- **significantly reduce CO2 emissions;**
- **provide the cheapest sources of electricity generation;**
- **create substantial numbers of jobs (especially in the regions);**
- **are safe;**
- **are good for the environment;**
- **are clean sources of energy;**
- **will eliminate fossil fuel use;**
- **have strong community support;**
- **are reliable;**
- **are sustainable.**

We have tried to be brief, but the topic and evidence is substantial, the research extensive and continues to evolve, so at best we will only provide summary points at this time. We urge readers to examine the hundreds of references quoted throughout this paper that support all our research, findings and conclusions. We will address the claims for the benefits of wind and PV solar "renewables", including the claims that battery, pumped hydro and biomass backup is all that is needed for a "modern" electricity system.

Firstly some definitions:
It is important that the reader understand the terms and acronyms used when discussing electrical energy. For example, the net **Capacity Factor** is the ratio of an actual electrical energy output over a given period of time to the maximum possible electrical energy output over that period e.g. a **1MW** wind turbine may produce **2,637MWh** in a year out of a possible **8,760 MWh**, therefore its **capacity factor is 2,637/8760 = 30.1%**, which is a typical value for modern wind turbines. A photovoltaic (PV) solar Industrial Electricity Generating Plant (IEGP) with a rated nameplate capacity of 400 megawatts alternating current (MWac) produces less than the third of the electricity over a year than does a modern HELE coal fired plant or combined cycle gas turbine (CCGT) power plant or a nuclear reactor. The electricity output of a power plant is described as megawatt hours (MWh). More detailed definitions are shown at Appendix A. The chart below shows the relative Capacity (MWac) vs Capacity Factor (%) of the main electricity generating technologies.



Estimated or actual annual output in MWh = Capacity factor % x (capacity MWac x 24hrs x 365 days)

Secondly, some basic facts:

- It is estimated from IPCC data that carbon dioxide (CO2) from all human-induced sources, not just electricity generation, is **3%** of the 0.04% of CO2 in the atmosphere. 97% of greenhouse gases (GHG) are naturally occurring. Australia is responsible for about **0.039%** (i.e. 1.3% of the 3%**)** of human-induced amount of total global emissions of carbon dioxide equivalents (generally stated as the main driver of global warming) and by signing the Paris

Climate Agreement has undertaken to reduce its human related carbon dioxide emissions over time.

However, Australia's Chief Scientist of Australia, Dr Finkel, told a Senate inquiry in June 2017 that if Australia reduced its **total** carbon emissions to **zero**, that it would do **virtually nothing to reduce global temperatures.**

Thus, Australia's policies on emissions reductions should be based on logic and practicality. For Australia, electricity consumption is about **33%** of our total energy consumption, i.e. a third of our total CO2 emissions. Restructuring our electricity system can have no affect on our climate but is negatively impacting our environments and electricity costs.

There is no justification for spending multi-billions of dollars every year in direct and indirect subsidies for no climate benefit, yet causing higher electricity bills, increasing hardship to Australians, damaging our economy and causing wide-scale damage to our environments, both in Australia and overseas.
[ref: https://www.facebook.com/SenatorIanMacdonald/videos/1343186319100574/; IPCC AR4 2007]

- Every country, such as Australia, Germany and Denmark or state, such as California, Texas and South Australia, that have significantly introduced solar and wind technologies into their electricity generation mix have not only significantly increased their electricity prices but also destabilised their electricity grids, which leads to more expenditure on 100% backup, extension of transmission infrastructure, more difficult electricity grid management and more ad hoc unproven "solutions" being pursued, such as the failed geothermal, wave generation and carbon capture experiments.

  Doing more of the same thing (i.e. increasing the percentage of weather-dependent renewables) and expecting a different result is totally illogical.
  [ref: afr.com 5/8/17 "MarkIntell, US Energy Information Administration"]

- The NSW Government in November 2020 declared the Central-West Orana a Renewable Energy Zone (CWO REZ), which will be an initial **3,000MW** installed capacity "pilot" for several already identified NSW Renewable Energy Zones. The NSW Electricity Strategy states it aims are to provide low cost electricity to consumers and provide a stable and reliable energy system, while achieving a net-zero emissions target by 2050. *"For households, the Strategy will lead to estimated bill savings of **$40 per year** "* by **2040**.

  The 2020 average residential bills were: **18-29yo $1906**; **60syo $1458**. We need to reduce electricity bills by **half or more not a miniscule $40pa or even AEMO's estimate of $55pa in 20 years' time**. No country, state or jurisdiction has been able to have a high percentage of renewables in their electricity system mix and still provide cheaper electricity or even a stable or reliable supply. Australians already support renewables through direct and indirect subsidies and other means to the tune of at least **$1300pa** per household, amounting to over **$13 billion** nationally, and still growing, each year.

  If the renewables subsidies were used to build two or three modern long-life HELE coal-fired (China, India, Japan and others are building hundreds of these right now) or a few combined-cycle gas turbine and/or a nuclear plant (50 nuclear reactors are globally under construction right now) or several of the USA approved Small Nuclear Reactor (SMR) then the average electricity bills should drop by meaningful amounts within in a few years.
  [ref: https://energy.nsw.gov.au/media/1921/ " NSW Electricity Strategy"; afr.com 5/8/17 "MarkIntell, US Energy Information Administration"; afr.com 5/8/17 "MarkIntell, US Energy Information Administration"; 23/08/20

Report by Dr Moran "The Hidden Cost of Renewables on Electricity Prices"; ddears.com/2020/07/14/dont-ignore-coal/ ; world-nuclear.org/information-library/current-and-future-generation/plans-for-new-reactors-worldwide.aspx' Daily Telegraph p2 9/11/20 "Road to cheaper and cleaner power in NSW"]

- Two of the biggest emitters of CO2 in 2019 were China (**27.9%**) and India (**7.2%**) who, under the Paris Climate Agreement, can continue to increase their emissions for several more decades. The USA, while the second biggest CO2 emitter in 2019 (**14.5%**) has reduced its emissions by substantially since Kyoto Protocol commenced in 2005, largely by significantly increasing gas for electricity generation instead of using coal. In 2019-20 China's emissions were 30% of world emissions despite a slower economy, increased renewables and the full-year operation of seven new large-scale nuclear reactors.

  Australia can have no practical effect in reducing global CO2 emissions.
  [ref: "2019 BP Statistical Review of World Energy"; Paris Agreement targets; iea.org/articles/global-co2-emissions-in-2019 ; https://www.facebook.com/SenatorIanMacdonald/videos/1343186319100574/;]

- Germany and Denmark are regarded as world leaders in transitioning to renewable energy electricity generation, yet in 2020 Germany had the highest household electricity prices in the world at **US$0.366/KWh** with Denmark at **US$0.337/KWh**), despite their massive shift to renewables at **46.5%** and **63%** respectively; the world average electricity price in 2019 was **US$0.14/KWh** , Australia was **US$0.23**. China and India, who generate most of their electricity from burning coal, were each **US$0.08/KWh**.

  The evidence is clear: the more weather-dependent renewables there are the greater the increase the overall cost of electricity supply. How can Australia be competitive when our electricity cost three times more than our competition and near trading partners?
  [ref: globalpetrolprices.com "Electricity prices for households, December 2020".]

- For energy generation, wind is an ancient technology and solar cells (invented in 1883 by C Fritz) and the first viable solar panel developed by Bell Laboratories in 1954, are both dilute inefficient and inconsistent forms of energy conversion. The energy density (amount of energy in mega-joules [Mj] released per kg) of different fuels in increasing order is wood (16Mj/kg), coal (24), oil (45), natural gas(55) and nuclear (3,900,000). The higher the energy density the lower the total demand on all resources and the higher the efficiency in producing electricity. A mega-joule is equivalent to 0.278KWh of energy.

  Logically, natural gas and zero emissions nuclear are the preferred fuels at this time.
  [ref: understandsolar.com "Who invented solar panels?"; energyeducation.ca/encyclopedia/energy_density]

- A study of Germany's electricity generation found that over their operating life solar and wind have very low energy output compared to the energy used to make and install them. The energy generated by nuclear, hydro, wind and solar was, respectively, **75, 35, 3.9** and **1.6** times greater than the energy required to make them. Wind and solar provide a poor return on an energy in/energy out basis compared with other methods. More energy in means the more emissions created and embedded in the product.

  Logically, nuclear energy should be preferred for electricity generation as it gives the best energy in/out result, causes fewer emissions in its creation and generates zero emissions during its operation. Also, the imbedded GHG in renewables must be taken into account.
  [ref: 30/6/20 M Shellenberger "Apocalypse Never" p192]

- Australia is the only country of the top 20 developed countries and the top 'developing' countries (China and India) that do not depend on zero-emissions nuclear power for part of their electricity generation. There are currently about **50** nuclear power reactors under construction, mainly in China, India, Russia and UAE.

Australia is being left behind due to its illogical and damaging ban on nuclear energy.
[ref: World Nuclear Association "Plans for New Reactors Worldwide" September 2020]

- California at the end of 2019 had 13 in-state sources of electricity (excludes over 30% imported from interstate). Its installed capacity (MW) was PV solar **14.1%**, wind **7.5%**, natural gas **50.6%,** nuclear **3%**, hydro **17.6%,** others **7.2%.** California, America's most populous state, is among the most expensive states for electricity and its electricity prices have increased at five times the average rate of the rest of the USA as they move each year to higher percentages of "renewables" and elimination of fossil fuels and nuclear power sources.

  Again, gas and nuclear should be the preferred power sources for Australia, especially as they do not involve major changes to the electricity grid or place huge demands on scarce resources as do weather-dependent renewables.
  [ref : 2001-2019 www.energy.ca.gov "Electric Generation Capacity and Energy"]

- CO2 emissions reductions have become an end in themselves and so the negative impacts of weather dependent renewables on the environment and on electricity prices, reliability and security are being ignored. Professor Steven Koonin, former New York University **professor** and former **undersecretary for science** in the Department of Energy in the President Obama administration, in his recently released book "Unsettled" highlights the lack of evidence to support claims of human induced climate change that is an "*existential threat, climate emergency, disaster, crisis, but in fact, when you actually read the literature, there is no support for that kind of hysteria at all*". This is in addition to two long-time, well known environmentalists, Michael Moore (documentary "Planet of the Humans" YouTube 21/04/20) and Michael Shellenberger (book "Apocalypse Never: Why Environmental Alarmism Hurts Us All" 30/06/2020) highlighting the environmental damage being caused by the obsession many countries have for weather-dependent renewables.

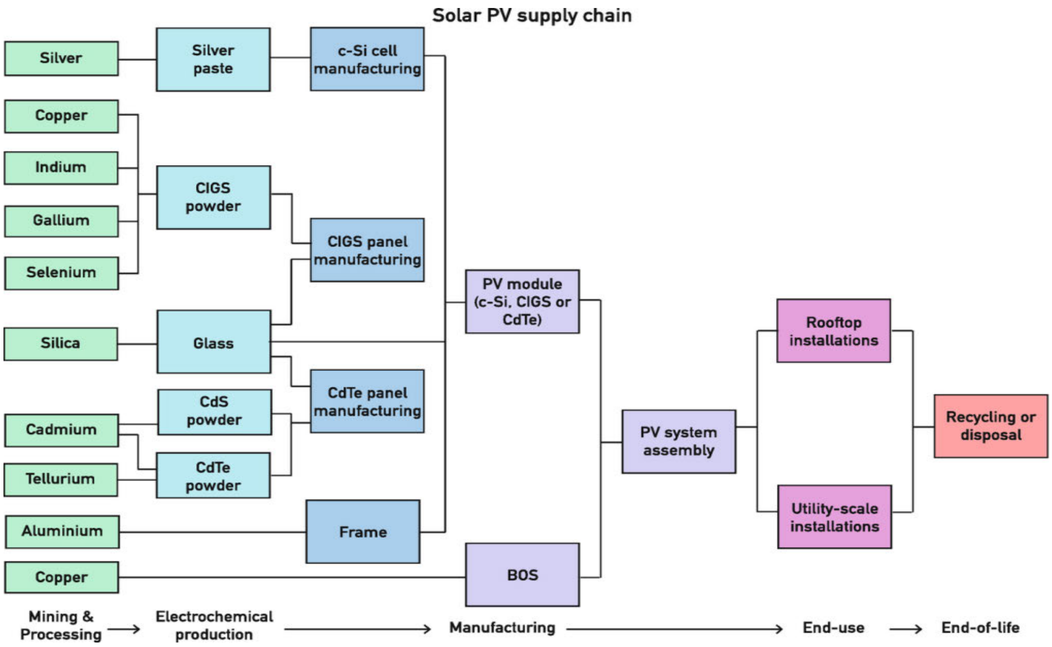
Claimed benefits of solar and wind electricity generation

The proponents of wind and solar electricity generation claim that these will:

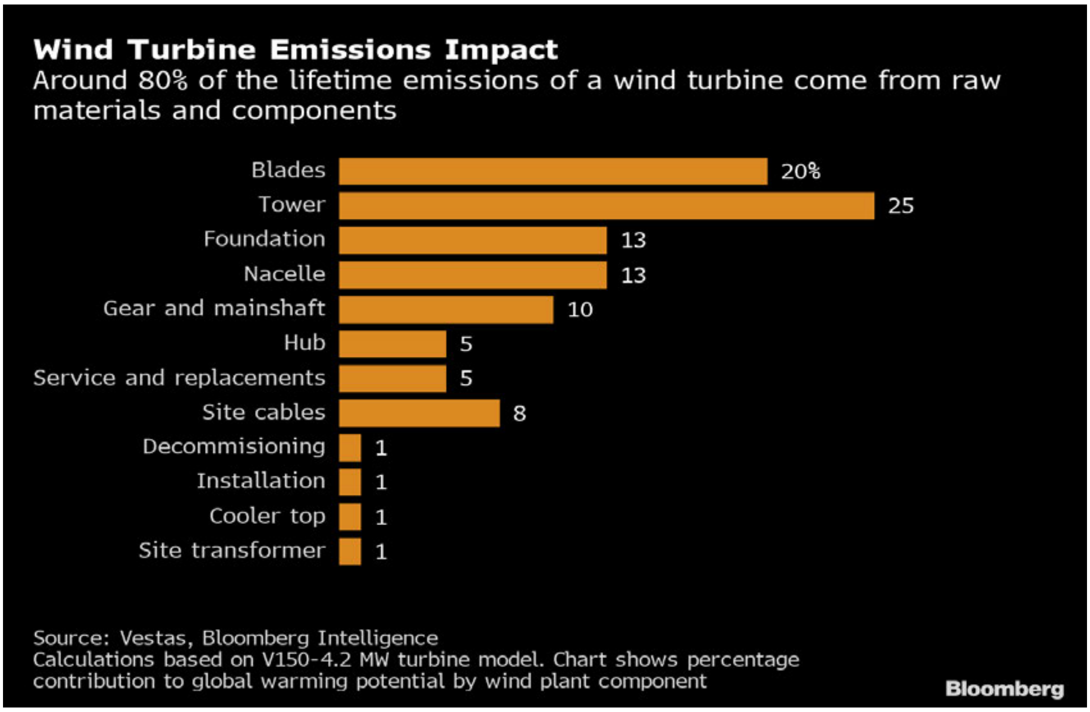
1. Significantly reduce CO2 (or CO2 equivalents) emissions

This claim is not supported by the facts, as advocates omit the multitude of associated emissions that weather-dependent renewables cause over their total short life-cycle, such as:

- Studies show, if the TOTAL life-cycle (e.g. mining, processing, manufacturing, transportation, land acquisition/lease, land clearing, construction, operation, decommissioning and disposal/recycling) of an industrial PV electricity generating system and the associated extra supporting infrastructure needed (e.g. backup power/storage, grid building/upgrades, substation building/upgrades, recycling facilities/storage, landfill facilities), creates substantially more CO2 emissions than say a nuclear power plant of the same nameplate capacity (megawatts). Only about **60%** more energy is generated over the claimed up to **30** years life of an industrial PV solar plant than it takes to build it. Nuclear generates about **7,400%** more energy than it takes to build it and operates for up to **80** years.
  [ref: 30/6/20 Michael Shellenberger "Apocalypse Never" p192; Oct 2020 Dr Lars Schernikau "The truth behind renewable energy"]



- Studies show, if the TOTAL life-cycle (e.g. mining, processing, manufacturing, transportation, land acquisition/lease, land clearing, construction, operation, decommissioning and disposal/recycling) of an industrial wind turbine electricity generating system and the associated extra supporting infrastructure needed (e.g. manufacture of large specialised vehicles & cranes, dock extensions, road building, backup power/storage, grid building/upgrades, substation building/upgrades, recycling facilities/storage, landfill facilities), creates substantially more CO2 emissions than say a nuclear power plant of the same nameplate capacity (megawatts). Only about **290%** more energy is generated over the up to **20** years life of an industrial wind turbine system than it takes to build it. A nuclear plant generates about **7,400%** more energy than it takes to build it and operates for up to **80** years.
  [ref: 30/6/20 M Shellenberger "Apocalypse Never" p192; Bloomberg "Wind turbines emissions impact chart]



- The relatively short life-cycle of PV solar systems (20 to 30 years) and wind turbines (15 to 20 years) and batteries (10 years) compared to the alternatives of coal, gas and nuclear plants (60 to 80 years) means that a PV solar plant or a wind turbine plant needs to be replaced/upgraded 2 to 3 and 4 to 5 times respectively during the lifetime of the alternatives, which generates more green house emissions each time. Over a 60 years period this frequent replacement of solar and wind electricity plants will continue adding CO2 to the atmosphere and drive up electricity prices for decades.
  [ref: 17/08/20 "The excess cost of weather dependent renewable power generation in the USA" from EDMHDOTME]

The low starting and declining efficiencies of wind turbines (**34%/1.6%**pa) and PV solar panels (under **25%/0.5 - 0.8%**pa) means that the initial resource demands of the installations has to be many times more than the alternatives for the same actual electricity generation output (megawatt hours pa) over their life-times and so adds more CO2 to the atmosphere.
[ref: sciencedirect.com Vol 66 June 2014 p775-786; 7/07/18 wholesalesolar.com "How long do solar panels last?"; 2012 NREL study; https://papundits.wordpress.com/2019/10/01/australian-daily-wind-power-generation-data-introduction-with-permanent-link-to-daily-posts/]

- Despite very significant expenditures on renewables, Germany (**A$830 billion** since 1999) and the state of California (**A$143b** on wind & solar) have not met/may not meet their emission reduction targets as at 2019. Germany, whose emissions reductions have been flat for several years, will reportedly miss its 2020 target by **7 to 11%**. California has to nearly double its rate of CO2 reduction in the next decade compared to the previous decade.
  [ref: nextbigfuture.com/2019/11/france-spent-less-on-nuclear-to-get-about-double-what-germany-gets-from-renewables; forbes.com/sites/michaelshellenberger/2020/08/15/why-californias-climate-policies-are-causing-electricity-black-outs/#6cf13471591a ; dw.com.en.germany " Germany unlikely to meet carbon reduction targets for 2020"; 16/1/20 mercurynews.com "California's behind on its 2030 climate goals. What's at stake if it doesn't catch up?"]

- Had California spent an estimated **US$100 billion** (A$143b) on nuclear instead of on wind and solar, it would have had enough energy to replace **all** fossil fuels in its in-state electricity mix. Thus, emissions-free nuclear reactors would have seriously reduced CO2 emissions and

lowered electricity prices, as is the case in France, which generates about 70% of its electricity from its nuclear reactors.
[ref: 15/8/20 forbes.com/sites/michaelshellenberger/2020/08/15/why-californias-climate-policies-are-causing-electricity-black-outs/#6cf13471591a]

- The development of nuclear power generation in Australia will lead to the establishment of an entire new industry with long-term environmental, technological, economic and social development benefits. These benefits will flow on progressively to other industries, all while bringing the economy closer to net zero emissions. It will also support our defence capabilities, including our decision to purchase nuclear submarines.
[ref: "The case for SMRs in Australia" by SMR Nuclear Technology Pty Ltd August 2021]

- Sulphur hexafluoride (**SF6**) is a synthetic greenhouse gas primarily used for insulating electrical connections to the grid. **SF6 is 23,500** times more potent than CO2 and its estimated lifespan in the atmosphere is over 1000 years, whilst CO2 is 100 years. SF6 in the atmosphere has more than doubled in the last two decades and will continue to rise as more renewable energy connections to electricity grids occur.
[ref: bbc.com 13/09/2019 "Climate Change: Electrical industry's dirty secret"]

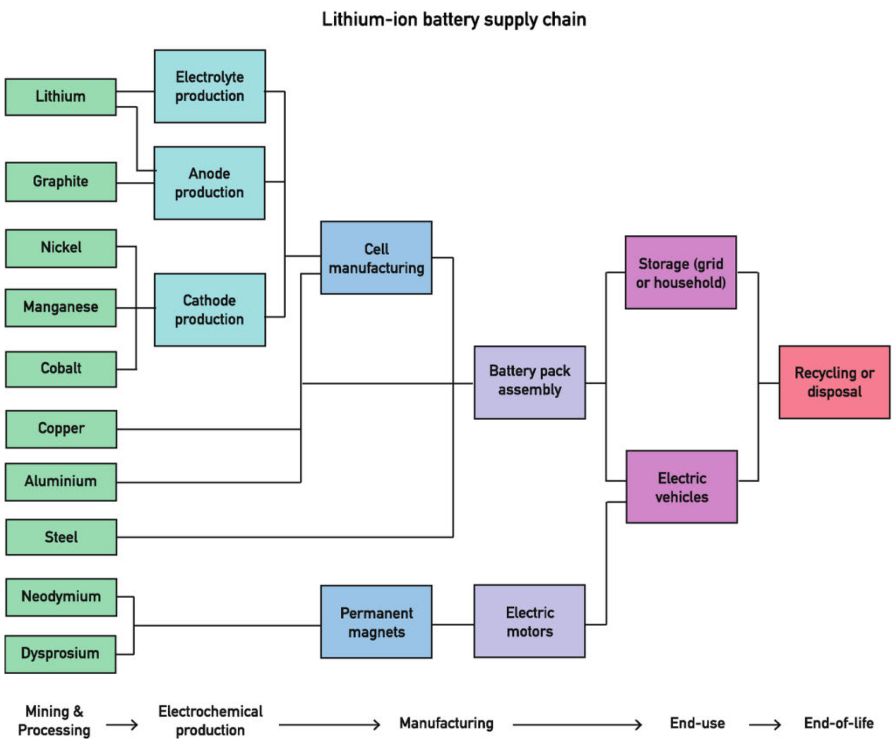
- According to US federal data, building solar panels significantly increases emissions of nitrogen trifluoride (**NF3**), which is **17,000** times more potent than carbon dioxide as a greenhouse gas over a **100** year time period. NF3 emissions increased by **1,057 percent** over the last **25** years. In comparison, US carbon dioxide emissions only increased by about 5% during that time period. A significant and growing proportion of NF3 emissions is due to the manufacture of solar cells.
[https://wattsupwiththat.com/2018/12/23/solar-panel-waste-a-disposal-problem/; Wikipedia "where is NF3 used]

- A study has shown that a PV solar system only generates **1.6** times the energy that was used leading up to its commissioning. It therefore starts operation with a CO2 and energy deficit. Assuming a 25 year life then the system will only offset its energy deficit at the time of commissioning after 10 years of operation, i.e. at least **40%** of its life before contributing to any global reduction in CO2.
[ref: https://doi.org/10.1016/j.energy.2013.01.029]

- It was been calculated in 2014 that just the footing for a small (1MW) wind turbine requires **45** tons steel rebar and **481m3** of concrete, which produces **241.85 tons of CO2**. The CO2 produced from mining, processing and transporting the materials was **not** included in the calculation. 241.85 tons (219.4Tonnes) of CO2 is equivalent to an average new petrol driven car in 2017 (0.1201kg/km of CO2) travelling 1,827,000km or 122 cars each travelling 15,000km in a whole year.
[ref stopthesethings.com 16/8/14 "How much CO2 gets emitted to build a wind turbine?"; 4/10/17 www.lightfoot.co.uk "How much CO2 does a car emit per year"]

A single wind turbine concrete base under construction

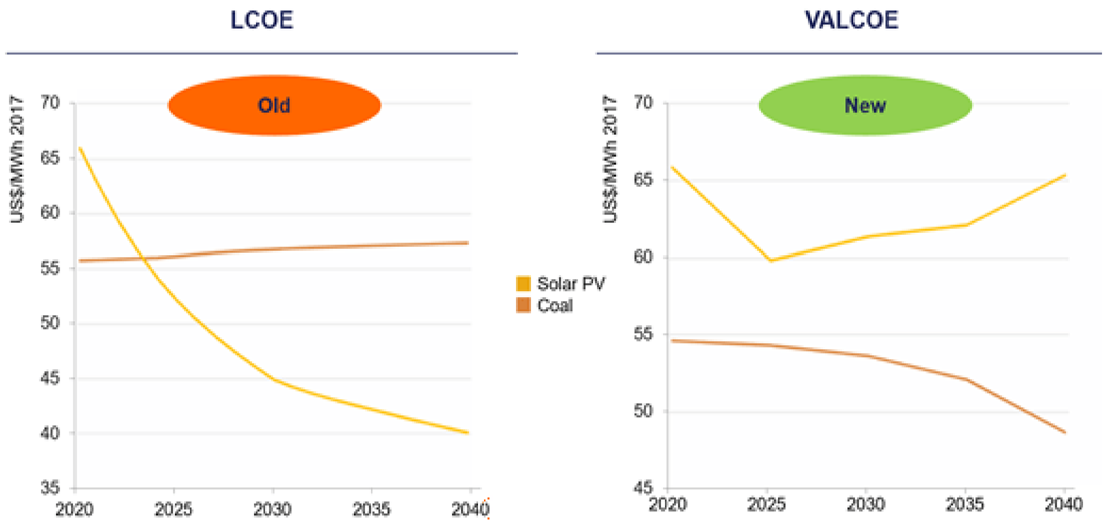
- Energy totalling **10-18MWh** is required to build one Tesla **850kg/85KWh** car battery, resulting in **15-20 tons of CO_2** emissions assuming 50 per cent renewable power is used in its production. Assuming conservatively that 1-2 per cent of mined ores end up in the battery in the form of metals (see diagram below), one Tesla battery requires **25-50 tons** of raw materials to be mined, transported and processed. Batteries are not a good backup solution. [ref: Oct 2020 Dr Lars Schernikau "The truth behind renewable energy"]



2. Provide the cheapest sources of electricity generation

This claim is not supported by the facts, and actually the opposite is true based on real world experiences, such as:

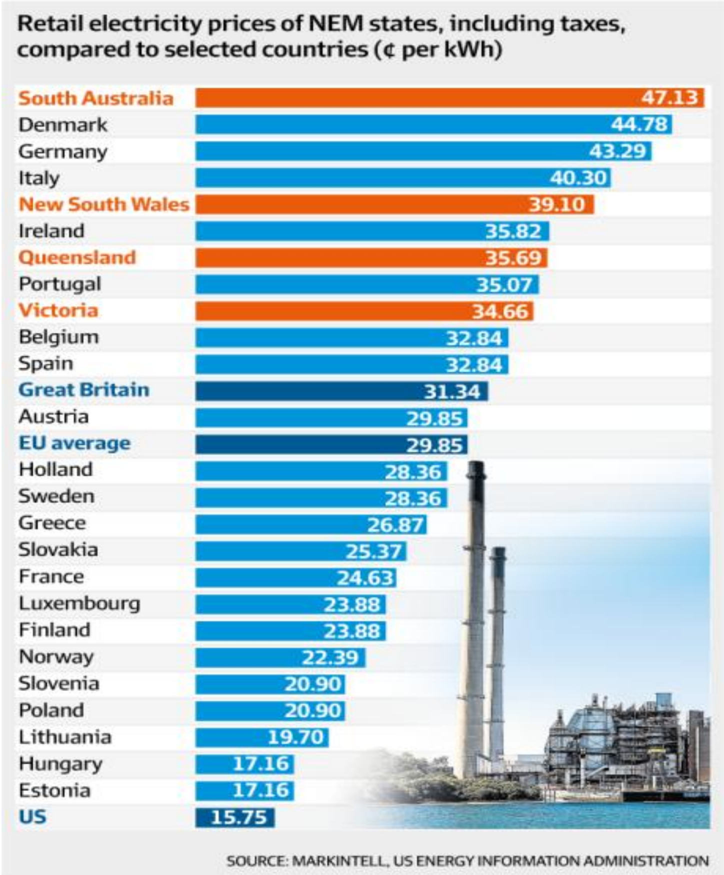
- The **Levelised Cost of Electricity (LCOE)** measure used in the popular press and by most governments is misleading. The still incomplete but better **Value-Adjusted LCOE (VALCOE)** from the **IEA** was first published in 2019. In January 2020 the prestigious Institute of Energy Economics Japan (IEEJ) published its 280-page 'IEEJ Energy Outlook 2020' and raised concerns about renewables' rising unaccounted-for integration costs, concluding that LCOE is not capable of capturing the true cost of wind and solar. Comparisons of alternate costs using VALCOE helps explain why electricity systems that have significant weather-dependent renewables in their mix have higher electricity prices than those that don't.
[ref: Oct 2020 Dr Lars Schernikau "The truth behind renewable energy"; www.iea.org/data-and-statistics/charts/levelised-cost-of-value-adjusted-lcoe-valcoe-for-solar-pv-and-coal-fired-power-plants-in-india-in-the-new-policies-scenario-2020-2040]



IEA chart

- In South Australia, Wholesale Electricity prices increased from an average of **$52.60 to $109.80/MWh** when the Northern power plant was closed in 2015 and, in Victoria, on the closure of Hazlewood power plant in 2017 from **$51.50 to $97.90/MWh**. If coal-fired power stations are claimed to be more expensive then solar and wind why do average wholesale prices rise when they are closed down or policies applied that reduce their efficiency?
[ref: "Life-cycle energy densities and land-take requirements of various power generators: A UK perspective: 18/02/2016]

- A comparison of retail electricity prices emphasises the disadvantage Australia has already created for itself with its high penetration of weather-dependent renewables. The more weather-dependent renewables the higher the electricity costs. A study of 2017 retail electricity prices in cents/KWh shows Australia's four NEM states ranked in the top nine highest electricity prices in the world, namely: **South Australia 47.13**, Denmark 44.78, Germany 43.29, Italy 40.30, **NSW 39.10**, Ireland 35.82, **Queensland 35.69**, Portugal 35.07, **Victoria 34.66.** In 1990s Australia had the lowest electricity prices in the world. Closing coal-fired power stations and substituting renewables has contributed to the increased rise.
[ref: afr.com 5/8/17 "MarkIntell, US Energy Information Administration"; Oct 2020 Dr Lars Schernikau "The truth behind renewable energy"; www.statista.com/ statistics/263492/electricity-prices-in-selectedcountries/ 2018]



- In 2019 Germany's electricity production mix was **24.6% wind, 9.0% solar**, 8.6% biomass, 3.8% hydro, 29.1% coal, 10.5% gas, 13.8% nuclear, resulting in the highest household electricity price of any country in the world at **US$0.381/KWh**, despite 46.0% (**33.6%** wind and solar) generated from renewable sources. This pattern of substantial increases in electricity prices appears to occur in all countries and states that have significantly increased their reliance on weather-dependent renewables.
  [ref: www.ise.fraunhofer.de/news January 15 2020, p2; globalpetrolprices.com "Electricity prices for households, December 2019"; Oct 2020 Dr Lars Schernikau "The truth behind renewable energy"]

- In 2019 Denmark's electricity production mix was **57% wind, 3% solar**, 20% biomass, 20% fossil fuels, resulting in the second highest domestic electricity price in the world at **US$0.361/KWh**, despite **60%** generated from weather-dependent renewable sources. This pattern of substantial increases in electricity prices appears to occur in all countries and states that significantly increase their reliance on weather-dependent renewables.
  [ref: globalpetrolprices.com "Electricity prices for households, December 2019"; https://en.wikipedia.org/wiki/electrcity_sector_in_denmark]

- In 2019 Australia's electricity production mix included **21%** of renewables, mainly from roof-top solar systems, and its average domestic electricity price was **US$0.246/KWh**. This already puts Australia in the high end of world prices. In 2019 the global average electricity price was only **US$0.14**. China and India, who both predominately use coal-fired electricity generation, were only **US$0.08/KWh** ,. This pattern of substantial increases in electricity prices appears to occur in all countries and states that significantly increase their reliance on weather-dependent renewables. What should Australia's target price be for, say, 2025?
  [ref: globalpetrolprices.com "Electricity prices for households, December 2019"; 26/05/20 energy.gov.au/publications " Australian statistics table O electricity generation by fuel type 2018-19 and 2019]

- It is often stated that renewables put downward pressure on wholesale prices. However, what the consumers are interested in is what they have to actually pay for their electricity. The previous analysis shows that no country or state with a high proportion of renewables has achieved lower electricity prices. This diagram from the NSW Energy website shows why:

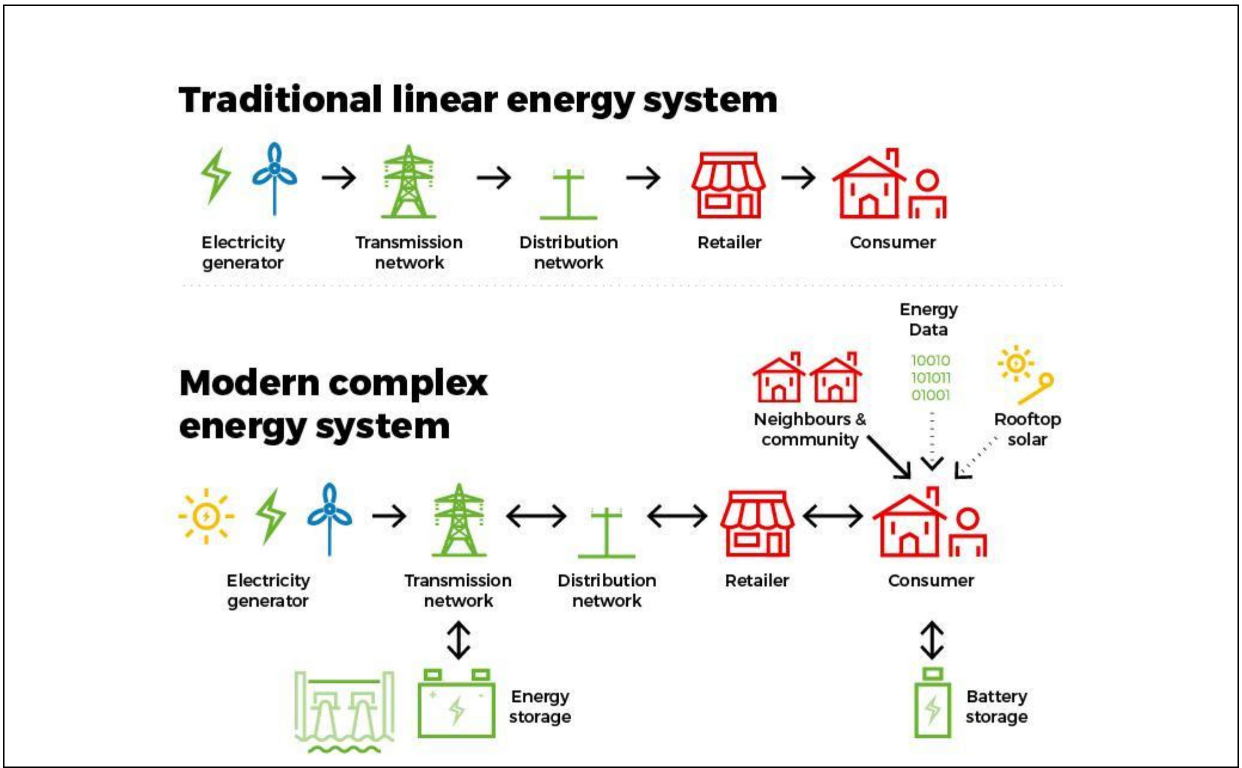


Diagram from NSW Energy 18/12/20 [Renewable Energy in NSW | Energy NSW]

Complexity adds cost and risk. Weather-dependent renewables cannot provide the electricity to run our society. They have to augmented with: expensive pumped hydro, of which Australia has virtually none; prohibitively expensive batteries that have to be charged daily, so requiring even more wind and solar plants; upgraded or new transmission lines and infrastructure, specifically to accommodate wind and solar generation; very much more difficult management of an unstable and complex system, something in which Australia has little experience. Since issuing the SOS Research Paper in November 2020 a lot more has occurred that shows electricity prices are or must continue to increase, not decrease.

Wholesale prices may be reducing but the retail costs are rising because of increased infrastructure costs (e.g. Tas-Vic underwater cable > $1b), massive subsidies, financial support and favourable regulations ($13 billion plus yearly), massive losses and write-downs and massive cost blow outs (e.g. Snowy 2.0 $2B to $10B and growing, NSW-SA interconnector $1.35B to $3.32B before its even started) have to be recovered from the consumer or taxpayers . Add to this the failure in 2018 of RC Tomlinson, with a loss of 3,400 jobs. In addition, shareholders in Origin Energy and AGL, both ASX listed companies, have seen nearly 50% falls in the value of their shareholdings in less than 12 months. Both Origin and AGL had losses due to write-downs against profits. AGL wrote off over $2.8billion on a wind electricity generation contract. Ultimately the consumer pays for these extra costs.

A NSW resident was advised by EnergyAustralia in January 2020 justified their 11.9% increase in the usage and supply rates were because *"...supply costs have increased significantly*" and in January

2021 the Feed-in Tariff rate was again reduced because *"..there's more solar-generated energy going back into the grid. This has reduced the wholesale price of energy going back into the grid during the day when the sun is out.*". More wind and solar IEGPs may well reduce wholesale prices during some parts of a day but it is the consumer and taxpayer who gets slugged. This has been the case throughout the world.

- The Electricity Infrastructure Investment Act 2020 became law in November 2020. The Act provides very favourable conditions for NSW weather-dependent renewable developers and operator. Rooftop solar already produces 9% of NSW electricity, at a much lower cost per kilowatt hour than solar IEGPs, compared to only 5% by industrial solar. However, the legislation gives no equivalent guarantees for rooftop solar producers. One typical NSW resident on the outskirts of a rural town paid $30,000 for a transformer and pole, which the distributor now owns, just to connect to the pole directly on the other side of the road. Several thousand dollars more was spent to get power onto the other side of the fence. More still was spent to connect to the building. Meanwhile, the feed-in tariff has been reduced by 24% from March 2019 to January 2021. Yet for industrial solar operators they get a government guaranteed minimum wholesale price and other favourable payments. The higher production costs and the costly guarantees will add to electricity costs overall and disadvantage the cheaper alternatives, such as rooftop solar, HELE, CCGT and nuclear.

- Energy Australia in 2019/21 increased its household electricity rates by **11.9%** and reduced its rooftop solar feed-in tariff by **24%** for some rural NSW consumers, despite the a nearby l PV industrial electricity generating plant becoming operational in May 2019. The reason given for the increase was "supply costs have increased significantly" despite several solar and wind industrial electricity generating plants (IEGPs) already operating in the Central West NSW region, and which is now designated as a NSW Renewable Energy Zone.
  [ref: a resident's EA notification of changes to their base rates]

- Energy Australia, which is Australia's third largest retail electricity distributor, did not pay any company taxes for years as they did not generate profits on their **$30 billion** in revenue during 2013-2017. They also own power stations, mines and wind IEGPs. Electricity prices will have to rise further if profits are to be made. Higher energy costs to their consumers.
  [ref: michaelwest.com.au/energy_australia_four_years_30_billion_zero_tax]

- Renewables in Australia have direct and indirect subsidies and loans by various levels of state and federal governments amounting to **$13 billion a year or $1300 per household**, yet electricity prices continue to rise and will continue to do so unless base-load power is put in place urgently. To put this expenditure in perspective , the JobKeeper scheme as part of the Government's response to the COVID-19 pandemic cost $13 billion to support 3.3 million jobs to the end of June 2020. Just one year's subsidies of **$13 billion** would pay for three **250MW** dual fuel combined cycle gas-fired power plants to be built every year for the next decade. Such plants are very efficient, flexible, provide base-load power, are quick to build and have low resource demands compared with wind and solar IEGPs.
  [ref: 23/08/20 Dr Moran "The Hidden Cost of Renewables on Electricity Prices"; smh.com.au 14/06/20 Infrastructure to get $1.5 billion boost and priority list"; finance.nine.com.au/business-news/agl-to-build-400m-gas-fired-power-plant/0ea6303e-65df-4c8d-b501-0cb52aa0d197]

- Germany is now facing the prospect of replacing/decommissioning **5,700** (4,500MW of capacity) of its over **29,000** wind turbines in 2021 alone. Decommissioning just one wind turbine, without removing most of the enormous concrete footing, costs about **US$532,000**,

while replacing with a new wind 3MW turbine costs about **US$3.9 million** plus transport and installation costs. Such frequent decommissioning and replacement costs are not reflected in the KWh price comparisons of renewables electricity against the alternatives using the Levelised Cost of Electricity (LCOE) method. Costing changes in the total electricity system costs is the best way to measure the impact of mixes of renewables and other solutions.
[ref: weatherguardwind.com 24/3/20 "Wind turbine cost: How much? Are they worth it in 2020": insituteforenergyresearch.org 2/11/19 "The cost of decommissioning wind turbines is huge"; stopthesethings.com 14/11/17 "Kaput!: German Wind Farms set for dismantling as subsidies dry up"; Oct 2020 Dr Lars Schernikau "The truth behind renewable energy"]

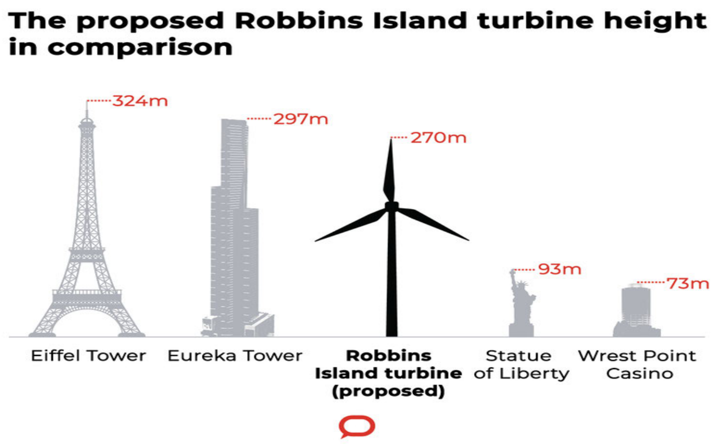
- Although electricity is available in a road in a rural NSW town in the centre of the NSW C-W REZ, a new owner had to spend over **$30,000** to have electricity connected to their small rural property. The extra pole and transformer, which they had to buy, became the property of the NSW government owned electricity infrastructure provider. So the land owner paid for the additional infrastructure , while the renewables local and overseas developers, who get various types of government subsidies , do not contribute to the grid upgrades/construction that are only needed because the installation of weather-dependent renewables create the need for it. These costs of extra infrastructure, which can be for each additional MW of generating capacity, cost **$275,000/km to $660,000/km** just for the high voltage transmission lines. Such extra costs are passed onto the consumer, which helps explain why electricity prices rise as more weather-dependent renewables are installed.
[ref: www.transgrid.com.au/news-views/publications/ "Transmission annual planning 2018" p28 Table 14]

- On 4/11/20 it was reported that the estimated cost of the proposed **900km** electricity inter-connector between Robertson SA and Wagga Wagga NSW had gone from **$1.53 billion to $2.43 billion (by September 2021 the cost estimate is now $3.3 billion)**, most of which will get passed onto mainly NSW consumers.
How did Transgrid and ElectraNet get their initial estimate so wrong? Such extra costs are passed onto the consumer, which helps explain why electricity prices rise as more weather-dependent renewables are installed.
[ref: https://www.transgrid.com.au/news-views/publications/ "Transmission annual planning 2018" p28 Table 14; The Daily Telegraph 4/11/20 page 4]

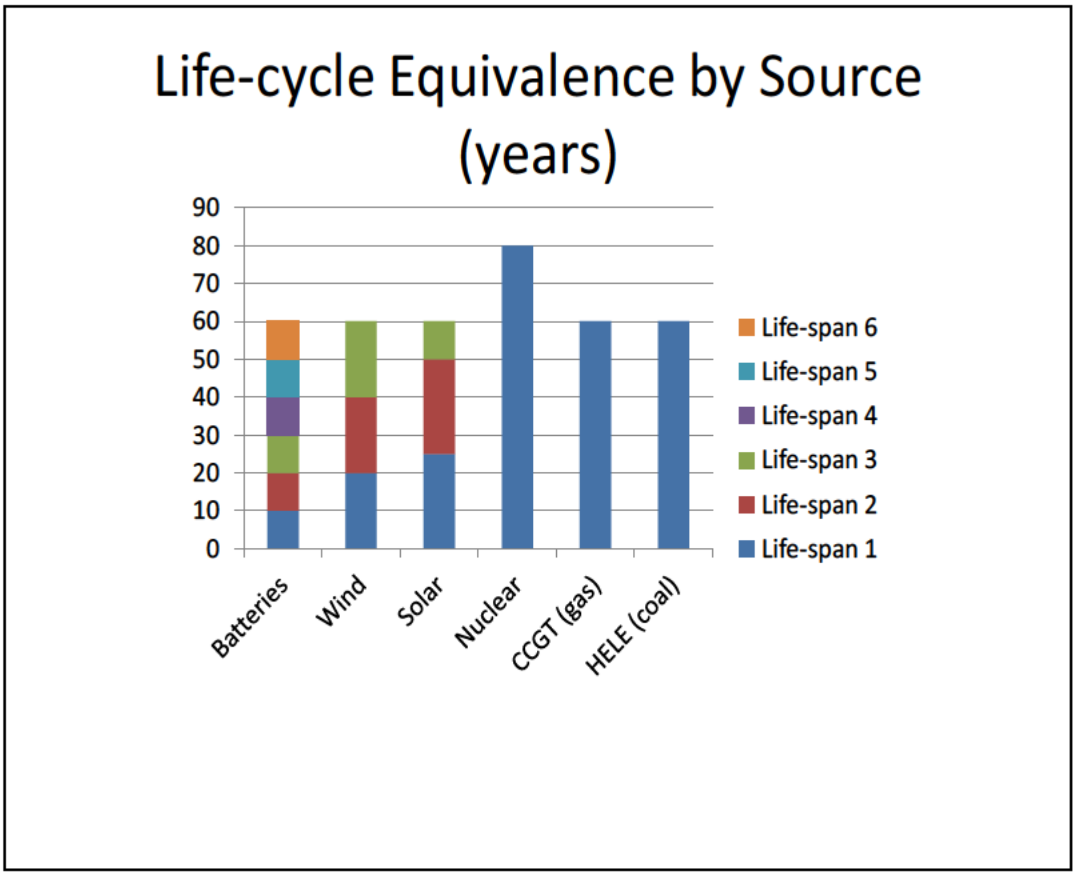
- The relatively short life-cycle of PV solar systems (20 to 30 years) and wind turbines (15 to 20 years) compared to the alternatives of coal, gas and nuclear plants (60 to 80 years) means that a PV solar plant or a wind turbine plant need to be replaced/upgraded 2 to 3 and 4 to 5 times respectively during the lifetime of the alternatives, which generates more costs into the electricity network each time. Over a 60 years period this frequent replacement of solar and wind plants will continue driving up electricity prices for decades. One study shows that wind and solar over **60** years is **SIX** times more costly per 1,000MWh than natural gas combined cycle turbine technology.
[ref: 17/08/20 "The excess cost of weather dependent renewable power generation in the USA" from EDMHDOTME]

- While wind turbines are getting bigger and solar panels cheaper to make, as well as more energy conversion efficient, the cost of electricity to consumers is not falling. The reasons for this appear obvious: land acquisition, transport and construction costs are increasing; 100% duplication by alternate backup generation; inefficient use of base-load coal and gas-fired power plants to backup the grid supply when the renewables outputs are low or zero; rising costs of extending and modifying the electricity grid to connect renewables; increased complexity of managing the grid due to instability caused by renewables' variable output; high level of subsidies even though renewables are a mature industry with over 20 years of field operation; the introduction of high cost, short-life batteries for short-term stabilisation of renewables plant output; frequent replacement of end of life renewable installations and battery backup; high increasing maintenance costs of wind turbines; very high costs of decommissioning renewables plants and disposing of their waste, some of which is toxic.

- For example. The proposed **$1.5 billion** wind IEGP for Robbins Island and Jim's Plain Tasmania will involve **163** turbines up to 270m tall for a nameplate capacity of up to **900MW**. For the project to go ahead the developer requires to be built: a bridge between the island and the Tasmanian mainland; a **500** metre wharf at the island; **115km** of new 220kV transmission lines; a new substation; the Marius Link Interconnector undersea cable to Victoria at about $1 billion plus. A direct link to Victoria at $1.5billion to $2Billion would have made the project unviable and so was abandoned by the developer. The amount of government (taxpayers) subsidies is unknown but for another project it was stated as **$660,000 per turbine per year**, therefore the subsidy could total $1.1 billion over just 10 years. So in reality, the project's viability depends on $billions being spent by others (i.e. taxpayers and other consumers). No wonder Australia's electricity prices are near the highest in the world and can't come down anytime soon with years' of committed subsidies. [ref: robbinsislandwindfarm.com/projects/; 3/7/20 skynews.com.au/details/_6169082592001 "Taxpayers 'taken for a ride' with subsidised windfarm"; Bing search - pics of wind turbines from theconversation]



- The following chart graphically displays the relative life-spans of various sources of electricity generation. Each life cycle requires more resources to replace their output and results in more waste each time.



- C Millis, a USA Carolina state representative was the lead sponsor of House Bill 745, which required proper decommissioning of utility-scale solar plants after they close, reclamation of the land to its original condition within two years, and posting financial guarantees to ensure the work gets done. For example, he said, a 3 megawatt project in Sacramento County, California, cost the owners US$220,000 to clean up even after they got US$375,000 for recycled materials. A 20MW solar project in Maryland cost US**$2.1 million** to remove *after* off-setting the recycling revenue.
  In Central West NSW alone there are several solar plants in place or proposed with capacities ranging from 87MW to 500MW or more where the cleanup cost will be astronomical. No bonds are required or guarantees that restoration will occur. This is another cost that will be borne by the electricity consumer or local rate payers if the company or land holder fails to properly clean up the site.
  [ref: carolinajournal.com/news-article/environmental-hazard/ "Moore County residents worry about solar's long-term environmental impacts - Carolina Journal"]

- The Lancet study, as with many other studies over the years, found that **6.5%** of deaths in Australia are due to cold weather while only **0.5%** of deaths are due to hot weather. In 2010-11 over **200 people a day died** during winter because they could not afford to heat their homes. High electricity prices cause many people to forego heating, resulting in premature death. In 2018 one charity provided **55,000** winter garments to Australian "families who can't afford to run their heating". Australia must get back to electricity prices near the cheapest in the world, as in the 1990s. Weather-dependent renewables cannot achieve this life-saving goal.
  [ref: theconversation.com/cold-weather-is-a-bigger-killer-than-extreme-heat-heres-why-42252;

theguardian.com/society/2011/oct/22/older-people-cold-energy-bills; Daily Telegraph 9/11/20 editorial p40]

- The House Standing Committee on the Environment and Energy launched an enquiry in May 2021 entitled *Federal House Committee on Energy - a new inquiry into dispatchable energy generation and storage capability in Australia.* SOS made a submission (sub050) in which it draws attention to many of the issues in the design of a national electricity grid based on projects in NSW near the communities of Gulgong, Wellington, the Riverina, etc, etc., especially increased instability and increased short and long term electricity prices.

- The ACT stated in 2020 that it uses 100% renewable energy. Yet in June 2021 it announced that electricity prices will rise by 12% from July. The ACT therefore joins the rest of the world in demonstrating the more renewables the higher the electricity cost. The facts are against the claims that wind and solar electricity generation will reduce electricity prices.

- AMEC recently proposed and which is now regulated, that rooftop solar systems pay to export their excess electricity to the grid. The AEMC argued a change was necessary because the current system is unsustainable as the huge uptake in household solar has overloaded the grid, and the alternative would mean more solar users being blocked from exporting their energy. The need for more the industrial solar plants is not justified, given that rooftop solar installations are still significantly increasing in number and already produce more electricity on some sunny days at a much lower cost than an industrial solar plant.

3. Create substantial numbers of jobs (especially in the regions)

This claim is not supported by the facts, logic or real world experience, such as:

- Experience with the Beryl 87MWac PV solar electricity generating plant constructed 5km from Gulgong NSW in early 2019 clearly highlights that virtually no local jobs were involved in the five months of construction. Of the claimed **150** 'construction workers' involved, nearby residents and businesses said that the majority were bussed-in, lowly paid, backpackers. There is believed to be only one full-time employee onsite during operation. Small (about 3 full-time equivalents) roaming maintenance crews are brought in if needed. So much for the claims of providing local jobs.
  [ref: 10/17 NSW P&E State Significant Development Assessment Report Table 1; 2019-20 Gulgong/Beryl residents' and business owners' comments; Daily Telegraph 6/11/20 p15 "Clean energy farm a fatal risk"]

- The DA for the PV electricity generating works proposed for Old Mill Road Gulgong stated that up to **50** construction workers would be required for a few months and would be bussed-in if needed, and that **2 to 4** maintenance workers would visit the site every three months and there would be no onsite workers once operational. So much for the claims that renewables provide local jobs.
  [ref: Developer's submission to MWRPP August 2020, DA0283/2019]

- A PV solar IEGP built in Wellington Central West Region employed **560** construction workers for under three months but the union said the workforce was "**primarily** made up of **backpackers** hired through contractors". A visit by SOS members also discovered that even the closest coffee shop was staffed by overseas backpackers. So much for creating local jobs.
  [ref: Daily Telegraph 6/11/20 p15 "Clean energy farm a fatal risk"]

- Huge areas of agricultural land within 5 to 12km of Gulgong will be lost for decades. Land has already been taken for Beryl IEGP (310ha) and the approved Stubbo IEGP (1772ha, which is equal to the land area of the new Western Sydney airport) and other IEGPs, such as the proposed Tallawang solar/battery works (1,370ha) and Barneys Reef wind/battery works (7,548ha), Birrawa solar/battery works (1,200ha) will reduce the available farmland by hundreds of square kilometres in the C-W REZ. Just these few industrial projects, if constructed, would use 122km2 of farm and bush land.
  This loss of land, which were/can be used for agriculture and grazing stock, reduces the ongoing job opportunities for Gulgong area local workers and businesses, such as those involved in farm fencing, machinery supply, equipment maintenance, irrigation, sheep shearing, hay bailing, chemicals supply/dispersion, provisions, fertiliser, feedstock, hardware supplies, goods and animal transport, sales yards, hay bailing, etc, and the support services (accommodation, food, entertainment, health services, etc) or, for permanent residents that live on the land, all the associated services (building, plumbing, electrical, etc). These solar IEGPs will take the agricultural/grazing/residential land out of alternative use for 20 to 30 years and will provide virtually no local employment benefits over that time, but jobs elsewhere will be diminished. So much for the claims that renewables provide local jobs.

- Once the upright supports for a solar industrial electricity generating plant (IEGP) are pile-driven into the ground the assembly of the cross-members and attaching of each imported PV panel (two person activity) are very low skilled jobs required for only a few months duration, hence the use of backpackers and unskilled labour where possible. How much of each project's $millions in costs is Australian content? So much for creating local jobs.
  [ref: https://www.youtube.com/watch?v=KjIiTjs2fjw; 8/9/20 SOS members' solar IEGW site/ town visit discussions with backpackers at Wellington NSW; www.dasolar.com/solar-panel-installation/solar-farms]

Land cleared. cables laid. pile-driven uprights in place   Crew of two install cross-members and panels

- Wind turbines cannot be major creators of jobs for Australians as all wind turbines are made overseas (e.g. Denmark, Spain, USA, but mainly China). In addition, most of the mined raw materials, material processing, component manufacture, transport by ship, specialised road transport and cranes also occurs overseas. How much of each project's $millions of costs is Australian content? Most likely very little. So much for creating lots of local regional jobs.
[ref: 26/5/20 bizvibe.com "Top 10 wind turbine manufactures in the world 2020"]

- PV solar systems cannot be major creators of jobs for Australians as they are nearly all made overseas (mainly China), including most of the mined raw materials, material processing, component manufacture, transport by ship and often construction labour (e.g. backpackers). How much of each project's $millions of cost is Australian content? We suggest very little. So much for creating local jobs for the country regions of Australia.
[ref: 2020 solarclap.com "Top 10 Solar Companies in the World"]

- The measure of job creation for Australia must be the net jobs gain or loss as renewables are promoted as a substitute for coal mining and gas extraction, which are things that directly employ many tens of thousands of Australians in well paid jobs. They also provide substantial export, company tax and royalty income, which gets reinvested into the Australian economy and contributes to the health, education and welfare services Australians receive. Once installed, weather-dependent renewables produce no export or royalty income and employ few people, so increasing the burden on productive businesses, taxpayers and electricity consumers. Once farmland is used for solar plants then the local jobs that were servicing graziers and farmers are reduced. A net job loss is likely.
[ref: abc.net.au 11/7/19 "Are there really 54,000 people employed in thermal coal mining"; statista.com/statistics/1120570 5/6/20 " Australia - Export value of coal 2019"; Deloitte report 26/3/19 "Estimates of payments of royalties and company tax in 2017-18";]

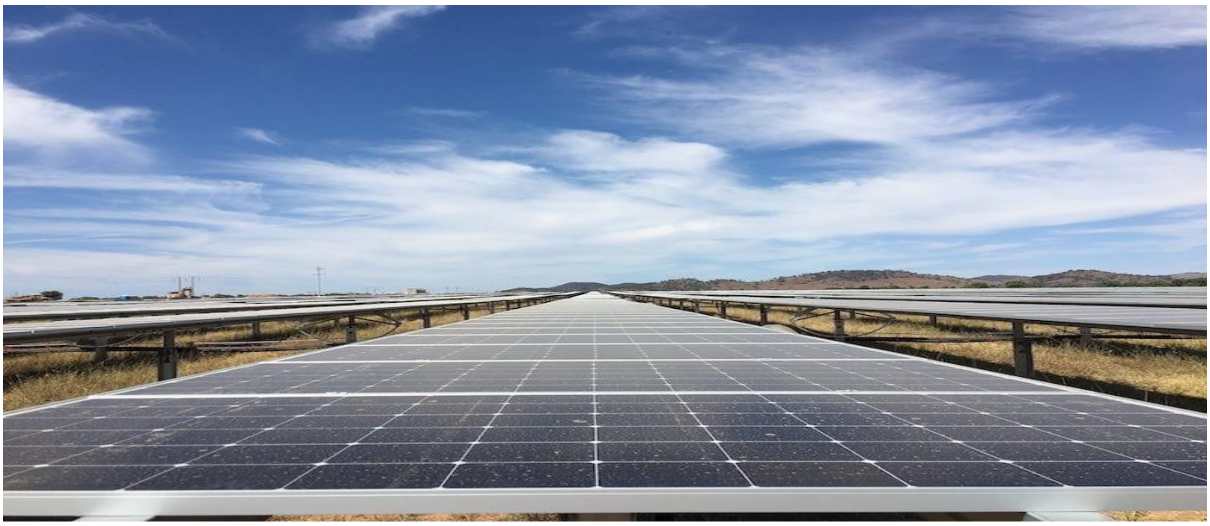
- An in-depth study in Spain concluded that for every subsidised job in renewables that 2.2 jobs were lost elsewhere in the economy. Australia can expect a similar result. So much for proponents claims that there will be an increase in Australian jobs. A recent report by Institute of Public Affairs concluded that "*for each new renewable activity job created between 2009-10 and 2018-19, five manufacturing jobs were destroyed*."
[ref: 23/08/20 Report by Dr Moran "The Hidden Cost of Renewables on Electricity Prices"p23; IPA-Net-Zero-Jobs-Report.pdf]

- Even with significant government subsidies, in its many forms, the PV solar industry has many failures resulting in fewer jobs and incurring A$billions in losses. Australian company RCR Tomlinson Ltd, an engineering company founded in 1898, collapsed in 2018 after 12 solar IEGP projects failed, leaving **3,400** of its own employees jobless and impacting thousands of subcontracting firms and their workers; creditors were owed **$630** million.

Another Australian company Downers EDI Ltd and a UK company, John Laing, have both withdrawn from the industry in 2020 after losing hundreds $millions in their ventures into Australian renewables. Many other companies have incurred $millions each in write-downs in 2019 (e.g. AGL $14m, QIC $70m, Enel $73.5m). So much for an increase Australian jobs, when we already start with at least a deficit of over 3,400 jobs lost.
[ref: 23/11/18 australianmining.com.au "RCR Tomlinson goes into administration" ; 4/12/18 www.abc.net.au; reneweconomy.com.au 13/8/20 "AGL joins growing list of investors hit by write-downs on wind and solar assets"]

- AGL Energy and Origin Energy, Australia's largest electricity retailers announced their half-yearly results in February 2021. Their write-downs and large profit falls, in addition to previous write-downs, are in the billions of dollars. Just AGL's first half year write-down of its unprofitable wind farm deals amounted to **$2.7 billion**. In its half yearly report AGL wrote in regards to increased supply that *"... the long-term outlook for wholesale electricity and renewable energy certificates now indicates a sustained and material reduction in prices*.". Cost-cutting (job losses?) were announced. Where are the jobs on weather-dependent renewables? Who ultimately pays for these huge losses?
[Ref: AGL Energy Ltd and Origin Ltd Quarterly Update December 2020 and half year results for 2020]

- The USA has many companies that have failed either building or operating renewable electricity generating works. Over 200 venture capital funded solar energy start-up companies in 2008 had failed by 2013. In addition, many solar IEGPs change ownership quite rapidly. This pattern seems to occurring in NSW with 15 solar plants and several wind turbine plants for sale in the first quarter of 2021.
For example, the $187million Beryl PV solar IEGP near Gulgong in NSW was built by Downer Group for First Solar FE Holdings Pty Ltd who sold the IEGP, before operations began in June 2019, to New Energy Solar Ltd in 2018, who in turn is currently divesting it and exiting the Australian renewables market. Downer has already exited the solar construction market and New Energy Solar, an investment company, has divested its two Australian solar IEGPs investments partly because the Australian assets are in a mature operational state. Neither are performing to expectations. Who received subsidies and who is responsible for decommissioning and disposal at end-of-life when companies fail, change ownership frequently and exit the market?
[ref: greentechmedia.com/articles/read/Rest-in-Peace-The-List-of-Deceased-Solar-Companies; 14/5/18 downergroup.com/downer-wins-beryl-solar-farm-contract; 9/11/20 pv-magazine-australia.com/2020/11/09/beryl-and-manildra-solar-farms-up-for-sale-as-investor-exits-oz/; New Energy Solar Ltd Quarterly Update December 2020]



Beryl PV Solar Industrial Electricity Generating Works, Central West NSW

4. Are safe

This claim is not supported by the facts, such as:

- A PV solar IEGP built in Wellington Central West Region currently employed 560 construction workers, "**primarily** made up of **backpackers** hired through contractors". SafeWork NSW has issued 13 improvement notices. Most of the breaches "could easily lead to electrocution of a worker on the project" and "could result in serious injury or death of a worker", most of whom are **backpacker**s "who were oblivious to the serious safety risks". So much for safe working conditions for "skilled" workers.
  [ref: Daily Telegraph 6/11/20 p15 "Clean energy farm a fatal risk"]

- Solar panels are a toxic mix of gallium arsenide, tellurium, silver, crystalline silicon, lead, cadmium, and heavy earth materials. Batteries use lead, lithium and cobalt, all of which are hazardous materials. The magnets in wind turbine generators are made from neodymium and dysprosium, rare earth minerals mined and almost exclusively processed in China, which has covered large tracts of China with fields and lakes of toxic waste. The mining and processing alone of the input materials have already caused human and animal deaths and illnesses, as well as contaminating soil, air and water. The creation of renewables is toxic.
  [ref: https://www.thoughtco.com/lithium-production-2340123;
  3/4/15 https://www.bbc.com/future/article/20150402-the-worst-place-on-earth; 5/3/18
  https://www.cbsnews.com/news/cobalt-children-mining-democratic-republic-congo-cbs-news-investigation/;
  abcnews.go.com/Technology/toxic-lake-black-sludge-result-mining-create-tech/story?id=30122911]


Toxic "lakes" in Baotou China from processing rare earths

- PV panels contain toxic contaminates, which is why the state of Victoria EPA lists solar panels as e-waste, as does the EU. A national study in the USA found that solar panels dumped into landfill leached toxic materials in as little as 30 days. Solar panels in solar IEGPs deteriorate and get damaged by hail, wind and fire and so potentially leaching their toxic chemicals into the soil and waterways. Are our governments knowingly risking the health of Australians, our crops, our domestic animals and our wildlife, almost exclusively in rural and regional Australia? Independent research in Australia is needed into the dangers of installed industrial PV solar IEGPs.
  [ref: www.epa.vic.gov.au/about-epa/news-media-and-updates/news-and-updates/e-waste-compliance-switched-on 3 July 2019; www.ncbi.nlm.nih.gov/pmc/articles/PMC5607867/;
  https://wattsupwiththat.com/2018/12/23/solar-panel-waste-a-disposal-problem/]

- Beryl Solar Plant near Gulgong NSW had major output issues in 2020 due to heavy rain, a lightning strike, inverter damage and other component failures. Extensive damage to weather dependent and weather exposed wind and solar plants is not unusual. Who monitors the release of toxic chemicals from these damaged plants? If not for the fact that the owners of some of these plants are listed companies and have a duty of disclosure the regional residents near these plants would be totally unaware of the potential risks. Will there be another "asbestos" health crisis sometime in the future?


Storm damage to a PV solar IEGP


Fire damage to a PV solar IEGP

- PV solar systems increase fire risks resulting from panel and electrical equipment failures, including battery systems, e.g. In June 2019 a bird caused a fire in California Valley Solar Ranch, which burnt out **1,127** acres of grassland causing over **US$8m** in losses. New Energy Solar Ltd had two solar plants severely damaged by grass fires in June 2020. They are still to get the plants fully operation, which they anticipated would occur by June 2021. Should such dangers be dismissed?
  [ref: 20/6/19 www.latimes.com/business/la-fi-bird-fire-solar-farm-20190624-story; New Energy Solar Ltd Quarterly Update December 2020 and half yearly report for 2020]

- Several fire-fighters from different regions advised SOS members that they can only fight fires in a solar electricity works from its perimeter because of the dangerous high voltages and toxic gases released; this also increases the risks to surrounding properties and land owners who may try to fight an IEGP fire themselves without knowledge of the risks. A risk assessment report prepared in response to requirements raised by the Gunnedah RFS confirms the fire-fighters statements. Should such dangers be dismissed?
  [ref: 23/05/18 Mr McCurdy MP (Ovens Valley) (10.19) speech to parliament; 3/8/20 MWRPP decision on Old Mill Rd Gulgong; www.windpowerengineering.com/the-true-cost-of-wind-turbine-fires-and-protection/; Eco Logical Australia April 2018. Gunnedah Solar Farm Bushfire Risk Assessment. Prepared for Pitt & Sherry (Operations) Pty Ltd.]

- In addition to fire risks PV solar panels and electrical components pose risks when damaged, such as by hail. The Clean Energy Regulator reported in December 2018 that up to one in five rooftop solar installations (potentially **425,000** systems) pose a high to severe risk because they are unsafe or sub-standard PV installations. Are IEGPs any different?
  [ref: pvstop.com.au/25-australian-pv-installations-unsafe-1000s-pv-systems-damaged-following-sydney-hail-catastrophe/; solarquotes.com.au/blog/taylor-solar-safety-mb0873/; sunpower.maxeon.com/int/blog/]


Remains of a solar panels fire


Solar panels damaged by hail

- Solar panels caused fires on the roofs of as many as seven of Walmart stores in the USA. A solar panel fire in March and two in May 2018 did millions of dollars in damages to the stores and merchandise. All 240 stores had their PV solar systems deactivated pending an investigation. Never-the less, another PV solar fire occurred at the Yuba City Walmart store in November 2018. In the lawsuit filed in August 2019 it is alleged that, among other things, that hotspots on the panels caused some of the fires. Hotspots, which can be caused by bird droppings, dirt deposits, leaf matter, etc, are but 9 common possibilities of how solar system fires can start. Just one fire in a PV solar IEGP could start a devastating grass or bush fire in a rural area. Should such dangers be dismissed?
  [ref: arstechnica.com/tech-policy/2019/08/after-seven-roof-fires-walmart-sues-tesla-over-solar-panel-flaws; sunengis.com/nine-common-problems-with-solar-panels]

- Wind turbines contain toxic contaminates, such as neodymium, dysprosium and rare earth minerals. About **1 in 2000** turbines catch fire each year. The burning turbine can release toxic gasses that can drift over residential properties and towns. Independent Australian research is needed into these risks. Such dangers should not be dismissed.
  [ref: stopthesethings.com/2020/01/26/toxic-shock-millions-of-wind-turbine-blades-leave-poisoned-landfill-legacy-for-generations-to-come/ ; windpowerengineering.com/the-true-cost-of-wind-turbine-fires-and-protection/]


Wind turbine on fire

- Both solar panels and wind turbines can and do catch fire, which can cause significant grass fires and bush fires due to being located in rural and regional areas. For example, the February 2017 Leadville-Dunedoo grass fire burnt 55,000ha of land, destroyed 35 homes and killed 6000 livestock. This area is near Gulgong and within the NSW Government's Central West Renewable Energy Zone. With every wind and solar IEGP built the risks of fire devastation increases. Our governments are knowingly risking the health of regional Australians, our crops and our domestic animals and local wildlife.
  [ref: abc.net.au/news/2018-02-08/dunedoo-coronial-inquiry-to-examine-catastrophic-nsw-fire/9408802; windpowerengineering.com/the-true-cost-of-wind-turbine-fires-and-protection/]



February 2017 Central West NSW Leadville-Dunedoo fire front


Why we hate grass fires

- Distributing solar and wind IEGPs into rural areas, such as Central West NSW, even though the electricity is consumed hundreds of kilometres away in the cities, creates the need for hundreds of kilometres of new transmission lines, which not only impact the environment but increase the incidence of bushfires. In the US, one power company caused 1,500 fires in

California over a period of six years including the 2018 Camp Fire, which killed 85 people. Devastating transmission line bush fires have also occurred in Australia. A new 180km high voltage transmission line to specifically cater for more weather-dependent wind and solar plants in the Central West REZ is in development. Should such dangers be dismissed?
[ref: newmatilda.com/2020/01/15/greener-power-comes-with-its-own-increased-risks-of-bushfire/]

- Wind turbines already kill trillions of insects and millions of birds and bats each year, some of them endangered species, such as the American Golden Eagle and Bald Eagle, the European Red Kite, The Hoary Bat, the Australian Wedge-tailed Eagle and migratory Arctic shorebirds. This destruction of wildlife and their habitats can only increase as more solar and wind electricity generating works are constructed where wildlife otherwise flourish in rural areas, including agricultural and grazing land. Should such dangers to wildlife be ignored?
[ref: 26/6/19 forbes.com/sites/michaelshellenberger/2019/06/26/why-wind-turbines-threaten-endangered-species-with-extinction/#7804852e64b4; 25/6/19 7news.com.au/news/environment/wind-turbines-killing-endangered-birds-c-183380; thegwpf.com/new-study-german-wind-turbines-kill-1200-tons-of-insects-per-year; discoverwindenergy.com/exploding-wind-turbines-a-look-at-the-max-speed-of-wind-turbines/]

The build up of dead insects reduces the output. Insects attract birds. Blade tip speed can exceed 280kmph

- Documented symptoms reported by individuals exposed to wind turbines sub-sonic noise includes such things as headaches, sleeplessness and dizziness. A farming community near Bald Hills Victoria were tormented by wind turbine noise for years. The Supreme Court's decision on 18/08/2020 declared the wind farm an unlawful nuisance. Should such dangers to rural residents be ignored?
[ref: science, howstuffworks.com ; www.ncbl.nih.gov; abc.net.au 20/08/20 "Bald Hills Wind Farm neighbours win historic legal battle against turbines 'too close to homes'"]

- A recent study by Caithness Windfarm Information Forum ("Summary of Wind Turbine Accident data to 30 September 2020") of wind industry accidents, including related deaths and injuries identifies hundreds of such events. Wind turbines have started bush fires (e.g. Sibley Iowa, Nolan County Texas), been involved in road accidents (NZ, Princeton Missouri), worker injuries (Germany) and deaths (Washington USA, UK, Denmark, Netherlands).
[ref: 30/0920 http://www.caithnesswindfarms.co.uk/accidents.pdf; gineersnow.com/industries/renewables/two-mechanics-died-wind-turbine-fire]

Road accident involving a wind turbine part


We hope nobody was home

- A fire incident at a turbine can cost up to $4.5 million, according to a GCube report from 2015, which also stated that, conservatively, one fire a year per 2,000 turbines occurs. Sending a fire-fighting team up the wind turbine tower to manually fight the fire constitutes a significant health and safety risk. How will fire-fighters fight a fire in an 280 metre high wind turbine? If the fire is left to burn, the whole turbine can be damaged beyond repair in a matter of hours and cause bush and grass fires.
[ref: 8/9/20 windpowerengineering.com/the-true-cost-of-wind-turbine-fires-and-protection/]


Burning wind turbines can easily result in starting devastating bushfires or grass fires in rural areas

- In April 2021 in The Woodlands Houston USA, a Tesla Model S Electric Vehicle crashed into a tree and ignited. It was reported that the fire department took 4 hours and used 30,000 gallons (113,562 litres) of water to try to extinguish the burning lithium batteries, but eventually had to let the fire burn itself out. Even worse was the fire that occurred in the 350MW/450MWh Battery Energy Storage System (BESS) during testing on 30 July 2021 in Geelong, Victoria. One of the 13 tonne battery packs caught fire. It burned for three days and resulted in the evacuation of residents because of the toxic fumes generated. Fire-fighters had to let the Lithium battery pack burn out, as water and ordinary fire suppression measures cannot extinguish a Lithium chemical reaction fire. The risk of BESS fires interrupting electricity supply for long periods, creating environmental disasters (grass fires and air pollution, risks to fire-fighters) and requiring special air conditioned cabinets to maintain battery temperatures below 30C are unacceptable risks to local communities.

- Adults and over 40,000 children work in artisanal cobalt mines in The Democratic Republic of Congo in appalling conditions. Many suffer illnesses and death, just to supply China with the cobalt used in the production of Lithium batteries, which are then used to back up weather -dependent wind and solar systems. More than 70 percent of the world's **cobalt** is produced

in the Democratic Republic of the Congo (**DRC)** and 15 to 30 percent of the Congolese **cobalt** is produced by artisanal and small-scale **mining.**
Should Australians ignore this human rights abuse to satisfy some peoples' ideological dogma? The use of cobalt from such sources is in breach of the Commonwealth Modern Slavery Act 2018. Is it being applied to the developers of wind and solar IEGPs?
[ref: 11/11/14 nationalgeographic.com/news/energy/2014/11/141111-solar-panel-manufacturing-sustainability-ranking/ ; https://doi.org/10.1016/j.gloenvcha.2019.102028 "The decarbonisation divide: contextualising landscapes of low-carbon exploitation and toxicity in Africa"; www.cfr.org/blog/why-cobalt-mining-drc-needs-urgent-attention; https://www.theguardian.com/global-development/commentisfree/2019/dec/16/i-saw-the-unbearable-grief-inflicted-on-families-by-cobalt-mining-i-pray-for-change]



Democratic Republic of Congo: E.g. of artisanal mining of cobalt, used in batteries, destroys many African lives

5. Are good for the environment

This claim is not supported by the facts, because of the huge amounts of land, materials and transport required as well as the destruction of habitat and killing of wildlife, such as:

- A 5.8ha Gulgong NSW property just on the town's outskirts has no natural water or dams, only a few trees, and is fully farm-fenced (1.2m high). Never-the-less, over thirty different species of fauna live on or visited the property in 2020 alone. At least three different mobs of kangaroos up to 20 at a time, echidnas, foxes in a den, Peron's tree frogs, flocks of up to 42 Ibis, micro-bats, Black Swan, Pelicans, large flocks of cockatoos and galahs, many varieties of parrots and finches, wag-tails, lizards, tortoise, Wedge-tail Eagles, Nankeen Kestrels, hares, rabbits, Peewees, Currawongs, Magpies, and field mice, are visible at various times. Such wild-life coexists with grazing animals, such as sheep, horses, Alpacas and cattle. Welcome to country NSW and biodiversity, which is valued by residents and visitors to our area. Solar and wind IEGP earthworks will remove the grasses, rocks, logs and top-soil that provide homes and food sources for many species necessary for maintaining the health of the surface layer, as well as being a source of food for larger creatures. Approved and proposed wind and solar IEGPs already total 122km2which will result the sites' inhabitants and ecosystems being destroyed. This wholesale destruction of ecosystems, which is against the concept of environment protection, is of very serious concern to regional Australians. Why do the authorities ignore this environmental vandalism? Biodiversity is not just endangered flora and fauna. It includes all flora, fauna and people.

  This

  or this

- The **land area needed** for an **industrial PV solar plant** per installed (name plate) 1,000MW or **one gigawatt** (GW) is **3,500 hectares** (ha). The **materials needed** on average are: 22,000t (tons) aluminium, 40t cadmium, 60,000t concrete, 2,000t copper, 3.5t gallium, 2t germanium, 13t glass, 20t indium, 3,250t plastic, 6,500t silicon, 0.3t silver, 75,000t steel and 46.7t tellurium for a **total of 169,363t**. **For a nuclear reactor the total is 259ha of land and 217,101t of materials** per **1GW** installed capacity.

  However, a **nuclear reactor annual output is over 90% whereas PV panels are, at best, initially well under 30%**. Hence, the **PV solar** installed nameplate **needs to be at least three times greater** to produce the same, albeit intermittent, output (GWh) yearly i.e. **10,500ha**

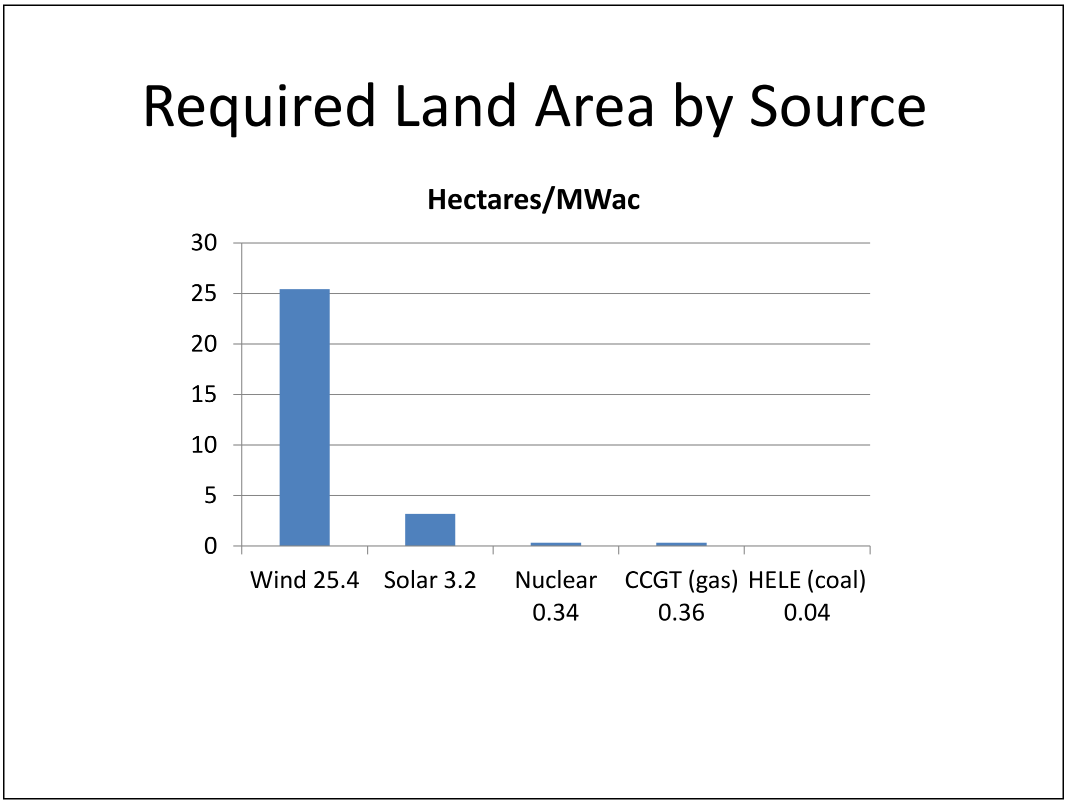
(3,500ha x 3) of land and **total materials of 508,089** (169,363t x 3) tons, which is **40.5 times more land** and **2.3 times more tons of materials than a 1GW nuclear plant**.

The negative impacts on the environment of the significant increase needed in mining, processing, transport, construction, reduction in productive land, etc. is very substantial for PV solar plants and should not be ignored, but it is ignored by our governments and proponents of IEGPs. How can such misallocation of resources be justified?
[ref: Average hectares based on developers' published figures for Beryl, Gulgong, Stubbo and Wellington solar works; materials from sciencedirect.com "global environmental change Vol 60 Article 102028 table 1"]

- The **land area needed** for a **modern wind turbine IEGP** per installed (nameplate) 1,000MW or **one gigawatt** is **25,900 hectares**. Materials needed are: 305,891t concrete, 211t copper, 19,863t fibreglass, and 84,565t steel for a **total of 410,530t**. For a **nuclear reactor the total is 259ha of land and 217,101t of materials per 1GW**.

  However, a nuclear reactor annual output is over **90%** whereas wind turbines are claimed, at best, initially under **38%**. Hence, the wind turbine installed nameplate needs to be **2.25** times greater to produce the same, albeit intermittent, output (MWh) yearly i.e. **58,275ha** of land and **total materials of 923,693 tons** per 1,000MW, which is **225 times more land and 4.3 times more materials than a 1,000MW (1GW) nuclear plant.**

  The negative impacts on the environment of the very significant increase needed in mining, processing, transport, construction, land clearing, etc. is very, very substantial for wind IEGW and should not be ignored , but it is ignored by our governments and proponents of IEGPs. How can such misallocation of resources be justified?
  [ref: Average hectares based on developer's published figures for Coopers Gap wind turbine works; materials from sciencedirect.com "global environmental change Vol 60 Article 102028 table 1"]

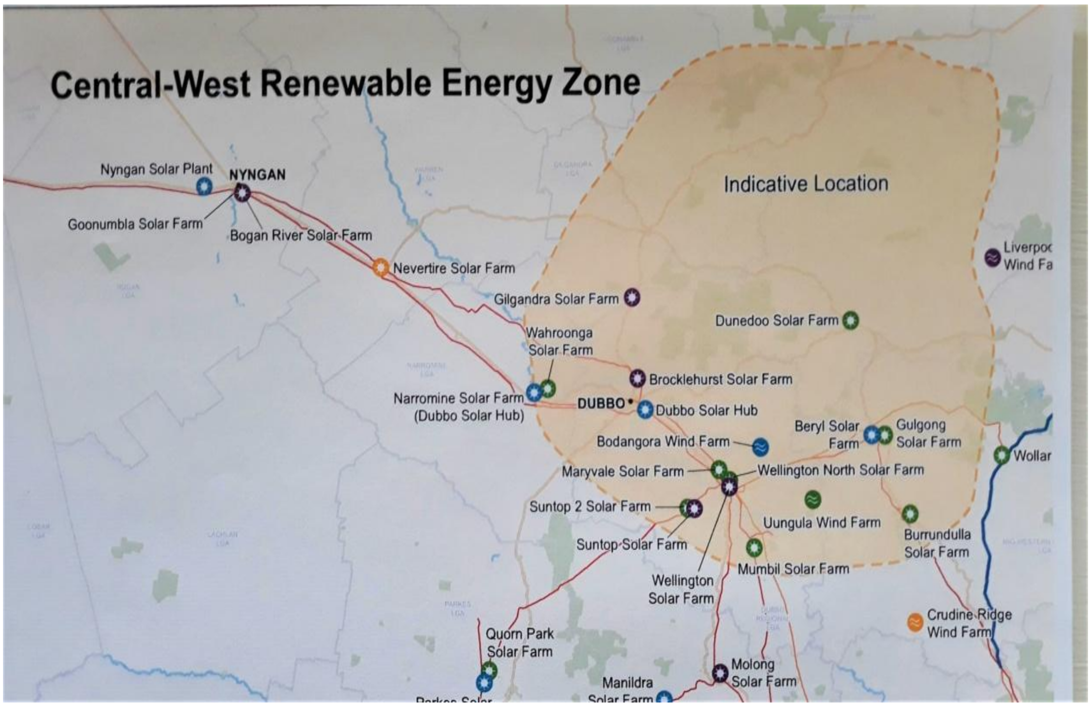


- **Liddell Power Station** is a **2,000MW** nameplate capacity coal fired power station. Using the previous land/materials for nuclear and solar installations to replace Liddell's nameplate generation capacity of **2,000MW**, and an assumed **90%** output annually of a similar modern replacement plant, will require: **Solar - 21,000ha of land, 1,016,178 tons of materials; Wind - 116,550ha of land (equals in area about 137 Sydney airports), 1,847,386 tons of materials**; **Nuclear - 518ha of land, 434,202 tons of materials.** A very substantial difference on their impacts on the world's environment and resources. Our environment is much more than just CO2. Why are the impacts on all the world's environments being be ignored?

  Although beyond the scope of this paper, the solar and wind land and material requirements will be much larger to account for frequent life-cycle replacement/upgrades and efficiency losses as well as the required backup/duplicated power sources. Not only is nuclear power (and closed cycle gas-turbine power for that matter) much less demanding on resources and can operate without alternative backup for over 70 years it also has much less impact on the environment (e.g. less mining, less reduction of flora and fauna habitats, much less volume of toxic waste). This frequent replacement requirement of wind and solar IEGPs is ignored in the papers published by NSW Energy, the AEMO ISP, CSIRO, etc. Why?
  [ref: www.energy.gov "What's the lifespan for a nuclear reactor" lifespan could be 80 years; 29/6/17 technocracy.news/solar-energy-produces-300-times-toxic-waste-nuclear-power/]

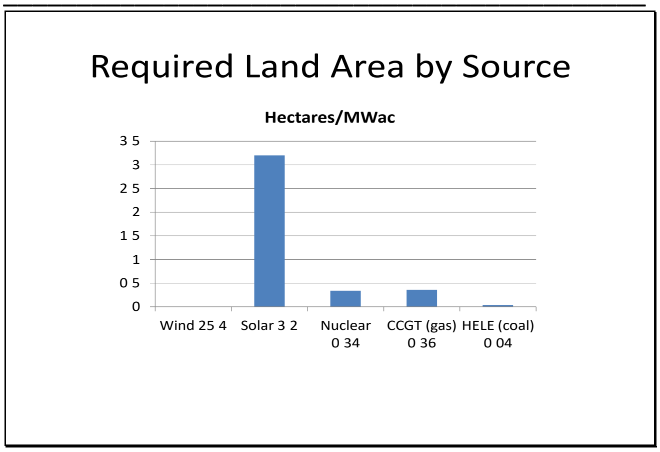
- The NSW Government in November 2020 legislated the creation of the Central-West Renewable Energy Zone (C-W REZ), which will be a 3,000MW (3GW) pilot for other NSW Renewable Energy Zones. What this means for the Central West, which already has several weather-dependent IEGPs in operation or under construction, is even more environmental destruction.
  Just for the stated small increase of 3,000MW nameplate capacity (potential output of 26,280GWhpa), excluding any backup/duplication power and new transmission infrastructure, etc, of:
  ***Nuclear plant* only, assuming a 90% capacity factor (i.e. 3 x24 x365 x 0.9GWh)**, would require only: land **777ha** (less than one Sydney airport in size); materials **651,303 tons.**
  ***Solar plants* only, assuming a 30% capacity factor,** would require: **31,500ha** of fully high-fenced farm land (size of 37 Sydney airports) and over **1,524,267 tons** of materials;
  ***Wind plants* only, assuming 40% capacity factor,** would require **174,285ha** of farm and mountain top land (size of 207 Sydney airports) and over **2,771,079 tons** of materials.

  Even putting aside all the pre and post negative impacts on the Australian and overseas environments of weather-dependent installations, the massive loss of local wildlife habitat, high increased risk of grass and bushfires destroying more habits and farmland, leaching of toxic substances into soil and waterways, loss of farmland for food production, visual pollution for all local people and visitors for 25 to 30 years minimum, increased water use, ever higher electricity bills, ongoing subsidies to developers, more unnecessary transmission lines scarring our lands and the risk that some of these industrial installations will remain in-situ after their end-of-life as many of the developers and land owners will no longer exist, is a high price to pay for no gain in reducing global temperatures or substantially reducing electricity prices.
  Why do rural and regional citizens have to bear the burden and known risks of weather-dependent renewables, which are driven by ill-informed, ideologically obsessed people?
  [ref: https://energy.nsw.gov.au/media/1921/ " NSW Electricity Strategy"; Average hectares based on developers' published figures for Beryl, Gulgong, Stubbo and Wellington solar works; materials from sciencedirect.com "global environmental change Vol 60 Article 102028 table 1"; Average hectares based on developer's published figures for Coopers Gap wind turbine works]



NSW C-W REZ map as at December 2019

- The National Electricity Market participants (QLD, NSW, VIC, SA, TAS) generated from coal and gas plants **151,900GWh** out of a total of **192,400GWh** in 2019/20. For just PV Solar IEGP or just Wind IEGP to replace this output would require at least **2,187km2** or **11,393km2** respectively of land taken out of other use and excludes the necessary backup/duplication sources (pumped hydro, batteries and roof-top solar) and new transmission lines and infrastructure. Using the 2019/20 mix of industrial solar (28%) and wind (72%) generation, the land mass would be **8,815km2** or **71%** of the size Greater Sydney (bounded by Gosford/Wyong, RNP and Blue Mountains), which is 12,368km2, or more than 58 times the size of The Royal National Park (151km2). This could be doubled when plants are replaced. The fencing of this land for solar and wind IEGPs will destroy wildlife corridors, nesting and feeding habitats for decades and possibly destroy whole ecosystems. Should we accept this devastation?
  [ref: solar 1.44ha/GWh, wind 7.5ha/GWh based on developers' published figures; https://aemo.com.au/-/media/Files/Electricity/NEM/National-Electricity-Market-Fact-Sheet.pdf 28/07/20; April 2020 www.cityofsydney.nsw.gov.au/guides/city-at-a-glance]



Wind removed as it distorts the relativity of solar to the other sources

- Visually polluting the land can detract from the natural beauty of the vistas, which in turn can deter tourists from visiting some small towns and surroundings in rural regions of Australia. Domestic and overseas tourists and life-style change people expect to see the best that rural areas have to offer, not thousands of km2 of weather-dependent wind and solar industrial complexes. Is this acceptable?
[ref: 3/8/20 MWRPP decision on Old Mill Rd Gulgong DA0283/2019]


Country scene


Now an Industrial scene

- The proposed **$1 billion** Star Hotel Project development in Pyrmont Sydney involved 254 rooms in a building of about **100 metres** tall to be viable. At this stage approval is unlikely for the hotel because of government imposed height restrictions. Sydney's tallest building is **305m** high plus a **4m** lightning rod.
However, the rural regions and very near regional towns are expected to accept hundreds of wind turbines that, even today can be **280m tall** and nearly 200m wide and getting larger each year. These wind turbines take up thousands of hectares of agricultural land or bushland hill tops and require dirt roads to be built that will erode the landscape. Such numerous and massive structures with very large fast moving blades are not just visual pollution but pose real dangers to wild-life and their habitats, people and property. Yet the residents in the NSW REZs have fewer rights to object than the people living near the proposed Star Hotel project in Sydney. Why are rural citizens in the REZs treated so adversely compared to the rest of NSW?
[ref: robbinsislandwindfarm.com/projects; Bing search- pics of wind turbines; The Daily Telegraph page 14 4/11/20; 8/9/20 windpowerengineering.com/the-true-cost-of-wind-turbine-fires-and-protection/]


Will our regions be dominated by multitudes of 280m wind turbines?


Sydney Tower at 309m dominates CBD

- Nature Communications published on 1/9/2020 a science paper on world-wide mining and its impact on the environment, which stated that: *"Most mining areas (82%) target materials needed for renewable energy production, .."* and so *"Mining threats to biodiversity will increase as more mines target materials for renewable energy production...". "The authors discovered that a greater proportion of pre-operational mines are targeting materials needed for renewable energy production (nearly 84%) compared to around 73% of operational mines".*
All this additional mining just for renewables is environmental vandalism. Why is this acceptable?

[ref: nature communications "renewable energy production will exacerbate mining threats to biodiversity"]

- Pre-construction pollution of the environment, both within and outside of Australia, is significant for solar installations. Apart from mining ores (coal, bauxite, copper, limestone, aggregate, silver, iron ore, etc.) used in producing construction materials (steel, aluminium, concrete) PV solar panels also need cadmium, germanium, gallium, indium, tellurium, silica, quartz, and plastics (made from cellulose, coal, oil, natural gas). Lithium batteries need rare earths, metals, plastics, cobalt and lithium. Extraction, purifying, and processing many of these inputs results in significant toxic waste, e.g. **producing one ton of rare earth elements releases up to 420,000 cubic feet (11,893m3) of toxic gases, 2,600 cubic feet (73.6m3) of acidic wastewater, and one ton (0.91 tonnes) of radioactive waste**. Why is this acceptable?
[ref: Plasticseurope.org "How plastics are made"; Sovacool 2010; thoughtco.com/rare-earth-metals-2340169; mineralseducationcoalition.org/mining-minerals-information/minerals-in-your-life/ Fact sheet "solar panels"; 16/4/20 heartland.org/_template-assets/documents/publications/PBdriessenmining2Apr20.pdf; samcotech.com/what-is-lithium-extraction-and-how-does-it-work/]

Extraction of lithium pumped from underground salar brine deposits into evaporation ponds

- Crystalline silicon is a key component of many solar panels. The production of crystalline silicon involves a by-product called silicon tetrachloride, which is highly toxic, killing plants and animals. Such environmental pollutants, which harm people, are a major problem for people in China and other countries. Those countries mass-produce "clean energy" solar panels but do not regulate how toxic waste is dumped into the environment. The country's inhabitants often pay the price. Should Australians ignore what happens to people overseas so that we can feel good about having "green energy".
[ref: 30/4/18 sciencing.com/effects-chlorofluorocarbons-humans-7053.html]

- Pre-construction pollution of the environment, both within and outside of Australia, is significant for wind turbine installations. Apart from mining ores (coal, bauxite, copper, limestone, aggregate, clay, gypsum, iron ore, etc.) used in producing construction materials (steel, aluminium, concrete) wind turbines also need rare earths (neodymium, dysprosium), cobalt and fibreglass/carbon fibre (made from oil).
Extraction, purifying, and processing many of these inputs results in significant toxic waste, e.g. producing one ton of rare earth elements releases up to 420,000 cubic feet of toxic gases, 2,600 cubic feet of acidic wastewater, and one ton of radioactive waste. According to the Bulletin of Atomic Sciences, a **2** megawatt (MW) wind turbine contains about 800 pounds (**363kg**) of neodymium and 130 pounds (**59kg**) of dysprosium. For each **ton of carbon fibre**, which is used for wind turbine blades, there is 10 tons (**9.1 tonnes**) of **CO2 emitted**. A **100m** carbon fibre blade weighs **40** tonnes. Three blades per modern turbine therefore weigh **120** Tonnes and these alone cause emissions of **1,092Tonnes of CO2**.
[ref: bbc.com/bbc news " What happens to all the old wind turbines?" 7/2/20; mineralseducationcoalition.org/mining-minerals-information/minerals-in-your-life/ Fact sheet "wind turbines"; 31/3/20 compositesworld.com/articles/wind-turbine-blades-glass-vs-carbon-fiber; July 2020 manhattan-

institute.org/mines-minerals-and-green-energy-reality-check]

- Both solar and wind electricity generation require several rare earth minerals. The yield per ton of ore ranges from a few grams to less than a gram depending on the rare earth involved. Extracting rare earths involves the use of toxic chemicals (sulphuric acid, alkali, nitric acid) and creates toxic waste (dust concentrate, sulphur dioxide, hydrofluoric acid) including radioactive waste. China processes the majority of rare earths. Processing of rare earths results in toxic lakes, such as Baotou Lake in Mongolia, China.
[ref: 3/4/15 bbc.com/future/article/20150402 "The worst place on earth"; 11/4/15 digitaljournal.com/news/environment/baotou-a-toxic-lake-created-because-of-a-thirst-for-technology/article/430511; chinapower.csis.org/china-rare-earths/]


Processing rare earths in China


Rare earths toxic waste containment

- Pollution of the environment, both within and outside of Australia, is significant for solar installations during and post decommissioning. The toxic chemicals in solar panels include cadmium telluride, copper indium selenide, cadmium gallium (di)selenide, copper indium gallium (di)selenide, hexafluoroethane, lead, and polyvinyl fluoride. Additionally, silicon tetrachloride, a by-product of producing crystalline silicon, is highly toxic. Lithium batteries used to backup IEGPs contain toxic lead, cobalt and lithium and in themselves pose immediate and future risks to the environment. Have our governments thought about these risks?
[ref: 30/4/18 sciencing.com/effects-chlorofluorocarbons-humans-7053; 5/3/18 https://www.cbsnews.com/news/cobalt-children-mining-democratic-republic-congo-cbs-news-investigation/; www.sustainablity.vic.gov.au "The growing issue of PV system waste]

- Pollution of the environment , both within and outside of Australia, is significant for wind turbine installations during and post decommissioning. Apart from the mining, processing, manufacture, transport, construction the disposal of the turbine blades has emerged as a significant issue for Norway, Germany and the USA as old wind turbines are currently being decommissioned.
[ref: stopthesethings.com/2015/04/25/wind-powers-toxic-embrace/; bloomberg.com/news/features/2020-02-05/wind-turbine-blades-can-t-be-recycled-so-they-re-piling-up-in-landfills]

- Wind turbine blades made from fibreglass or carbon fibre are being buried because they are too difficult to economically recycle. Carbon fibre is not biodegradable and will last indefinitely. Germany has over 5,900 wind turbines due for decommissioning in 2021 and therefore 17,700 blades to dispose of soon. In Tennessee USA, 1,000 end-of-life turbine blades were buried near a river. In other cases the wind turbines remain in situ, just rusting monuments to the lack of foresight of what happens to all these turbines at the end of life. Have our governments thought about these issues? Apparently not.

[ref: CF technewsworld.com "The Perplexing Carbon Fiber Repurposing Problem"; bloomberg.com/news/features/2020-02-05/wind-turbine-blades-can-t-be-recycled-so-they-re-piling-up-in-landfills]

Disposing of cut up wind turbine blades

- Photovoltaic manufacturers use a lot of water for various purposes, including cooling, chemical processing, and air-pollution control. The biggest water waster, though, is dust control and cleaning panels during installation and use. Utility-scale PV solar projects in the 230 to 550 megawatt range can require up to **1.5 billion litres of water** for dust control during construction and another **26 million litres annually** for panel washing during operation. An installed **400MW** PV solar IEGP has about **800,000** panels, which should be washed whenever dust accumulates as dust reduces efficiency by up to 10% and other contaminants by up to 30%. Water is precious in the rural areas of Australia where nearly all these solar IEGPs have been or are being built, or are proposed to be built. Have our governments thought about these issues? Apparently not.
  [ref: spectrum.ieee.org/green-tech/solar/solar-energy-isnt-always-as-green-as-you-think; pveducation.org/pvcdrom/modules-and-arrays/degradation-and-failure-modes]

Construction site dust control

Cleaning PV solar panels

- The Kathleen Valley WA lithium project needs to mine **139 million tonnes of ore to get 1.8 tonnes of lithium** (**1.3% yield**). The extraction and processing of lithium requires considerable heat and the by-products, such as chlorine gas, can contaminate the soil, air and water. More extensive mining and all the habitat destruction, polluting activities and transport will grow and grow as more batteries for renewables backup/grid stabilisation and electric cars expands.
  For example, a Tesla utility scale power pack weighs **2199kg** and contains about **45kg** of lithium, which equates to mining **3,475,000 tonnes of ore per power pack**.
  The Hornsdale Power Reserve in South Australia uses over **150** Tesla Power Packs. Thus, 521,250,0000tonnes of ore had to be mined, initially processed, shipped to China for further processing and ultimately used to make batteries. Compared with a natural gas power

plant, the total mining required for solar, wind and their backup is at least **10** times as many total tonnes mined, moved, and converted to deliver the same quantity of energy. Are the expanding environmental impacts of all this additional mining, transport and processing being ignored by our governments? Apparently yes.
[ref: thoughtco.com 21/8/20 "An overview of commercial lithium production"; salon.com 17/6/19 "Electric cars are still better for the environment"; www.boardroom.media 20/02/20 ASX:LTR Liontown's victory"; manhattan-institute.org/mines-minerals-and-green-energy-reality-check ; tesla.com/powerpack; electrek.co/2016/11/01/breakdown-raw-materials-tesla-batteries-possible-bottleneck/]



Open cut Lithium mines, many of which could swallow the regional towns in just the Central West NSW

- The **7,500** hectare Hornsdale Windfarm in SA has a capacity of **316MW** and a claimed capacity factor of **37.9%** (1,050GWh annually). When the wind turbines are becalmed, sometimes for days, then no electricity is produced. Advocates for renewables claim battery backup (they oppose coal, natural gas and nuclear electricity generation) can fill this void. On average, wind IEGPs in Australia do not produce electricity for three days (72 hours) of each week.
  How much would the Hornsdale Power Reserve batteries (currently **150MW/193.5MWh** in size) need to be expanded to supply the backup electricity needed for, say, 72 hours before being exhausted? A staggering increase of **118** times as large (316MW x 72h /193.5MWh). The Hornsdale Power Reserve cost about **$130m** (stage 1 was $90M plus annual fees of $4m+), required 1ha of concrete slabs, and 4.3T of batteries and inverters). Scaled up 118 times comes to **$1.534 billion cost**, **118ha of concrete slab** and **504 Tonnes of battery equipment.**

  Compare this with AGL's proposed **250MW** capacity, **90%** (1,971GWh annually) capacity factor, dual fuel combined cycle gas turbine with carbon capture plant (CCGT-CC) on only **91ha** at a cost of only **$400m** and expected life of **25 years**. The CCGT has longer life than the Hornsdale wind turbine plant yet produces nearly twice the electricity output annually and when required almost 24/7 at a very much lower capital cost and demand on resources.

  The extent of mining (10 times more than an equivalent capacity natural gas power plant) of lithium, cobalt, nickel, graphite, etc. is staggering, especially when the output of Hornsdale only represents less than 0.5% of Australia's 2019-20 electricity consumption (NEM **192,400GW** plus WA & NT add 10% more). A similar calculation for solar IEGP would be 30% worse due to their much lower capacity factors.

  In addition, one can calculate that one annual gigafactory production of 50GWh of Tesla batteries would be enough to provide back-up for 6min for the entire US power consumption (and then no Teslas to drive). Today’s battery technology cannot be the solution to renewables intermittency. Why do our governments and renewables proponents continue to falsely claim that batteries will solve the intermittency and variable electricity output of wind and solar IEGPs when they cannot?

How can consuming so much extra of the Earth's resources ever be justified, especially as replacement of weather-dependent renewables is necessary every one, two or three decades?
[ref: hornsdalewindfarm.com.au; The Daily Telegraph p5 21/10/20 "Kean backs kids opposed to govt's gas strategy'; http://joannenova.com.au/2020/08/wind-power-failure-100-times-a-year-we-get-a-500mw-outage ; hornsdalepowerreserve.com.au; abc.net.au/news/2018-09-27/tesla-battery-cost-revealed-two-years-after-blackout/10310680; tesla.com/powerpack; gizmodo.com.au/2017/07/all-the-details-on-teslas-giant-australian-batteryt/; power-technology.com/projects/newcastle-power-station-new-south-wales-nsw/; electrek.co/2016/11/01/breakdown-raw-materials-tesla-batteries-possible-bottleneck/; Oct 2020 Dr Lars Schernikau "The truth behind renewable energy"; AER: AEMO, data 9/10/20]

Hornsdale Power Reserve (batteries) and Wind IEGP, South Australia

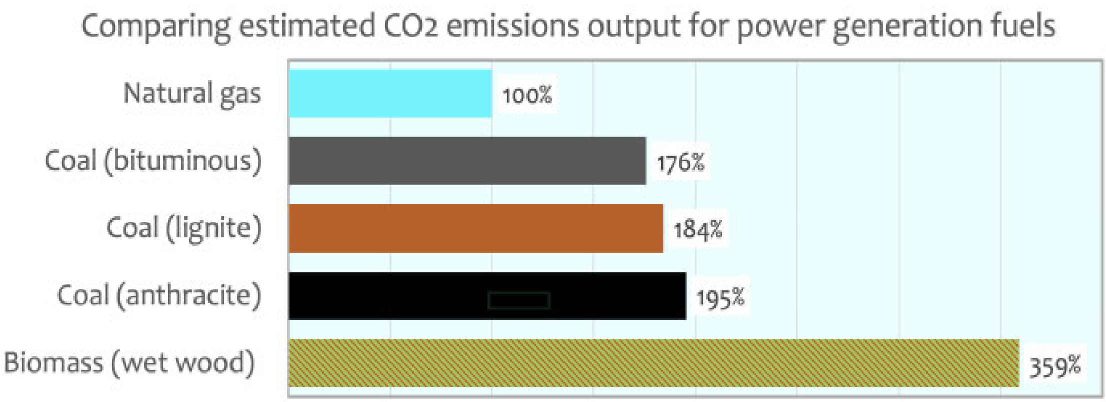
- Apparently, many advocates of weather-dependent renewables regard CO2 emitting bio-mass power stations that burn wood as a better backup/base load power source than coal, gas or nuclear and better for the environment. The ARD's "Das Erste" reports how satellite images show deforestation has risen **49%** since 2016 in Sweden, Finland, and the Baltic countries, for use in biomass electricity plants.

  Also, the EU import wood chips/pellets from North American and Chilean forests for burning in biomass plants, which involves lots of fossil fuel used in harvesting, drying, pelletising, and transport by road and ship. Also, large losses of habitat for wildlife. A harvested forest replacement can take **100** years to reach to the same level of stored carbon that existed prior to harvesting . Biomass plants result in an additional, instantaneous CO2 release into the atmosphere of about **3.6** times that produced by burning Natural Gas for the same power output. Biofuels also destroy whole ecosystems.

  At least some well known environmentalist are speaking out against Biomass and Biofuel plants, stating that they are unsustainable and environmentally damaging methods of pro-ducing electricity. Will Australian governments rule out creating biomass power plants?
  [ref: 6/9/20 notrickszone.com/2020/09/06/environmental-disaster-northern-europe-deforestation-up-49-due-to-effort-to-meet-co2-targets/; 30/06/18 theguardian.com/environment/2018/jun/30/wood-pellets-biomass-environmental-impact 20/11/18; https://www.nytimes.com/2018/11/20/magazine/palm-oil-borneo-climate-catastrophe.html; 11/11/20 'The contradictions of Green policies to limit CO2 emissions'; Environmentalists M Moore and M Shellenberger]


Biomass power plant


Biomass fuel



Graph from 11/11/20 'The contradictions of Green policies to limit CO2 emissions'

- *"Solar panels create 300 times more toxic waste per unit of energy than do nuclear power plants. If solar and nuclear produce the same amount of electricity over the next 25 years that nuclear produced in 2016, and the wastes are stacked on football fields, the nuclear waste would reach the height of the Leaning Tower of Pisa (53 meters), while the solar waste would reach the height of two Mt. Everests (16 km)."*
  [ref: quote from https://wattsupwiththat.com/2018/12/23/solar-panel-waste-a-disposal-problem/; Jemin Desai and Mark Nelson, "Are we headed for a solar waste crisis?", Environmental Progress, June 21, 2017]

- *"Contrary to previous assumptions, pollutants such as lead or carcinogenic cadmium can be almost completely washed out of the fragments of solar modules over a period of several months by rain water."*
  [ref: quote from https://wattsupwiththat.com/2018/12/23/solar-panel-waste-a-disposal-problem/; Michael Shellenberger, "If solar panels are so clean, why do they produce so much toxic waste?", Forbes, May 23, 2018]

- C Millis, a USA Carolina state representative was the lead sponsor of House Bill 745, which required proper decommissioning of utility-scale solar plants after they close, reclamation of the land to its original condition within two years, and posting financial guarantees to ensure the work gets done. The article raised the concern that not enough research has gone into the decontamination impacts of solar panels on the soil. One study concluded that after land restoration peanuts could no longer be grown because of the high zinc concentrations in the soil that leached from solar panels.

  In Central West NSW alone there are several solar plants in place or proposed with capacities ranging from 87MW to 500MW where the potential contamination to the soil, surface and underground water supplies are very high. Planning submissions from developers do not currently include independent research on the risks and or a requirement for ongoing monitoring and reporting of soil and water condition on and around the site. Also, fully funded

decommissioning, site restoration and disposal plans should be a requirement and be lodged with the submissions. Why are our governments and planning panels apparently ignoring the legitimate regional concerns and safety requirements of rural residents?.
[ref: carolinajournal.com/news-article/environmental-hazard/ "Moore County residents worry about solar's long-term environmental impacts - Carolina Journal"]

- In time, the resource requirements for renewables can be doubled as new IEGPs must be operational before an old plant is decommissioned. For instance, a 400MW solar installation with back up batteries approved for construction near Gulgong on close to 18km2 of quality agricultural land. The average lifespan of solar plants is 21 years. So before this 400MW solar IEGP reaches its end of life, an additional 18km2 of land will need to be acquired and a new IEGP built to ensure continuity of electricity supply. Taking planning and building into consideration, this needs to be at least in the planning stages several years before starting the decommissioning of the original solar plant. In addition, extra transmission infrastructure, battery backup and other backup will be needed, possibly in a different distant location. Any omission or understatement of this overlapping of resources will drastically impact the complexity and costs of the electricity system as whole. It appears that the government bodies have not factored this into their modelling simply because they only estimate over a claimed life-cycle for renewables of 25 to 30 years.

6. Are clean sources of energy

This claim is not supported by the facts or actual experience, largely because the toxic waste occurs both inside Australia but mainly outside of Australia, such as:

- The PV cell manufacturing process includes a number of hazardous materials, most of which are used to clean and purify the semiconductor surface. These chemicals include hydrochloric acid, sulphuric acid, nitric acid, hydrogen fluoride, 1,1,1-trichloroethane, and acetone. The amount and type of chemicals used depends on the type of cell, the amount of cleaning that is needed, and the size of silicon wafer .
  [ref: https://www.ucsusa.org/resources/ environmental-impacts-solar-power]

- Weather-dependent solar and wind electricity generation, including the use of Lithium batteries for partial backup/grid stabilisation, involve mining and extraction processes that generate huge amounts of toxic waste, especially in China and The Democratic Republic of Congo. Solar panels contain a toxic mix of gallium arsenide, tellurium, silver, crystalline silicon, lead, cadmium, and heavy earth materials. Batteries use lithium and cobalt, both of which are hazardous materials. The magnets in wind turbine generators are made from neodymium and dysprosium, rare earth minerals mined and processed almost exclusively in China and which has covered large tracts of China with fields and lakes of toxic waste.
  [ref: https://www.thoughtco.com/lithium-production-2340123;
  3/4/15 https://www.bbc.com/future/article/20150402-the-worst-place-on-earth; 5/3/18
  https://www.cbsnews.com/news/cobalt-children-mining-democratic-republic-congo-cbs-news-investigation/]

- The Victorian government has declared all solar panels as e-waste, as has the European Union. Disposal of solar panels, even after some recycling, cannot go to land-fill because of the toxic materials in each panel. EPA Regulatory Programs Director Rachel Gualano said *'officers would be inspecting sites with a focus on preventing harm to the environment and human health, including land and groundwater contamination, stockpiling and mitigating fires'*.
  Panels are unsuitable for burying in landfill but our governments think covering thousands of hectares of rural land with solar panels is alright. Why?
  [ref: www.sustainablity.vic.gov.au "The growing issue of PV system waste"; www.epa.vic.gov.au/about-epa/news-media-and-updates/news-and-updates/e-waste-compliance-switched-on 3 July 2019]

- Victoria's government has stated that: *"It is estimated that more than 100,000 tonnes of solar panels will enter Australia's waste stream by 2035. This has the potential to create a hazardous waste management issue, as materials contained within solar panels can leach into soil and groundwater, causing environmental contamination and safety concerns if managed poorly. Keeping these materials out of landfill prevents environmental and human health problems, and rescues valuable resources for reuse. Compounding the issue is a lack of dedicated processing facilities in Australia that can recover valuable materials contained in PV products."*
  [ref: www.sustainablity.vic.gov.au "The growing issue of PV system waste"]

- Globally, the toxic waste already produced from mining for and processing of rare earths metals, cobalt, silver, lithium, etc. for use in wind and solar systems, including backup batteries, is causing pollution of land and soil, serious health conditions in residents, workers, animals and crops and the exploitation of children in cobalt mines. Is this acceptable?
  [ref: 11/11/14 nationalgeographic.com/news/energy/2014/11/141111-solar-panel-manufacturing-sustainability-ranking/ ; https://doi.org/10.1016/j.gloenvcha.2019.102028 "The decarbonisation divide: contextualising

landscapes of low-carbon exploitation and toxicity in Africa"]

- As wind and solar systems reach their end-of-life, the decommissioning, recycling and disposal are creating more toxic waste. It is estimated that the waste from just solar panels will grow from **0.25 million tonnes** in 2016 to **78 million tonnes** by 2050. At present most of these toxic panels go to landfill or storage. Should this be tolerated?
  [ref: www.sustainablity.vic.gov.au "The growing issue of PV system waste"; https://www.irena.org/publications/2016/Jun/End-of-life-management-Solar-Photovoltaic-Panels]

- The main environmental problems linked with photovoltaic panels, if not properly disposed of are: leaching of lead; leaching of cadmium; loss of conventional resources (primarily aluminium and glass) and; loss of rare metals (silver, indium, gallium, cadmium and germanium). Studies have shown that rain can leach toxic materials from solar panels over time in-situ due to deterioration or within 30 days if disposal is in land-fill. Recycling solar panels is not currently economic and is becoming less so as the silver content is reduced, so more and more panels will go to land-fill, whether locally or sent to developing countries. Alternatively, as in the EU, levies and charges will apply when installing solar panels and on disposal to subsidise their safer disposal. How many more subsidies will the wind and solar industry require from the us?
  [ref: ec.europa.eu/environment/waste/weee/pdf/Study on PVs Bio final.pdf; 15/0/15 www.ncbi.nlm.nih.gov "Leaching of cadmium and tellurium from cadmium telluride (CdTe) in thin-film solar panels under simulated landfill conditions"]

- Wind turbine blades are made of toxic composite materials, such as fiberglass, epoxy, polyvinyl chloride foam, polyethylene terephthalate foam, balsa wood, and polyurethane coatings. These blades cannot be economically recycled and are being incinerated in the EU countries or buried in other countries. The plastics in the blades are highly toxic, and contain Bisphenol A, which is so dangerous to health that the European Union and Canada have banned it. How are our governments ensuring the safety of regional citizens?
  [ref: stopthesethings.com/2020/01/26/toxic-shock-millions-of-wind-turbine-blades-leave-poisoned-landfill-legacy-for-generations-to-come/]


Cutting up end-of-life wind turbine blades


Disposing of cut up wind turbine blades

- Fire-fighters have to take special precautions when fighting a fire in a PV solar electricity generating plant because of the dangerous voltages and the release of toxic fumes from burning panels and cables. Their approach is to just contain the perimeter of a solar IEGP.
  [ref: submission on DA0283/2019 to MWRPP 3 August 2020; 23/05/18 Mr McCurdy MP (Ovens Valley) (10.19) speech to parliament; www.windpowerengineering.com/the-true-cost-of-wind-turbine-fires-and-protection/]


PV solar IEGW left to burn out


PV solar panel fire

- Fossil fuels are regarded by renewables advocates as not being clean energy. Then weather-dependent renewables and their required backup (batteries and biomass plants) cannot be clean either as coal and oil are extensively used throughout the life-cycle of these weather-dependent renewables. For example: for mining and processing materials; to make steel and plastics; for lubrication; for use in transporting components; for clearing land; for decommissioning and; for disposal.

  Also, to produce just one ton of metallurgical grade silicon (MG-Si) for use in making solar cells the ingredients includes high grade quartz (2400kg/59%), coal (550kg/14%), oil coke (200kg/5%), charcoal (600kg/15%) and hardwood chips (300kg/7%). In addition, their manufacture involves 5 days of continuous heating in a furnace at 1100 degrees Celsius. Most solar cells are made in China and therefore rely extensively on fossil fuels to supply the required energy to the furnaces. Five to six tons of CO_2/ton of SG-Si is produced during the smelting process. More fossil fuels are required to the upstream processes to make the solar cell wafers, 50% of which is discarded, the solar cells and a complete solar panel. Hence, this is why installed renewables start with such huge emissions and energy deficits requiring years of electricity production before these deficits are eventually offset.

  Without carbon, in its various forms, there can be no solar panels. Why is this basic fact ignored by proponents of solar plants?
  [Ref: Troszak, Thomas. (2019). Why do we burn coal and trees to make solar panels?. 10.13140/RG.2.2.15715.71207/6].

- The use of biomass (burning wood and vegetation) power plants as a backup to weather dependent wind and solar electricity generation when they are not producing sufficient/any electricity is being recognised by prominent environmentalists as adding more CO_2 and airborne particulates than burning coal because wood has a lower energy density than all other fuels.
  [ref: Michael Moore documentary "Planet of the Humans" 21/4/20 Youtube; 30/6/20 Michael Shellenberger "Apocalypse Never" p192 - 193]

Biomass energy plant - trees to woodchips to fuel


Biomass energy from wood chips by the truck load

- If Australia is to have a clean energy system then it must include nuclear energy generation in its mix. The more electricity generated from large-scale nuclear reactors and small modular reactors (SMR) the cleaner, cheaper and more reliable our electricity system.
[ref: "The case for SMRs in Australia" by SMR Nuclear Technology Pty Ltd August 2021]

- According to an article in Nature.com the lead from perovskite, used in the next generation of solar cells, leaking into the ground can enter plants, and consequently the food cycle, ten times more effectively than other lead contaminants already present as the result of the human activities. All solar panels contain some degree of contaminates yet the developers do not disclose these risks and in some cases do not even specify what type of solar panels they will install. We must be given this information at the EIS stage. Our environment and health are at risk. Will our governments introduce appropriate regulations?
[ref: 21/01/20 nature.com/articles/s41467-019-13910-y]

7. Eliminate fossil fuel use

This claim is not supported by the facts, such as:

- Mining for metals and minerals required for renewables is targeting **82%** of all mining on Earth. With increased mining comes increased use of fossil fuels to manufacture equipments, undertake mining, transport and process ore, etc, etc, etc.
  [ref: Nature Communications "renewable energy production will exacerbate mining threats to biodiversity"]

- Fly ash is a useful by-product of burning coal in coal fired power plants. It has several uses but a very important use is in making concrete, either Portland or Geopolymer, for use in building dams and wind turbine footings. Fly ash use in concrete reduces the amount of cement required, which reduces the cost of concrete and also reduces CO_2 emissions.
  [ref: cementaustralia.com.au/products/fly-ash; gharpedia.com/blog/fly-ash-for-concrete-uses-advantages-and-disadvantages]

- Transport, much of it specialised for wind turbines, requires tyres, lubricants, diesel fuel, plastics to name a few examples essential to the construction of wind and solar IEGPs. In 2011, moving just one complete turbine took 9 to 10 trucks, most of which were specialized trailers. Different trailers are needed for the nacelle, blades, and towers. In 2020 wind turbines are significantly bigger and heavier. Ports and ships also have to be modified and extended to handle such sizes and weights. All these equipments depend on fossil fuels for their construction and operation.
  [ref: windpowerengineering.com/challenges-in-moving-huge-and-heavy-components/]


Unloading a wind turbine blade from a ship


One wind turbine blade being taken to its site

- Steel manufacture needs coke (solid carbon and some ash) derived from heating metallurgical coal at 1000 degrees Celsius. The coke is added to iron ore in a 2,000 degrees Celsius flame blast furnace. The furnace heat is created from either oil or natural gas combined with oxygen. It takes around **770 kilograms** of coal to make **one tonne** of steel. Steel is essential in all stages of weather-dependent renewables from mining, processing, transport, manufacture, construction, decommissioning and disposal. Hence, coal remains essential to creating wind and solar IEGPs.
  [ref: bhp.com/our-businesses/our-commodities/metallurgical-coal/; Oct 2020 Dr Lars Schernikau "The truth behind renewable energy"]

- *"Plastics are derived from natural, organic materials such as cellulose, coal, natural gas, salt and, of course, crude oil"* and are heavily used in solar panels and wind turbine systems, including lithium batteries. Fossil fuels would have to remain in use for many decades.
  [ref: plasticseurope.org " How plastics are made"; sciencedirect.com]

- To produce just one ton of metallurgical grade silicon (MG-Si) for use in making a component of solar cells the ingredients includes high grade quartz (2400kg/59%), coal (550kg/14%), oil coke (200kg/5%), charcoal (600kg/15%) and hardwood chips (300kg/7%). In addition, their manufacture involves 5 days of continuous heating in a furnace at 1100 degrees Celsius. Most solar cells are made in China and therefore rely extensively on fossil fuels to supply the required energy to the furnaces. Five to six tons of CO2/ton of SG-Si is produced during the smelting process. More fossil fuels are required for the upstream processes to make the solar cell wafers, 50% of which is discarded, the solar cells and a complete solar panel. Hence, this is why installed renewables start with such huge emissions and energy deficits requiring years of electricity production before these deficits are eventually offset.

  Without carbon based input, in its various forms, there can be no solar panels. Why is this basic fact ignored by proponents of solar plants?
  [Ref: Troszak, Thomas. (2019). Why do we burn coal and trees to make solar panels?. 10.13140/RG.2.2.15715.71207/6].

- In time, the resource requirements for renewables can be doubled as new IEGPs must be operational before an old plant is decommissioned. For instance, a 400MW solar installation with backup batteries is being built near Gulgong NSW on close to 18km2 of quality agricultural land. The average lifespan of solar plants is 21 years. So before this 400 MW solar IEGP reaches its end of life, an additional 18km2 of land will need to be acquired and a new IEGP built to ensure continuity of electricity supply. Taking planning and building into consideration, this needs to be at least in the planning stages several years before starting the decommissioning of the original solar plant. In addition, extra transmission infrastructure, battery backup and other backup will be needed, possibly in a different distant location. This duplication will require even more coal and hardwood, which is essential for the manufacture and transportation of solar cells and solar panels.

8. Have strong community support

This claim is not supported by the facts, such as:

- The May 2019 Australian Federal election was billed as a referendum on addressing climate change through the aggressive transition to renewables. The majority of voters rejected this proposition at the ballot box. Our elected governments should abide by the majority decision made by the Australian people. Why are they ignoring the will of the majority?

- The NSW mid-west historic town of Gulgong is one of many rural and regional towns around Australia that oppose the locating of wind and PV solar electricity generating works close to their towns. They already have the 310ha Beryl IEGP only 5km from town. The historic rural town of **2500** people lodged **435** objections against a DA for another solar electricity generating works close to the Gulgong township. The objections represented 17% of the residents and therefore a significant proportion of households. Ultimately they achieved a unanimous decision by the Mid-Western Regional Planning Panel (MWRPP) on 3/8/2020 to not approve the development application for a PV electricity generating works at Old Mill Road.
[ref: 3/8/20 MWRPP decision; soundcloud.com/user-645092504/western-regional-planning-panel-ppswes-1-mid-western-3-august-2020 6/8/20 www.mudgeeguardian.com.au/story/6867372/solar-farm-at-old-mill-road-in-gulgong-will-not-go-ahead/?cs=12]

- Similarly, a proposed solar IEGP proposal for Burrundulla, near Mudgee, had over 1100 objections (about 10% of the residents). The Mid-Western Regional Planning Panel (MWRPP) on 22/12/2020 unanimously decided to not approve the development application for a PV electricity generating plant.

- There many community groups that oppose weather-dependent renewables, especially those in country and regional Australia where residents have to live with the consequences of ill-conceived and ruinous government policies. Examples, just in the Central West region of NSW, include: *28/6/19 " Residents and business leaders opposed to the location of the proposed Burrundulla Mini Sustainable Energy Park, met in Mudgee on Friday to voice their concerns." (Over 1100 objections were lodged); "16/9/2020 · Local News RURAL ANGER: Farmer Rob Green is upset about plans for 12,180 solar panels to be built in 140 rows on this land next to his property."; "26/11/2018 · Local residents, farmers in the Suntop district southwest of Wellington, are gathering to oppose the installation of a giant solar farm covering one-and-a-half times the area of Wellington itself."*
[ref: theland.com.au/story/6254162/hugely-visible-and-too-close-issues-raised-over-proposed-solar-farm/; centralwesterndaily.com.au/story/6925887/farmer-fights-12000-panel-solar-farm-blight-planned-for-the-property-next-door/;theland.com.au/story/5768400/suntop-residents-heated-over-proposed-second-solar-farm/]

- EPYC withdraws application to develop **54** turbine wind farm 5km from Tarago NSW, after two planning department rejections and **400** plus **community** objections.
[ref: reneweconomy.com.au "Jupiter wind farm plans abandoned in face of community objections"; abc.net.au/news/2018-03-18/controversial-wind-farm-application-withdrawn/9560698]

- *"Nundle, a small town in NSW is pleading with Sydneysiders to join them in a fight against a $600 million wind farm. The historic village of Nundle, in the New England region, is fighting against a proposal to build 98 wind turbines, spanning 20km between Nundle and Hanging Rock".*
"A picturesque little village of 300 people near Tamworth, Nundle is about to be transformed by a wind farm on its doorstep. Within a few kilometres of this tourist town, and visible to

almost everyone in the district, there's a proposed $600 million wind farm with nearly eighty 220m high turbines stretching over 20 kilometres of ridge line." What they're trying to do here is force it on a community that doesn't want it".
Why are our governments not listening? Why are they destroying our surroundings?
[ref: 1/7/20 2gb.com/we-need-your-help-small-towns-impassioned-plea-to-sydneysiders/;
4/7/20 dailytelegraph.com.au/news/ Peta Credlin]

- A proposal for eight wind turbines, a one hectare solar farm, and an environmental sustainability centre on land at North Head on The Northern Beaches of Sydney is not supported by 'green' politicians Zali Steggall MP Warringah, James Griffin MP Manly and Michael Regan Mayor of NBC. All three have all stated they do not support the proposal for a wind farm at North Head, but that such developments are more appropriate in the Renewable Energy Zones in Western NSW, i.e. over 100s of kilometres from where they are well out of their sight from their electorates.
[ref: www.northernbeachesadvocate.com.au/2020/07/17/politicians-oppose-wind-farm]

Wind, solar & sustainability centre proposal for North Head, NBC Sydney

- There is now significant opposition by rural citizens in Germany to any more wind turbines. So much so that the construction of new wind IEGP collapsed in 2019.
[ref: ft.com/content/d8b9b0bc-04a6-11ea-a984-fbbacad9e7dd " Germans fall out of love with wind power"]

- Victoria's Corangamite Shire Council has unanimously rejected a proposal for a massive 550 hectare **solar farm** at Bookaar near Camperdown. The Rural City of Wangaratta has voted to oppose construction of a new $170 million solar farm at Glenrowan.
[ref: 25/9/18 www.standard.net.au/story/5667482/huge-solar-farm-gets-flick-from-council; 30/8/2018 weeklytimesnow.com.au]

- Councils and communities in Victoria reject solar and wind IEGP. e.g. The government pushes 3 wind and 3 solar IEGPs on regional communities in Victoria, and, RURAL communities are trying to stop solar farm developments across some of Victoria's prime irrigation land. Sunraysia citrus, dried fruit and winegrape growers have joined lifestyle-block owners in campaigning against three solar developments of 75,000 panels being built next to their properties.
[ref: www.theaustralian.com.au/nation/politics/ "communities forgotten in Victoria's rush to renewables"; weeklytimesnow.com.au "Rural communities campaign against solar farms" "

- Just a few examples of the depth of feeling , stress and anxiety suffered by residents in various rural communities when an industrial solar works is proposed or approved near their town are:

  - *"Hi [name of addressee], I'm gutted! We lost! So unfair. Are you aware of any appeal process we may have, or is that it? In anger, [Name of sender]*", Solar works approved in Orange December 2020,

  - "gut-wrenching ...", says another when a solar works was approved near Jindera NSW, December 2020

  - The renewables energy project *"had a lot of resistance. They are worn out....don't even want to talk about it"*. Wagga Wagga resident.

  - "*I'm so disgusted [name] with how this government, all governments are allowing this to happen to our pristine, countryside our environment and Australians in general*" , Mudgee resident, January 2021 following lodgement of Stubbo EIS.

  - *"The only positive thing I have considered will come out of this significantly stressful situation is that I will have found some sensible, thoughtful and lovely people in the same situation that are prepared to support each other in need. Thanks for reaching out."* Resident impacted by Culcairn Solar and loss of agricultural land. January 2021

- Communities around the world reject wind and solar IEGPs. e.g. Mexico: *One killed and 20 injured in wind farm protest*. Mexico: *Unhappy residents have also managed to stop at least four other solar and two wind projects in Yucatán, again due to the lack of prior consultations and environmental impacts.* USA: *Pennsylvania Richmond Township supervisors rejected a proposal that would have allowed a solar panel project to move forward.* USA: *North Carolina Woodland rejected rezoning application for a solar farm. But then they went further, supporting a complete moratorium on new solar farms, after residents made their opposition crystal clear.* UK: *The Say No to Sunnica **action group** is not **against solar**, we are not 'NIMBY's' (Not in My Back Yard) but do not agree with losing our entire back yard to a scheme (solar farm with batteries) that is simply too large and too intrusive.*
  [ref: wind-watch.org/news/2011/11/03/one-killed-and-over-20-injured-in-mexican-wind-protest; 5/5/20 dialogochino.net/en/climate-energy/35244-mexican-communities-reject-chinese-solar-yucatan/; 14/12/15 *Roanoke-Chowan News-Herald*; 5/5/20 *wind-watch.org/news/2020/05/11/mexican-communities-reject-chinese-solar-farm-in-yucatan/; wind-watch.org/news/2020/05/09/mexican-government-halts-grid-connection-of-new-solar-and-wind-projects;* 13/10/20 readingeagle.com/news/environment/richmond-township-supervisors-reject-zoning-change-for-solar-farm/; 14/12/15 SMH "Woodland North Carolina reject solar farms"; www.saynotosunnica.com]

- On 14 July 2020 the Benton Public Utility District of Washington State, USA, issued a report detailing many scientific and economic reasons why they now oppose wind turbine IEGPs. Just one of the points made was: *"Customers and citizens throughout the region are desirous of the natural beauty and open spaces that are part of their way of life. This is the reason for the report and for their formal declaration that Benton PUD does not support further development of wind power in the PNW. The PUD's position is consistent with a recent decision in California as the San Bernardino County's Board of Supervisors slammed the brakes on big industrial solar projects and highlighted a challenge for the huge landscaping demands of renewable intermittent electricity"*.

The rural regions of Australia totally agree with these points as we are the people affected by having wind and solar IEGPs thrust onto us, without regard for the health of us and our environment. Why are our governments ignoring us?
[ref: https://wattsupwiththat.com/2020/10/12/washington-state-blows-away-wind-fantasies/]

- Bob Brown, environmentalist, founder and long-time leader of the Australian Greens Party opposes a major wind farm development because its towers will affect an area's natural beauty and could kill endangered wildlife without any economic benefit to the state. Many communities throughout Australia, mainly in the rural regions, are those who are the most impacted by such developments. Why are our governments not supporting us?
[ref: 15/07/19 the guardian.com; 25/07/19 abc.net.au]

- Two long-time, well known environmentalists, Michael Moore (documentary "Planet of the Humans" YouTube 21/04/20) and Michael Shellenberger (book "Apocalypse Never: Why Environmental Alarmism Hurts Us All" 30/06/2020) highlight the environmental damage being caused by the obsession many countries have for weather-dependent renewables. Michael Shellenberger, in June 2020, publicly apologised for the decades of misleading the public. "But as an energy expert asked by the US congress to provide objective testimony, and invited by the Intergovernmental Panel on Climate Change to serve as a reviewer of its next assessment report, I feel an obligation to apologise for how badly we environmentalists have misled the public."
[ref: stopsolarfarms.com/news/i-cried-wolf-on-climate-change-says-michael-shellenberger; Forbes Censored Michael Shellenberger: Here Is His Full Apology - The Global Warming Policy Forum (thegwpf.com)]

- The Australian Energy Infrastructure Commissioner made two observations recently. Land holders who lease their land to wind and solar project developers may have their land rezoned from primary industry to industrial uses and so face additional costs of land tax, insurances, levies, and council rates. Land holders who lease their land to wind and solar project developers may also be responsible for removing the wind or solar infrastructure and rehabilitating their land at the end of the industrial wind or solar plants life. Evidence to date indicates this could cost the landowner a lot more than the total of all the lease income received over 25 years. SOS previously also highlighted examples of such cases occurring in the USA where even small solar plants cost landowners $millions (net) to decommission.

- Community consultation started in April 2021 on the jointly proposed 500MW solar plant with a 1000MWh BESS only 8km from Gulgong and a 441MW, wind turbine plant (63 x 280m high turbines) plus BESS only 12km from Gulgong. If the already approved Stubbo 400MW plus 200MW BESS, and the Tallawang and Barneys Reef Road projects were to be approved, together with the existing Beryl solar plant only 5kms from Gulgong, the small township would be overwhelmed with industrial scale weather dependent electricity generating plants. This is even before the proposed 180km TransGrid transmission line is built from Wollar to Wellington and passing a few kilometres north of Gulgong to allow even more such projects to be built. All the risks and issues with the such industrial projects will be multiplied many times over. Such impositions on the residents and the rural surroundings of Gulgong for at least a decade and beyond is unreasonable, damaging to the local environment and the health of some residents. The communities across Australia continually express their unreasonable treatment but are ignored by their governments.

9. Are reliable

This claim is not supported by the facts, real world experience and logic, such as:

- As wind and solar electricity generation are weather-dependent, then by definition, they cannot ever provide a continuous 24/7 energy supply in themselves. During August and early September 2020 California had several days of rolling blackouts affecting hundreds of thousands of homes, despite demand falling short of the state's peak years. The Governor proposed extending the planned forced shut-down of gas-fired plants past 2020 to counter the unpredictable renewables output. The failure of the Texas power system in February 2021, resulted in several deaths, shortages of food, water and heat during its winter storms. Texas has a largely independent electricity system and a 23% proportion of wind and solar generation. Virtually all parts of the Texas system were impacted by the extremely cold weather. It is unclear from the conflicting reports from the USA the extent of failure of each part of the system. However, the wind and solar IEGPs were heavily affected by ice and snow, so limiting their output. Wind and solar are not only weather-dependent but also weather exposed more so than other forms of electricity generation. Even solar panels and lithium batteries are temperature affected. Both lose efficiency in temperatures over 30C. They are therefore less reliable as a generator/provider of electricity.
  [ref: latimes.com 24/08/20 "The power went out. Now California might let these gas plants stay open" 4/9/20 "State of emergency declared as California faces historic heat, possible power outages" ; www.nytimes.com 16/8/20 "Rolling blackouts in California have power experts stumped'; Texas - State Energy Profile Overview - U.S. Energy Information Administration (EIA)]

- Likewise, the Australian electricity grid is becoming more and more unstable and unreliable as more weather-dependent renewables are added. The AEMO, who manages the grid, has proposed several measures, including their right to remotely shut down roof top solar systems, and charge owners of roof top solar systems to pay to export excess electricity to the grid, in an effort to prevent increasing frequency of blackouts. Roof top solar systems, which are on about 30% of Australian households, currently supply more electricity to the grid than does either wind or solar IEGPs. Why then do we need more IEGPs instead of just continuing to expand roof top solar? The owners of roof top solar systems are to be penalised to the benefit of the developers/owners of IEGPs. Why?
  [ref: reneweconomy.com.au/aemo-sees-urgent-need-to-have-power-to-switch-off-rooftop-pv-94963/amp/]

- In parts of Gulgong NSW, during the 2019-20 summer, there were five unplanned blackouts, three of which were two hours or more duration. Without electricity, many residents were not only without power but also water, as they rely on tank water and electric pumps. The Beryl 87MW IEGP, only 5km west of Gulgong town, was operational since May 2019. The days were cloudy and there were equipment failures at Beryl. In fact, according to the then owner of Beryl and Manildra solar IEGPs located in the Central West REZ both suffered component failures and Beryl suffered damage from a lightning strike. In addition, their output was further reduced due to heavy rain, lack of sunshine and curtailment of output due to roof top solar systems producing more electricity than all users required. Beryl has not achieved its expected electricity output since commissioning. Reliability of IEGPs is not a strong point.
  [ref: reneweconomy.com.au/component-issues-hit-beryl-solar-farm-new-energy-solar-cuts-dividend-89936/; 25/2/21, New Energy Solar (ASX: NEW) Full Year Results 2020]

- A number of previously ASX listed renewables companies delisted because they regarded their share price as not reflecting the value of their assets. No, the share price reflected what the investors regarded as not a good investment. For instance, New Energy Solar was $1.35

in January 2020 but $0.85 ex 3 cents dividend on 12/2/21. New Energy was seeking a 50% sale of its portfolio in January 2020 but nothing eventuated. It has now managed to sell its Australian solar assets and exit the Australian renewables market. Why should the regional communities of Australia put our faith in the government's drive to more and more renewables when so many others don't?

- Germany relies on alternative back up (e.g. imports electricity from France who generate about **74%** of their electricity from nuclear power at a cost **59%** less than Germany) to keep the country operating when the wind speed is inconsistent, too light or too strong. Australia does not have the luxury on calling on other countries when its electricity system can't cope. Yet Australia continues to go down the damaging renewables path.
  [ref: forbes.com/sites/michaelshellenberger/2019/02/05/if-saving-the-climate-requires-making-energy-so-expensive-why-is-french-electricity-so-cheap/#183179541bd9; https://stopthesethings.com/2019/01/06/germanys-renewable-energy-fail-german-co2-emissions-10-times-higher-than-nuclear-powered-france/]

- Both solar panels and wind turbines lose efficiency over time. Solar panels decline by about **0.5% to 0.8%** a year and wind turbines about **1.6%** a year. They also can suffer failures from deterioration of plastics, solar cells, components, etc. and the weather (e.g. hail, storm, strong winds and fire). Not only are IEGPs not reliable they produce less and less electricity each succeeding year. Such rapid declines in output means ever greater capacity has to be installed to make up the growing output shortfalls as more IEGPs are added to the grid. Has this been considered by the supporters of wind and solar IEGPs?
  [ref: PV, www.wholesalesolar.com " How long do solar panels last"; Wind: www.science direct.com "How does wind farm performance decline with age"]


Fire shuts down whole solar array


Wind turbine collapse

- Both solar and wind IEGPs have to shut down if a major component fails. For example, just a fire in one turbine requires shut down of the plant. Once a fire starts, the project must be shut down and taken off grid for a period of time as a safety precaution, resulting in lost revenue. Likewise, for example, storm damage to part of a solar array may close down the whole works, such as the Queensland Oakey 2 IEGP.
  [ref: 8/9/20 windpowerengineering.com/the-true-cost-of-wind-turbine-fires-and-protection/ ; reneweconomy.com.au/uk-developer-takes-write-down-after-another-storm-hits-oakey-2-solar-farm-32373/]


Lightning strike shuts down wind turbine


Oakey 2 wind damage

- On average, Australia, loses 500MW of wind IEGP of output every 3 days. About 50 times a year we get the equivalent of 500MW or more outage within an hour or less when the wind becomes too strong. About 20 times a year a whole wind IEGP region can become becalmed, sometimes for days, causing a loss of output between 2GWh and 4GWh. Building more IEGPs in the same region makes the intermittency worse, not better. To counter this intermittency, base load generation must sit idling ready-to-go to pick up the slack or the Snowy Hydro scheme must sit in reserve. Therefore, capital infrastructure is being used inefficiently for unreliable and expensive wind (and solar) generators.
  This is an additional cost attributable to adding renewables to grids but is ignored by advocates of renewables.
  [ref: Aug 2020 joannenenova.com.au "Wind power generation intermittency - It's worse than you think it is - Part one"]

- Solar panels deteriorate, resulting in additional lost efficiency, total failure or even fire. e.g. by delaminating /internal corrosion, electrical wiring issues, micro-cracks, hot spots, birds, dust, "snail trails" and inverter problems. These failures can cause significant loss of output for an entire solar array or IEGP.
  [ref: https://www.sunengis.com/nine-common-problems-with-solar-panels/; reneweconomy.com.au/uk-developer-takes-write-down-after-another-storm-hits-oakey-2-solar-farm-32373/; pveducation.org/pvcdrom/modules-and-arrays/degradation-and-failure-modes]

Examples of some types of PV panel deterioration

- The House Standing Committee on the Environment and Energy launched an enquiry in May 2021 entitled *Federal House Committee on Energy - a new inquiry into dispatchable energy generation and storage capability in Australia.* SOS made a submission (sub050) in which it draws attention to many of the issues in the design of a national electricity grid based on projects like Stubbo, Wellington, the Riverina, etc, etc., especially increased instability and increased short and long term electricity prices.

- Through Snowy Hydro the Federal and NSW governments have proposed in May 2021 a 750MW gas fired power plant to be built in the Hunter Valley (Kurri Kurri). Also in May, EnergyAustralia, with the support of the NSW and Federal governments will build a 316MW carbon neutral gas fired power plant in the Illawarra region (Tallawarra). These two projects, which can actually produce significant amounts of electricity on demand and continuously at their rated capacity, should be operational by the time Liddell coal fired power station closes in 2023. Both gas electricity plants will, unlike the industrial renewables plants, require very substantially much less land and material resources and provide more local jobs, among other benefits.

- Germany, the other UE members and the USA are in dispute over the building of a dedicated gas pipeline (Nord Stream 2) from Russia to Germany to be used in German gas fired power plants. Such plants are necessary to sure up the intermittent and unreliable wind and solar plants. More renewables projects in Australia are already causing similar problems with the

NEM grid.

- Several jurisdictions with significant dependence on weather dependent electricity plants suffered severe blackouts and power availability over the period February to October in 2021. e.g. Queensland, Texas, China, UK and Germany to name a few. When base load power fails or the weather is not favourable, or both, for solar and wind generation plants then they add to the power shortages, not alleviate them. The UK had to pay to start up a remaining coal-fired power plant because they, and most of Western Europe, suffered from long periods of virtually no wind, an unreliable energy source, in early September and so no wind generated electricity was available. Also, more use of gas-fired power plants was necessary to make up the shortfalls in renewables output and so substantially drove up the price for natural gas, which in turned significantly increased electricity costs for businesses and other consumers.
  [Why are factories shutting down in Europe and China? Not enough coal - Advance Australia 1/10/21]

- The NSW Tomago aluminium smelter shut down three times in one week in May 2021 due to insufficient electricity being available causing the wholesale price to reach the cap of $14,500MWh. More weather -dependent renewables exacerbate the instability of the NEM, as 95% of all electricity infrastructure expenditure over the last five years has been on renewables. The retail price of electricity has risen substantially in Australia, which has been the global experience.

- Investing in more wind capacity doesn't make the wind blow harder when there isn't any wind; and if there is little or no wind, wind power output will be as close to zero that it makes no difference. Likewise, solar IEGP produce zero or little output when the sun is obscured or at night or in winter months. These obvious facts appear to be glossed over by energy policymakers and the experts advising them. Very expensive batteries and pumped hydro storage is then claimed to solve these problems but these fail to address the fact that more energy has to be put into them then they will provide. So where does the energy come from, say at night, when there is no/little wind power, no solar power and the stored capacity is empty? Renewables can never be reliable because our policy makers cannot regulate the weather.

10. Are Sustainable

This claim is not supported by the facts, such as:

- Just as coal, gas, and oil have a finite lives so do the many rare earths, metals, and numerous materials needed to produce, to transport, to provide backup support (e.g. Lithium and Cobalt for batteries) to maintain and replace weather-dependent renewables. The growing demand for lithium is already forecast to exceed the world's production supply by 2023 and various scenarios indicate supply could run out between 2040 and 2100. Weather-dependent renewables already need up to ten times the resources (mining raw materials to end-of-life disposal) than required by the equivalent capacity coal, gas or nuclear plants. This enormous magnitude of depletion of Earth's resources for renewables is unsustainable, some of which may disappear even in this century.
  [ref: www.pv-magazine.com/2020/09/15/how-long-will-the-lithium-supply-last/; sciencedirect.com "global environmental change Vol 60 Article 102028 table 1; Oct 2020 Dr Lars Schernikau "The truth behind renewable energy"; manhattan-institute.org/mines-minerals-and-green-energy-reality-check; nature communications "renewable energy production will exacerbate mining threats to biodiversity"]

- In 2019, **37%** of known reserves of rare earths, which are used in renewables, as well as many electronic devices, are in China. In 2019 China produced **85-90%** of all rare earths output. That country has already twice threatened to cut off its supply to other countries. If they act on that threat, or even withhold some supply so forcing up prices, then solar and wind renewables expansion and frequent replacement could largely and abruptly cease.
  [ref: statista.com/statistics/277268/rare-earth-reserves-by-country/; 7/8/20 .forbes.com/sites/timtreadgold/2020/08/07/chinas-rare-earth-threat-sparks-an-international-backlash/amp/ https://chinapower.csis.org/china-rare-earths/]

- The huge volume of water needed for mining and processing rare earths is now at risk in China. Widespread water pollution from growing industrial development in China continues to diminish freshwater supplies. The rapid economic growth and the increased consumption of animal products, is putting a further strain on the freshwater resources of China. Priority for human water consumption becomes clear, and this could put the zirconium and rare earths industry way down the list.
  The increasing huge amounts of water used by the renewables industry for the life-cycles of their wind, solar and battery products is likely unsustainable in coming decades.
  [ref: investorintel.com/sectors/technology-metals/technology-metals-intel/china-is-facing-a-water-crisis-that-could-threaten-rare-earths-production-and-their-mining-industry/;]

- The world has spent $trillions on all renewables to only get their share of global energy from **22% in 2001 to 34.7% in 2019**. To get to 100% renewables by 2050 is estimated to be many $trillions (USA alone, $5.7 trillion).
  In the light of the damage done so far to nearly all economies in the world as a result of dealing with the global COVID-19 Pandemic, it is not feasible that these economies can sustain such extraordinarily high expenditures for renewables, including their 100% backup duplication and grid reconfiguration for three more decades.
  [ref: https://www.americanactionforum.org/research/what-it-costs-go-100-percent-renewable/; www.irena.org/-/media/Files/IRENA/Agency/Publication/2020/Mar/IRENA_RE_Capacity_Highlights_2020.pdf]

- Currently it costs Australians **$13 billion** or more annually to support the wind and solar expansion in Australia. However, the AEMO 2020 Integrated Planning Report Overview states a benefit to consumers of only **$11billion** over **20** years i.e. by 2040.
  This meagre benefit will not provide a significant reduction in Australia's already high electricity prices to maintain existing manufacturing let alone significant growth to help

Australia's economic recovery post COVID-19 Pandemic. We need meaningful reductions (50% or more) in our electricity bills. 39% of our bills are already caused by funding renewables and can only increase further if government policies do not change now..
[ref: Report by Dr Moran "The Hidden Cost of Renewables on Electricity Prices"; https://aemo.com.au/energy-systems/major-publications/integrated-system-plan-isp/2020-integrated-system-plan-isp]

- *"Unlike other forms of electricity generation, like nuclear plants or coal plants, there doesn't seem to be any foresight on how to deal with the waste that will be generated when solar panels and wind turbines reach the end of their short lifetimes. Remember, nuclear plants can run for 80 years, as can coal plants with proper maintenance and upkeep, but even the best wind turbines and solar panels will last for just 25 years, creating staggering amounts of waste products."* Waste generated from renewables in the next 30 years is expected to be 866 greater than all the waste produced by nuclear power in the last 50 years. Recycling solar panels in the USA cost 10 times more than the revenue obtained according to a Arizona State University solar researcher Meng Tao.
  The disposal of mega tonnes of weather-dependent renewables toxic waste to landfill, storage or by incineration, as currently done in the EU, is not sustainable.
  [ref: americanexperiment.org/2020/08/solar-panels-are-starting-to-die-what-will-we-do-with-the-megatons-of-toxic-trash/; 22/07/20 onlinelibrary.wiley.com/doi/abs/10.1002/pip.3316]

- It was reported in April 2021 that about 89,000 roof solar systems were installed within Australia in 2010 and over 360,000 systems in 2011. Today 2.8 million or 28% of households have roof top solar systems and new installations are growing daily. In NSW, unlike Victoria, the damaged and older solar panels (10 to 11 years old!) are largely going to landfill. An estimated 3,000 tonnes of panel waste is expected to go to landfill in 2021. It cost more to recycle the panels than it does to dispose of them, even though the early panels had a very high silver content. Some councils are already banning disposal of panels in landfill. The Federal Environment Minister announced in June 2021 that she is demanding solar panel companies produce a 'clear timeline' for an industry-led national solar panel recycling program by June 2022 for how to deal with old, unusable technology to avoid a looming 'landfill nightmare' or face harsh regulations from the federal government. SOS has been raising this toxic waste issue, both when in situ and upon end of life, with our governments for over 24 months.

- On June 12, 2021 it was reported that the demand for Lithium, as used in the lithium batteries for most BESS, could quadruple by 2030. The processing of lithium ore is extremely toxic and mining intensive (a Western Australian mine's yield is only 1.3% lithium per tonne of ore). The BESS projects will add to this toxic waste and environmental damage. Facts which most officials and renewables proponents ignore.

- Table 1 below compares the approved Stubbo (near Gulgong NSW) 400MW solar and very small battery storage (BESS) plant with the output and resource requirements of alternatives over an 80 years period. Clearly, such resource requirements and poor energy payback for intermittent, short life, solar is not sustainable over the longer term.

Table 1. Comparison of 400MW capacity Generation Types

Generator Type	Land Req't Hectares *	Capacity Factor %	Output MWh/year	Availability	Tonnes Material Requirement	Expected Life yrs	Energy out/in Payback %	Materials Over 80 years MT
Stubbo Solar	1772	25.2	883,008	Daylight Hrs #	74,200##	30	60	218,666###
Industrial Solar (ave)	1280	25.5	893,520	Daylight Hrs	67,745	25	60	216,784
Rooftop Solar	0	24.5	858,480	Daylight Hrs	13,550	25	>60	43,360
Wind (no BESS) ave	10,160	30.1	1,054,704	Wind dependent	164,212	20	290	656,848
HELE	30	82.3	2,915,328	24hrs/7days	< 108,550	60	3,000	<144,733
CCGT-CCS	146	90	3,153,600	24hrs/7days	< 108,550	25	3,000	NA
Nuclear	169	91.3	3,199,152	24hrs/7days	108,550	80	7,400	108,550

* Ratios used to bring to all types to 400MW capacity level, except nuclear, used 50% for 1000MW plant
# plus up to one hour from BESS
Stubbo estimated by SOS: 4,800T batteries, 16,000T (20kg x 800,000) solar panels, 53,400T steel (40kg/m x 5m lengths X 133,500 piles plus 133,500 cross members) but no allowance for concrete, inverters, wiring, etc.
Batteries replaced 7 times, rest of system 2.67 times (80yrs/30 yrs)
[ref: Average hectares based on developers' published figures for Beryl, Gulgong, Stubbo and Wellington solar works; materials from sciencedirect.com "global environmental change Vol 60 Article 102028 table 1"]

- Current technologies of wind and solar renewables are getting close to their theoretical limits of energy efficiency, which is well under 60%, have relatively short lives and need 100% backup due their intermittent operation. Whereas coal, gas and nuclear energy generation are already 60- 90% efficient, have considerably longer lives, can operate with capacity factors in the 90% plus range and so need minimum backup.
  In addition, modern coal and gas plants produce much less CO2 emissions than the existing operating plants. Nuclear reactors produce no CO2 emissions, have the longest lives, and the development of small module reactors and Thorium reactors (India is constructing one for commissioning in October 2022 and plan to build up to 62 for operation by 2025), will be cheaper and quicker to deploy. Also, new technologies are likely to appear in the next decade or two, such as nuclear fission and hydrogen driven turbines. These new technologies are likely to cause inefficient, intermittent and unreliable weather-dependent technologies to again be abandoned.
  Placing faith in weather-dependent renewables with battery and expensive and environmentally damaging pumped- hydro as the 100% backup will not be sustainable. As other technologies are improved and invented in the next decade, renewables will become uneconomic stranded assets and outdated technologies.
  [ref: wattsupwiththat.com/2020/10/18/the-truth-behind-renewable-energy/; Michael Shellenberger "Apocalypse Never: Why Environmental Alarmism Hurts Us All" 30/06/2020; en.m,wkpedia/thorium-based nuclear power]

Photo by Jarek Radimersky Aug 2015

Photo by Daniel Hagerman March 2013

Is this our future: abandoned wind turbines

- It was reported on the 13 June 2021 that Clean Energy Resources Pty Ltd claims that it has developed a method of extracting hydrogen from coal without producing greenhouse gases. If true and if commercially viable, given that 95% of the world's hydrogen is currently derived from fossil fuels as electrolysis is too expensive, it would make wind and solar plants obsolete and stranded assets. In addition, both Hyundai and Toyota started trialling their Hydrogen Electric cars in Australia. If hydrogen driven cars, which only need a few kilograms of liquid hydrogen to travel hundreds of kilometres, gain favour over Electric Vehicles then this will affect electricity demand and the viability of weather dependent renewables.

11. Australia is a laggard in emissions reductions

This claim is not supported by the facts, such as:

- Australia has the highest uptake of solar globally, with more than 28% of homes with rooftop solar PV. As of 31 December 2020 more than 2.66 million rooftop solar power systems have been installed across Australia (source: CER). Angus Taylor, Minister for Energy and Emissions Reduction, said in February 2021 that Australia has the highest uptake of solar in the world with one in four homes using it and the highest wind and solar capacity of any non-European country.
  [ref: : Clean Energy Regulator; Rooftop solar drives Australia to renewable energy record – pv magazine Australia (pv-magazine-australia.com)]

- "In 2019, Australia deployed new renewable capacity at least 10 times faster per person than the global average and four times faster per person than China, Europe or the United States," Mr Taylor said. "In 2020, Australia invested $7.7 billion or $299 per person in renewable energy. This places us ahead of countries like Canada, Germany, Japan, Korea, New Zealand and the United States on a per-person basis."
  [ref: Rooftop solar drives Australia to renewable energy record – pv magazine Australia (pv-magazine-australia.com)]

- In its submission to the House of Representatives Standing Committee on the Environment and Energy hearing held in January 2021, the Dept. Industry, Science, Energy and Resources (DISER) Submission, Attachment E, highlighted that Australia leads the world in 2019 in new renewable energy capacity per person (240.3 watts) and per capital investment in renewables ($A324.7). The next closest country is Germany (74.3 watts) and USA (A$259.9) respectively.
  [ref: sub588 Climate Change Bills 2020]

- Attachment E of the DISER submission also shows that Australia is highly ranked in its emission reductions 2005-2018 on a per capita basis (-29%) when compared to the next best countries of UK (-40%), EU (-22%), USA (-19%) and Germany (-16%). China increased by +60%. Australia is hardly a laggard.
  [ref: sub588 Climate Change Bills 2020]

- According to Climate Action Tracker only eight of the 200 signatories are on track to meet their emissions targets. Apart from India the other seven countries are small contributors to emissions. Australia sits just outside this group and is also a small contributor to emissions.

- The IEA as of 10/02/20 compared the emissions of the advanced economies and the rest of the world for the period 1990 to 2019. The 14 advanced economies are Australia, Canada, Chile, EU (including UK), Iceland, Israel, Japan, Korea, Mexico, Norway, NZ, Switzerland, Turkey and USA have not collectively increased their emissions in 29 years. Meanwhile, the Rest of the World have increased their emissions by 239% from 9.2 to 22Gt (refer table below). In 2019 China emitted 10 gigatons (Gt) of the 22 Gt of CO_2 emitted by the Rest of the World.
  [ref: iea.org]

Year	Advanced Economies Emissions (Gt)	Rest of World Economies Emissions (Gt)
1990	11.3	9.2
1999	12.3	10.1
2019	11.3	22.0

If significant reduction in global emissions is a goal then it is not the advanced economies that have to do a lot more as they only represent 33% of emissions in 2019.

Conclusion

The two drivers of more renewables for electricity generation in Australia are reductions in CO_2 emissions so as to reduce future human-induced global temperature rises, and to significantly reduce electricity prices to stimulate the Australian economy, especially in manufacturing. It is clear from the evidence provided in this research paper that neither of these goals can be achieved by more expenditure on renewables, especially weather-dependent renewables with only battery and hydro storage as backup.

All the various claims made by advocates for renewables have been shown to not stand up to scrutiny. At under 1.2% contribution to global emissions Australia can not affect global temperatures. The two biggest contributors to global emissions are China and India, who both have about the lowest cost electricity in the world and the smallest renewables percentage for electricity generation.

The countries (e.g. Germany & Denmark) and states (e.g. South Australia and California) with the highest proportion of renewables also have the highest electricity prices and unreliable grids in the world. As Australia continues down the path of more renewables our governments somehow think the we will achieve what no others have so far.

The unspoken tragedies of these government policies is the damage being done to the world's environments, to wildlife and to people in Australia and other countries. How can it be justified to use ten times more resources for environmentally damaging, unreliable, dangerous and intermittent weather-dependent wind and solar renewables than for modern coal, natural gas and nuclear plants?

The same MWh output from industrial wind or solar plants can be achieved at a fraction of the materials and land required by nuclear power plants because of their much higher capacity factors. Nuclear also has the advantages over wind and solar of three times the life, three times the output, much less additional infrastructure, a fraction of the lifecycle waste and the ability to provide electricity almost 24/7 with zero CO_2 emissions.

Why do our governments ignore the obvious solutions to achieve their stated policies of CO_2 reduction, electricity price reductions and job increases? Why do they use CO_2 emissions reductions as an excuse when their actions will not affect the climate? Why do they pursue energy policies that reduce our economic activity? Why do they risk the safety of its regional communities? Why do they support large-scale destruction of regional and overseas environments? Why do they think that 100% duplication of weather-dependent renewables at great cost makes economic sense? Why do they turn a blind eye to the use of slave labour to produce materials for renewables? Why do they support outdated unreliable renewables technologies that are likely to become obsolete in the near future?

By reading this research paper they can no longer continue to proceed on their current course in ignorance.

Appendix A: Definitions

In any discussion about electricity generation it is essential that the various terms used are fully understood as some people mislead others, either accidentally or deliberately, by their incorrect use. The main terms and their acronyms used in this paper are:

- **Megawatt (MW):** A megawatt (MW) is equivalent to 1,000 kilowatts or 1 million watts of electrical energy e.g. a 1MW ("nameplate capacity") wind turbine can, under ideal conditions, produce a maximum of 1MW of electricity at an instant in time. MW and MWac (ac = alternating current) are usually synonymous but MWdc (dc = direct current) is sometimes used as it gives a higher nameplate capacity value, i.e. output before conversion to ac, which involves energy losses. e.g. Beryl solar is 110MWdc but only 87MWac capacity.

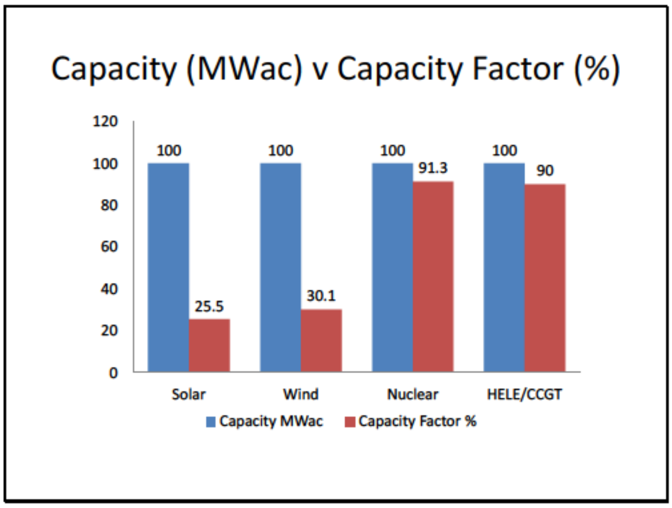
- **Gigawatt (GW):** A gigawatt (GW) is equivalent to 1,000 megawatts or 1 billion watts.

- **Megawatt hour (MWh):** A megawatt hour is equal to 1,000 Kilowatt hours (KWh). It is equal to 1,000 kilowatts of alternating current electricity used continuously for one hour e.g. a **1MW** wind turbine may only produce over a year **3,240 MWh** of electricity depending on the average strength of the wind. The theoretical maximum annual electricity output for a **1MW** system is **1MW x 24hours x 365 days = 8,760MWh.**

- **Gigawatt hour (GWh):** A gigawatt hour (GWh) is equivalent to 1,000 megawatt hours.

- **Capacity factor:** The net capacity factor is the ratio of an actual electrical energy output over a given period of time to the maximum possible electrical energy output over that period e.g. a **1MW** wind turbine may produce **2,637MWh** in a year out of a possible **8,760 MWh**, therefore its **capacity factor is 2,637/8760 = 30.1%**, which is a typical value for modern wind turbines. For solar panels the typical capacity factor is less than **26%**. For new coal, gas and nuclear power stations the typical capacity factor is **90%** or more, which is why they are the backbone of most of the electricity systems throughout the world (refer chart below).

- **Artisanal:** Made in a traditional way by someone who is skilled with their hands; in this paper it refers to Cobalt mining done by hand.



Estimated or actual annual output in MWh = Capacity factor % x (capacity MWac x 24hrs x 365 days)

Appendix B: Abbreviations

Acronym	Description
AC or ac	Alternating current (e.g. 240Vac electricity supply to homes)
AEMO	Australian Energy Market Operator
CCGT	Closed Cycle Gas Turbine, also known as Combined Cycle Gas Turbine
CCGT-CC	Closed Cycle Gas Turbine with Carbon Capture
CO2	Carbon Dioxide (colourless gas making up 0.04% of the Earth's atmosphere)
C-W REZ	Central-West Renewable Energy Zone
DC or dc	Direct current (e.g. 12Vdc car battery)
EPA	Environmental Protection Agency
EU	European Union
GW	Giga Watts (equals 1000 megawatts)
GWh	Giga Watt hours (equals 1000 megawatt hours)
Ha	Hectares (1 hectare equals approximately 2.471 acres)
IEA	International Energy Agency
IEGP	Industrial Electricity Generating Plant (excludes roof-top solar and domestic wind turbines)
IPCC	Intergovernmental Panel on Climate Change
ISP	Integrated System Plan (Annual plan issued by AEMO)
Kg	Kilograms (equals 1000 grams)
Km2	Square kilometres (one Km2 equals 100 hectares or about 247 acres)
KV	Kilovolts (equals 1000 volts)
KW	Kilowatt (equals 1000 watts)
KWh	Kilowatt hours (e.g. household electricity is billed as cents per KWh)
LCOE	Levelised Cost of Electricity (a method of expressing $/ MWh over a period of time)
Mj	Mega joule (a measure of energy equals one million joules or 0.27778 KWh)
MW	Megawatt (equals 1000KW or 1,000,000 watts)
MWh	Megawatt hour (equals 1000KW hours)
NEM	National Energy Market (covers QLD, NSW. ACT, Vic, Tas, SA; excludes WA & NT)
NF3	Nitrogen Trifluoride (a very potent colourless greenhouse gas)
PV	Photovoltaic
SF6	Sulphur Hexafluoride (a highly potent **human-made** colourless greenhouse gas)
t	Ton or short ton (equals 2000 pounds; used by USA)
T	Tonne or metric ton or long ton (equals 1000kg or 2240 imperial pounds)
TW	Terawatt (equals one million megawatts)
TWh	Terawatt hour (equals one million megawatt hours)
VALCOE	Value-adjusted Levelised Cost of Electricity (developed in 2019 by IEA to reflect more of the revenue timing and costs associated with renewables)

Appendix C: Save our surroundings (in pictures)

This

or This over hundreds of km2 for decades instead?

This

Or This over hundreds of km2 for decades?

This

This

Or This over hundreds of km2 for decades instead?

None of these local animals can get though a PV solar IEGP fence

Like this

From:	noreply@feedback.planningportal nsw.gov au
To:	DPE Energy and Resources Policy Mailbox
Subject:	Webform submission from: Revised Large-Scale Solar Energy Guidelines
Date:	Friday, 25 February 2022 12:16:12 PM
Attachments:	20220224-cotton-australia-sub-draft-updated-solar-guidelines.pdf

Submitted on Fri, 25/02/2022 - 12:14

Submitted by: Anonymous

Submitted values are:

Submission Type
I am submitting on behalf of my organisation

Name

First name
Jennifer

Last name
Brown

I would like my submission to remain confidential
No

Info

Email
[redacted]

Suburb/Town & Postcode
Mascot

Submission file
20220224-cotton-australia-sub-draft-updated-solar-guidelines.pdf

Submission
On behalf of Cotton Australia please find attached our submission on the revised guidelines

I agree to the above statement
Yes

24 February 2022

Matthew Riley, Director – Energy and Resources Policy
Department of Planning and Environment
Locked Bag 5022 Parramatta NSW 2124

Electronically via https://www.planningportal.nsw.gov.au

Revised Large-Scale Solar Energy Guidelines

Dear Mr Riley,

Cotton Australia is the national peak body representing up to 1,500 cotton growers and ginners across 152 rural communities, the majority (approx. 66%) are in New South Wales. Notably, 90% of cotton operations are family farms that also grow other crops like sorghum, soybeans, wheat, and have livestock. While cotton production does vary considerably from season to season, the crop generates between $1.5 and $2.5 billion for the annual national economy.

Our members recognise the benefits of increasing the amount of energy generated from renewable and low carbon technologies to secure energy supply, reduce greenhouse emissions and stimulate investment in new jobs and business. They also farm and operate gins within two of NSW's Renewable Energy Zones.

We therefore welcome the opportunity to comment on the Revised Large-Scale Solar Energy Guidelines and firstly state, as per our previous submissions: it is Cotton Australia's view that high value agricultural land is protected from the installation of large-scale solar infrastructure period, and hence this document should be mandatory not optional. Let not the brief nature of this submission detract from this important starting planning principle.

COTTON AUSTRALIA LIMITED
Head Office Suite 4.01, 247 Coward St, Mascot NSW 2020 Australia
Phone + 61 2 9669 5222
Brisbane Level 3, 183 North Quay, Brisbane QLD 4000
Toowoomba Unit 3, 6 Rutledge St, Toowoomba QLD 4350
Narrabri Level 2, 2 Lloyd St, Narrabri NSW 2390
ABN 24 054 122 879
www.cottonaustralia.com.au

Cotton Australia recognizes the potential energy and economic benefits that large-scale solar projects can provide. At the same time, we also consider both protecting high-value agricultural land and preserving the amenity of traditional cotton growing regions to be of utmost importance.

In that respect, we note the guidelines go some way to address impacts on the productive value of the agricultural land for the owner of the proposed solar installation site and, to some degree, its agricultural neighbours. However, there is no mention of considering the intrinsic value they place on the existing state of the proposed location. For instance, the cumulative impact of this particular project to the adjacent landscape, neighbours and community raises questions such as:

- Is this project going to be 'yet another installation' in a district where there are already a number?
- Will its presence have insurance or valuation impacts for adjoining properties during the 25 years of operation, and be an impediment to activities the owners have planned for (farm stays or farm gate produce sales)?
- Does the 'open space' actually have, at the present time, a beneficial purpose for productive agriculture or the community and despite the absence of infrastructure? The land may be more than just 'empty', rather:
    - purposedly planted with introduced species or set aside, as it hosts native species
    - a refuge of useful insects and bats that feed on pests and weeds in adjacent perennials, or
    - a biosecurity measure to reduce dust and noise etc. entering the agricultural land, such as from neighbours or adjacent transport corridors

Cotton Australia suggests this be resolved by including the land use principle "agent of change" in both 5.3. Agricultural land use conflicts discussion and in Appendix B, Agriculture Impact Assessment Requirements for Large-scale Solar Energy Development. The principle was most recently described in the NSW Agricultural Land Commissioner's "Improving the Prospect for Agricultural and Regional Australia in the NSW Planning System" paper:

> The agent of change principle is an established principle in land use planning but is not always applied in practice. The principle places the onus on proponents of new developments to recognise and mitigate any potential impact that their development may impose on, or experience from, the normal and legal operations of existing land uses in the vicinity. This is commonly seen in residential development where neighbouring properties cannot be built in a way that impacts solar access of neighbouring properties and is also applied in Victoria around music venues and managing noise complaints (p27)

Specific to Appendix B, we note some of the hyperlinks to the NSW DPI documents cited on p9 have incorrect address details.

Cotton Australia acknowledges the revised document now has more explicit commentary about decommissioning and rehabilitation issues, as well as expectations. It is particularly pleasing to see the inclusion of these two key principles in 5.5.2

> Dot point 1
>
> The land on which large-scale energy projects and supporting infrastructure is developed must be returned to pre-existing use if the solar energy project is decommissioned.
>
> Dot point 3
>
> Land must be rehabilitated and restored to pre-existing use, including the pre-existing land and soil capability class if previously used for agricultural purposes

Cotton Australia has advocated for some considerable time that the land concerned is all of the community's asset, which is being 'loaned out' during the life of the solar facility. If we can make a further refinement, it would be to include a final sentence to 5.1.1

> I.e. following current last sentence
>
>> Solar energy projects are able to be decommissioned and rehabilitated without any long-term impacts on the land, including soil fertility.
>
> Insert
>
>> "Doing so respects the landholder and community's ability to continue to derive benefit (cultural, aesthetic, or economic) from it and addresses aspects of the solar industry's social-licence-to-operate."

Our final observation relates to the future ability of the solar proponent or future owner to conduct this decommissioning and rehabilitation. It is Cotton Australia's recommendation that security deposits and bonds are used to secure decommissioning activities for large scale solar facilities, similar to those required for mining projects. Also, that the quantum of security held is adequate and it needs to be reassessed during the project's life, particularly in light of the risk of future insolvency of a company.

If you would like more information concerning the matters raised in this submission, please do not hesitate to contact me on 02 9669 5222 or jenniferb@cotton.org.au.

Yours sincerely,

Jennifer Brown

Jennifer Brown
Policy Officer
Cotton Australia

From:	noreply@feedback.planningportal nsw.gov au
To:	DPE Energy and Resources Policy Mailbox
Subject:	Webform submission from: Revised Large-Scale Solar Energy Guidelines
Date:	Friday, 25 February 2022 4:12:53 PM
Attachments:	walchaenergy-submission-solar-energy-guidelines-25-2-2022.pdf

Submitted on Fri, 25/02/2022 - 16:11

Submitted by: Anonymous

Submitted values are:

Submission Type
I am submitting on behalf of my organisation

Name

First name
Mark

Last name
Waring

I would like my submission to remain confidential
No

Info

Email
[redacted]

Suburb/Town & Postcode
Walcha

Please provide your view on the project
I support it

Submission file
walchaenergy-submission-solar-energy-guidelines-25-2-2022.pdf

Submission
Please see the submission letter with comments.

I agree to the above statement
Yes

WalchaEnergy Pty Limited ACN 629 271 969
PO Box 641 GLADESVILLE NSW 1675

25th February 2022

Mr Matthew Riley
Energy and Resources Policy
Department of Planning, Industry and Environment
Locked Bag 5022
Parramatta NSW 2124

Attention: Matthew Riley,

Draft Large-Scale Solar Energy Guideline

WalchaEnergy thanks the department for the opportunity to submit this feedback for your consideration in finalising the Draft Large-Scale Solar Energy Guidelines for NSW.

Walcha Energy, a joint venture between Energy Estate and Mirus Wind, is developing the Walcha Energy Project, situated within the New England Renewable Energy Zone in northern New South Wales. It comprises more than 4GW of wind, solar, pumped hydro and battery storage projects. Due to the scale and density of the proposed projects, the overall development is a mini-REZ within the recently declared New England REZ. The Salisbury Solar Project near Uralla is one of the WalchaEnergy projects. It has submitted its Scoping Study and we are now working through the EIS.

Since 2004 we have been attempting to master plan its development so as to deliver the high quality renewable energy resources of the Walcha plateau to the NEM in a manner that is win-win for all parties, including residents and wider community, those affected by the prospective grid connections and the state of New South Wales as well as providing generously for affected land owners and their neighbours and protecting the environment.

We welcome the NSW Electricity Roadmap and the declaration of the New England REZ. We believe that these guidelines will provide clarity for the developers, landholders and neighbours for large scale Solar Projects in NSW in balancing the needs of all stakeholders and broadly support these draft guidelines. We would like to comment on some specific details of the guidelines.

Visual Assessment Framework

The draft visual assessment approach as outlined in the guideline will provide much greater objectivity to an issue that is prone to the subjective view of the observer. Having some quantifiable measures that can be included in the early design and the project approval processes will provide much more certainty for all stakeholders. We support this approach.

It is not clear in the descriptions of the process that there is a distinction between associated and non associated dwellings. Non associated dwellings should not be included in the Second Stage – Detailed Assessment process nor any dwellings with a negotiated agreement.

Agricultural Impact Assessment

Whilst we can understand the approach that has been taken to assess the possible capacity of the land for agricultural purposes by using soil mapping it does not take into account the actual current use of the land by the landholder. For most landholders agriculture is their business and they make assessments about what would provide the most value to them. We consider that they have the opportunity to assess in detail the actual condition of the soil and potential land use much better than a desktop analysis. The actual current use of the land should be the driving determinant in considering land use not the theoretical use.

The integration of ongoing agricultural use of the land with a solar project is very important as it will provide a much better outcome for the landholder and the broad community. There are now many examples where this has happened, as described in the Clean Energy Council – Australian Guide to Agrisolar for Large-Scale Solar (Clean Energy Council – March 2021).

Agricultural uses such as cropping and cattle grazing are difficult to co exist with solar projects. The best results for the integration of agriculture and solar projects is with grazing of sheep. Should the current land use and intended future use predominantly centre on grazing sheep then the detailed soil type analysis described in the draft should not be required. The current agricultural value of the land is maintained not diminished.

Yours faithfully,

MARK WARING
Director
WalchaEnergy Pty Limited

m 0407 812 053
e mark.waring@walchaenergy.com.au
www.walchaenergy.com.au

From:	noreply@feedback.planningportal nsw.gov au
To:	DPE Energy and Resources Policy Mailbox
Subject:	Webform submission from: Revised Large-Scale Solar Energy Guidelines
Date:	Friday, 25 February 2022 10:08:20 AM
Attachments:	mdeg-submission-large-scale-solar-farms.pdf

Submitted on Fri, 25/02/2022 - 10:06

Submitted by: Anonymous

Submitted values are:

Submission Type
I am submitting on behalf of my organisation

Name

First name
Rosemary

Last name
Hadaway

I would like my submission to remain confidential
No

Info

Email
[redacted]

Suburb/Town & Postcode
Budgee Budgee NSW 2850

Please provide your view on the project
I am just providing comments

Submission file
mdeg-submission-large-scale-solar-farms pdf

Submission
Mudgee District Environment Group (MDEG) supports the guidelines with some improvements that relate to local community needs around solar projects, outlined below.

I agree to the above statement
Yes

mdeg
mudgee district
environment group

PO Box 114, Mudgee NSW, 2850
contact@mdeg.org.au
http://mdeg.org.au

Matthew Riley

Director – Energy and Resources Policy

Large-Scale Solar Draft Guidelines

Thank you for the opportunity to provide feedback on the NSW Government's draft large-scale solar guidelines. Mudgee District Environment Group (MDEG) supports the guidelines with some improvements that relate to local community needs around solar projects, outlined below.

Our group reviewed the Guidelines, and as we considered our response we also reviewed a suggested template submission written by RE-Alliance. We found we were in agreement with their template and have copied it here under our own banner. Please consider this as a discrete and unique submission from MDEG.

Land Use

It's critical to balance the needs of food production and biodiversity protection, with the need for clean, cheap energy and with the benefits that large scale renewables bring to host landholders and regional communities.

Where high-value agricultural land is used by solar developers, the project should always be designed for dual use, enabling farming to continue under panels. For example, offering agistment for sheep grazing, horticulture or growing pollinator habitat(p 35).

While the guidelines should protect the utility of high-value agricultural land, solar farms should be planned on cleared sites and avoid clearing remnant or high-value vegetation, where possible. The guidelines should protect against land clearing for solar developments, which will be opposed by environmental groups and local communities.

Community consultation including community mapping to identify sites of high agricultural, environmental or cultural value is key to identifying local perceptions of the agricultural value of the land, in combination with traditional measures of agricultural value. (p 2 Appendix B)

First Nations

The Guidelines must uphold best-practice engagement and benefit-sharing with First Nations peoples, to ensure proponents embody the principles of free, prior and informed consent of Traditional Owners.

Appropriate care and consultation must be taken with local First Nations groups and restrictions placed on renewable energy developments impacting First Nations cultural heritage.

Representative local First Nations Working Groups are creating general and region-specific engagement and benefit guidelines for NSW Renewable Energy Zones. These should be utilised by all developers, including those outside of designated REZs.

Neighbours

All levels of Agricultural Impact Assessments should include consultation with neighbours of host landholders as a minimum. (p 6-8 Appendix B)

The Guidelines recommend assessing impacts on neighbour properties, however, the impact of insurance on neighbours should be identified in all Levels of Assessment. An outline of how an increase in premiums will be mitigated by the proponent should be included in the assessment.

Visual Impact Mitigation

RE-Alliance notes the mitigation measures provided for proposals with moderate or high visual impacts on pages 14-15 of Appendix A. We support options such as:

- Re-siting or removing arrays
- Re-sizing
- Vegetation screening
- At-source mitigation and
- Negotiated agreements

With regards to vegetation screening, we agree that vegetation screening can take many years to establish and during drought conditions may not achieve optimal growth or have the desired screening effect. We support the use of appropriate plant species that are suited to the environmental conditions (for example, drought-tolerant native species if relevant), sufficient irrigation (e.g. six months) and if possible, of suitable maturity to provide maximum screening effectiveness in the shortest possible time.

Community Enhancement Funds (CEFs)

Community benefit programs should prioritise locally impacted communities in the sharing of benefits from renewable energy projects (p.37). All benefit-sharing programs should be co-designed with the local community to ensure real benefit.

Solar projects should consider three different levels of benefits: neighbour benefits for directly impacted neighbouring properties; local benefits for the town most impacted by the project, and; regional benefits for the broader region hosting the project

Community representation, including representatives from highly impacted areas, should be mandatory on committees for decision making on how CEFs are spent, no matter who is responsible for administering funds.

Voluntary Planning Agreements (VPAs)

VPAs through Councils are not the preferred mechanism to administer CEFs (p 37). CEFs should be separate from VPAs.

While VPAs should be separate from CEFs, there should also be community representatives included in early VPA negotiations between developers and Councils.

Other Types of Community Benefits

There are many types of community benefit programs beyond CEFs and VPAs. These include: local decision-making, in-kind contributions, regional enhancement funds, empowerment of First Nations communities, neighbour benefits schemes, community co-investment and co-ownership, tourism and education programs, local jobs and procurement.

Ideas and Australian examples of benefits can be found in RE-Alliance's Community Benefits Handbook: www.re-alliance.org.au/community_benefits_handbook

Local Engagement

Project proponents and government need to consider the issues of consultation burden which is already being felt in REZs.

Communities need to be valued for the time they are required to put towards contributing to various consultations, Information Days, surveys and CCCs.

Part of early benefit-sharing arrangements could include providing a fund to cover the costs of people's time when they attend particular consultation sessions.

Sincerely,

R. Hadaway

Rosemary Hadaway

Chair

Mudgee District Environment Group

25th February 2022

Mob: 0411 755 682

From:	noreply@feedback.planningportal nsw.gov au
To:	DPE Energy and Resources Policy Mailbox
Subject:	Webform submission from: Revised Large-Scale Solar Energy Guidelines
Date:	Friday, 25 February 2022 10:34:28 AM
Attachments:	waternsw-submission---solar-energy-guidelines-feb-2022.pdf

Submitted on Fri, 25/02/2022 - 10:33

Submitted by: Anonymous

Submitted values are:

Submission Type
I am submitting on behalf of my organisation

Name

First name
Alison

Last name
Kniha

I would like my submission to remain confidential
No

Info

Email
[redacted]

Suburb/Town & Postcode
Parramatta 2750

Please provide your view on the project
I am just providing comments

Submission file
waternsw-submission---solar-energy-guidelines-feb-2022.pdf

Submission
Please see attached correspondence

I agree to the above statement
Yes

PO Box 398, Parramatta NSW 2124
Level 14, 169 Macquarie Street
Parramatta NSW 2150
www.waternsw.com.au
ABN 21 147 934 787

25 February 2022

Contact: *Stuart Little*
Telephone: *0436 948 347*
Our ref: *D2022/11702*

Mr Matthew Riley
Director, Energy and Resources Policy
Planning & Assessment
Department of Planning, Industry and Environment
Locked Bag 5022
Parramatta NSW 2124

Dear Mr Riley

RE: Exhibition of the Revised Large-Scale Solar Energy Guideline

I refer to the public exhibition of the Revised Large Scale Solar Energy Guideline (the Guideline), which provides guidance on the planning framework and issues to be addressed in the assessment and determination of large-scale solar energy projects under the *Environmental Planning and Assessment Act, 1979* (EP&A Act). We note that key updates include the areas of visual impact assessment, agricultural land, contributions and voluntary planning agreements, and guidance for the assessment of glint and glare.

WaterNSW has an interest in the Guideline as we have a number of renewable energy projects in preparation for our land including utility-scale solar energy developments. The proposed amendments will influence how solar energy proposals are planned and assessed on our land.

We believe the Guideline is largely comprehensive, clearly written and easy to understand. It also follows a logical format and structure which is easy to follow. The document will assist applicants, stakeholders and decision-makers in the planning and assessment of soil energy projects.

We make the following comments:

- The Guideline (Section 1.3.1; p. 3) discusses Renewable Energy Zones, which seek to expand transmission and generation capabilities in strategic areas across NSW. The Guideline could also more broadly explore approaches for large-scale solar to co-exist with other renewable and energy storage technologies. This could include designs that allow for multiple technologies and which optimise energy storage close to sources of energy generation, thereby minimising energy losses over distance.
- The new 'regional cities' provisions of the Infrastructure SEPP are discussed on pages 22-23. This includes for new development to avoid significant land use conflicts with existing or approved residential or commercial uses and to not significantly adversely impact a regional city's capacity for growth or scenic quality and landscape character. The dot points listed should also mention that the consent authority must consider measures that are proposed to be included in the development to avoid or mitigate conflicts or adverse impacts. This would also encourage proponents to take into account mitigation measures in the location and design of solar energy developments. The Guideline may also benefit by specifically referencing clause 39A of the Infrastructure SEPP to guide proponents to the relevant provisions.

- Section 5.5 (p. 38) discusses decommissioning and rehabilitation. As this is the last step in the process, it would be better positioned after Section 5.6 Waste Management.

- While the document advocates measures to ensure water supply and prevent water pollution (p. 23), there is limited guidance on soil and water management. We suggest that the wording on water management under Section 5.7 (p. 40) is expanded to include reference to stormwater impacts and related management measures. Consideration also needs to be given to ground disturbance activities, specifically as it relates to the installation of the solar arrays, transformers and associated buildings. This section should also identify how buildings, equipment foundations and footings can change the surface conditions and surface water flow paths. We suggest that the Guideline cross-reference the Managing Urban Stormwater: Soils & Construction (4th edition, Landcom, 2004) (Blue Book) as referenced in the Infrastructure SEPP.

- There is also little to no guidance on siting arrangements with respect to waterways, including advice for solar energy developments to avoid drainage features, drainage lines and waterways. The consideration of flooding risks could also be expanded to seek that such developments generally avoid floodplain areas that can be periodically flooded. Groundwater considerations are currently lacking, and the Guideline may benefit by directing solar energy related developments away from areas with high water tables.

- While soil information is provided throughout the document, the information mainly relates to agricultural values, soil fertility and the assessment of soils. The detail is provided in Appendix B – Agricultural Impact Assessment with a heavy emphasis on soil analysis relative to Land and Soil Capability Class. The consideration of geotechnical aspects of soils and their constraints to the solar energy development is almost absent. We also note that the consideration of soils is also absent from Section 5.7 (Other Assessment Issues).

  We suggest soil constraints and management be included as a separate topic under Section 5.7 with guidance offered on identifying soil hazards, constraints, impacts to soils generated by solar-related development, and associated controls. This could include identifying risks from soil sodicity (dispersive soils), salinity (which may affect concrete and durability of structures), erosion hazards (proximity to gullies) and drainage features, and reference the need for geotechnical investigations irrespective of the land use zoning. Soil compaction issues are also likely to be relevant, given that the emplacement of solar arrays may result in localised soil compaction, which in turn can affect rainfall infiltration and flow directions and intensity of sheet-wash and lead to increased overland flow and sheet erosion.

- Under section 4.1 (p. 26) the last sentence does not make sense and warrants correction.

Please note that any solar energy development in the Sydney Drinking Water Catchment is required to have a neutral or beneficial effect on water quality as required under State Environmental Planning Policy (Sydney Drinking Water Catchment) 2011 (SEPP). Development in the catchment also requires the concurrence of Water NSW under the SEPP unless it is State Significant Development.

Should you have any questions regarding comments raised in this letter, please contact Stuart Little at stuart.little@waternsw.com.au.

Yours sincerely

Daryl Gilchrist

DARYL GILCHRIST
Manager Catchment Protection

From:	noreply@feedback.planningportal nsw.gov au
To:	DPE Energy and Resources Policy Mailbox
Subject:	Webform submission from: Revised Large-Scale Solar Energy Guidelines
Date:	Friday, 25 February 2022 1:48:44 PM
Attachments:	220225_spark-renewables-submission_draft-large-scale-solar-energy-guidelines.pdf

Submitted on Fri, 25/02/2022 - 13:47

Submitted by: Anonymous

Submitted values are:

Submission Type
I am submitting on behalf of my organisation

Name

First name
Will

Last name
Stone

I would like my submission to remain confidential
No

Info

Email
[redacted]

Suburb/Town & Postcode
Manly 2095

Please provide your view on the project
I support it

Submission file
220225_spark-renewables-submission_draft-large-scale-solar-energy-guidelines.pdf

Submission
Please find submission attached

I agree to the above statement
Yes

25 February 2022

Matthew Riley, Director – Energy and Resources Policy
Department of Planning, Industry and Environment
Locked Bag 5022 Parramatta NSW 2124
Via online submission

Submission: Draft Large-Scale Solar Energy Guidelines

Dear Matthew,

Spark Renewables Pty Limited (Spark Renewables), is pleased to provide a submission in response to the New South Wales Department of Planning, Industry and Environment's ("DPIE's") Draft Large-Scale Solar Energy Guideline (the "Draft Guideline").

Spark Renewables is a developer, long-term owner, and operator of renewable energy projects in the National Electricity Market (NEM), with a development portfolio in excess of 3GW, consisting of wind, solar, and storage projects, as well as operational portfolio consisting of the Bomen Solar Farm (100MW).

Spark Renewables is part of the Spark Infrastructure Group – an owner of essential energy infrastructure, including generation, transmission, and distribution infrastructure across Australia, with an investment portfolio comprising ownership in 15% of Transgrid, 49% of Victoria Power Networks, and 49% of SA Power Networks.

Large-scale solar will play a crucial role in New South Wales' transition to secure, reliable, and affordable clean energy. Spark Renewables appreciate the Draft Guideline highlights the need for large-scale solar to continue to be developed in an equitable and efficient way, providing positive outcomes for developers, stakeholders, and communities.

Spark Renewables is grateful for the opportunity to provide feedback on the Draft Guideline, from the perspective of a project proponent. We are supportive of the detailed breakdown, illustrative tools, and prescriptive approach which will ensure more consistency in large-scale solar assessment. As part of our review of the Draft Guideline, we have undertaken trial assessments using the tools provided and discussed the tools with specialist consultants to inform our comments, as outlined below.

2.2.1. Landholder consent

- It is important to distinguish between Crown leasehold land (e.g. Western Plains Lease) and Crown/paper roads which are often found on rural properties. Crown/paper roads are either closed or a licence is required to be obtained to utilise and construct infrastructure on the land. The process is time consuming and is completed after development consent has been granted. It is not practical to seek Crown consent for lodging a development application, and these small parcels of land should not delay the lodgement of a development application.

5.2. Glint and glare management

- The main issue is that the brightness of glare is not considered in the Guideline, and is not well defined, which will cause difficulty when predicting the impact of the glare. Experienced glare consultants that have conducted a large number of assessments for Australian solar farms have traditionally used the Sandia Labs SGHAT Ocular Plot criteria for Aviation Glare and the "Threshold Increment (TI)" value Road and Rail Disability Glare and Residential Nuisance Glare, the TI Value is calculated as the ratio of "veiling" luminance (e.g. from reflection) to the overall average background ("adaptation") luminance. In Australia, a TI of 2-3 has been used at critical locations such as pedestrian crossings when conducting building reflective glare studies and this conservative value has been used as a useful benchmark for solar assessments of Residential Nuisance Glare by these consultants. If a threshold is not set for any of the relevant glare conditions of concern (aviation, road and rail, residential), this may result in any reflection being considered glare, no matter how low the brightness, which presumably is not the intended outcome of the draft guideline. We therefore submit that DPIE should apply a brightness criterion threshold into its definition of glare, as appropriate for Aviation Glare, Road and Rail Disability Glare, and Residential Nuisance Glare, or alternatively, where no generally acceptable criterion is available (as in the case of Residential Nuisance Glare) to request Proponents (or their consultants) to suggest one.

- The assessment of glint and glare up to 4km seems somewhat arbitrary. It is possible that the solar farm can be viewed from this distance and that reflections could also be seen. However, any reflection would be low in brightness and not necessarily classed as glare. We consider that assessing glint and glare from this distance to be a less accurate and burdensome requirement. It also has potential to set an unreasonable understanding and expectation that glint and glare may be able to be seen from 4km's in most cases. We therefore suggest that it should be amended to 3.25km, consistent with the visual amenity assessment requirements.
- We submit that the criteria in Table 3 should clearly state "X mins per day and Y hours per year". Currently the criteria implies that either/or situation would classify as the corresponding level of glare. This outcome would result in an exceedingly low threshold, as it would not be difficult to exceed the 10 mins per day threshold at some dwellings, but it may only occur a few times per year. An alternative would be to replace the criteria table is replaced with a simple matrix where impact increases as a function of mins per day (x axis) vs hours per year (y axis), similar to a risk management matrix (likelihood vs consequence).
- It is our understanding that Internationally, and certainly in Australia, any reflection of the sun where the viewing angle of the sun is no greater than 10 degrees from the viewing angle of the object (in this case, the solar farm) is not considered to be glare. We submit that this convention should be recognised and adopted in the Revised Guideline.
- We suggest the inclusion of an index or scale to quantify glare events, as not all software use the same methods to calculate and/or quantify glare.

5.3 Agricultural land use

- Spark Renewables acknowledge the complexity and competing land use issues surrounding proposals of large-scale solar farms on high quality agricultural land, as well as the concerns and perceptions from communities that arise as a result. Existing land use and agricultural land quality is a key consideration, among others, that determine site suitability. We understand land uses will need to be balanced appropriately for the NSW Govt. to meet its renewable energy goals.
- A concern with the use of land classifications as suggested by the Guideline is that existing landscape scale land and soil capability assessment categories often do not reflect actual local conditions. The relative agricultural productivity of different paddocks and properties, particularly at granular levels, does not always align with the Land and Soil Capability Classes ("LSCC").
- Moreover, the Draft Guideline provides considerable weighting on soil type and the data collected as part of a soil survey, in comparison with other factors that influence agricultural productive capacity. Soil quality is also not static, being influenced by management practice, seasonal conditions, and amelioration options, for instance, liming for acid soils. The actual productive capacity is included by local rainfall, in paddock soil constraints, or waterlogging issues.
- Spark Renewables believe there should be an option for proponents to adopt a conservative view and accept the designated land classification (e.g. LSC 1-3). This would allow the proponent to bypass the requirement for a soil test but still proceed under the "Level 3 detailed assessment" pathway.
- It is also important to note that solar farming and agriculture are not mutually exclusive and that multi-use of the site is possible and increasingly common, as acknowledged by the Draft Guideline. Evidence is emerging that there are not significant drops in agricultural productivity, especially in the cases of properties that were originally grazed. Therefore, we submit that the first principle listed in section 5.3.2 should include the words

“where possible”. That is, “siting of solar energy projects on important agricultural land should be avoided *where possible*”.

Appendix A: 3. Visual assessment approach

3.1.1. Step 1 - Preliminary Assessment Tool

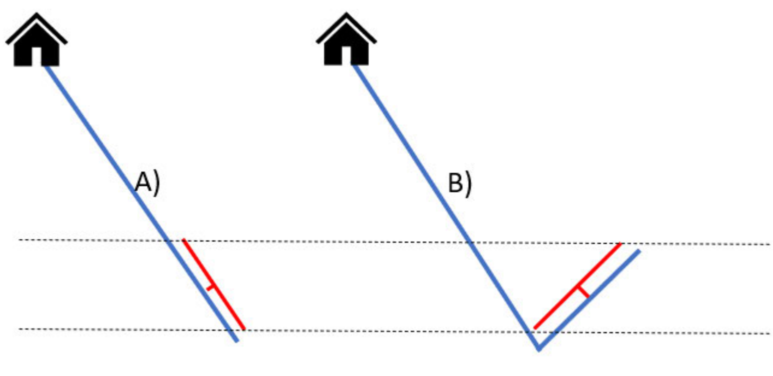
- The following sentence needs to be better defined with examples and diagrams: ‘*determine the height difference between the array and each viewpoint. This is calculated as the height difference between the project and the viewpoint plus the height difference from the lowest point on the project area to the highest point on the project area, including the height of the PV panels*’.
- Please provide the equations that describe the tools: *Figure 2. Preliminary Assessment Tool* and *Figure 4. Visual Magnitude Tool 1 – Vertical magnitude zones*.
- Some of the mitigation criteria proposed in Table 6 is concerning, especially the target of 75% efficacy in screening the PV array. It is also not clear whether this 75% target is screening of the entire PV array or the section that is theoretically visible. Also, it is not possible to use landscaping to screen views from day 1 of operations due to the time required for this vegetation to grow. No timeframe is given in this table.

3.1.2. Step 2 - Viewshed mapping

- Please specify conditions for the viewshed analysis: relative viewpoint height, refraction, maximum/minimum angles, maximum radius.
- Please specify whether temporary infrastructure, as construction compounds, must be included in the analysis.
- Please specify the minimum elevation contour resolution required for the analysis.

3.2.2. Step 2 - Visual magnitude

- We appreciate the simplicity of the calculation of the horizontal magnitude and the explanation and illustrations provided, however the sectors are defined somewhat arbitrary. As an example, let’s assume a scenario where a receiver sees three 1 m^2 areas in three different 30-degree sectors. The method over quantifies the overall impact to the receiver. We suggest revising this procedure by dividing the horizontal sectors in 1 degree and update the Visual Magnitude Tool to an equivalent value, i.e. one 30° visible sector is equivalent to 30 or less 1° sectors, two 30° visible sectors are equivalent to between 31 and 60 one degree sectors, etc. The visual assessment does not consider the slope of the land and its influence on what proportion of the solar farm is visible from the receiver. The figure below shows two examples with the same high/low heights and distance of the visible array, the Preliminary Assessment Tool and the Vertical Magnitude Zone would provide the same result, while the actual visual impact is significantly different. The height difference equation should include the visual area of the array, defined by the area of the array multiplied by the projection of the normal orientation of the array to the receiver-array orientation, to weight the impact of visibility.



3.2.4. Step 4 – Visual Impact Assessment

- What encompasses a "dwelling" the primary orientation of the living area could be better defined. It would be useful to insert a definition, otherwise this is left to the interpretation of landholders and assessors. For example, should outdoor living areas such as the porch, external swimming pool or the front/back yard be included in the analysis?

Thank you for the opportunity to provide feedback on the Draft Guideline. Please don't hesitate to contact me if you have any questions about this submission.

Will Stone
Head of Development
Spark Renewables
will.stone@sparkrenewables.com

From:	noreply@feedback.planningportal nsw.gov au
To:	DPE Energy and Resources Policy Mailbox
Subject:	Webform submission from: Revised Large-Scale Solar Energy Guidelines
Date:	Friday, 25 February 2022 3:44:58 PM
Attachments:	submission large scale solar.pdf

Submitted on Fri, 25/02/2022 - 15:40

Submitted by: Anonymous

Submitted values are:

Submission Type
I am submitting on behalf of my organisation

Name

First name
Elizabeth

Last name
O'Hara

I would like my submission to remain confidential
No

Info

Email
[redacted]

Suburb/Town & Postcode
2350

Please provide your view on the project
I am just providing comments

Submission file
submission large scale solar.pdf

Submission
Mat hew Riley, Director – Energy and Resources Policy
Department of Planning, Industry and Environment

Dear Mr Riley,

Thank you for considering the New England Greens Armidale Tamworth submission contained in the attached file.

Elizabeth O'Hara,
Co-convenor, New England Greens Armidale Tamworth.

I agree to the above statement
Yes

Submission: draft Large-Scale Solar Energy Guideline

Thank you for the opportunity to provide some comments on the NSW draft Large-Scale Solar Energy Guidelines.

Below are some suggestions about how to make the draft even better, so that it provides even greater benefits for both the communities that host large scale solar installations, and the whole of NSW.

1.1 Need better objectives, e.g. sustainable solar industry generating widespread benefits

The Guideline should aspire to do more than just support '*the development of a sustainable solar industry by providing a consistent and responsive policy framework.*'

There is tremendous interest in NSW's Renewable Energy Zones (REZ), which have the potential to create win-win outcomes for local communities, including low-cost power to soak up surpluses when generation exceeds transmission capacity, local jobs to take advantage of the local power that will boost the local economy, other community benefits to help attract workers to the area, and at the same time create a renewable energy powerhouse that substantially reduces global warming.

Over half of NSW's emissions will be offset by the New England REZ. The 8 GW of renewable energy in the New England REZ will offset 57.4 million tonnes of CO2-eq, over half the total emissions of NSW (111.3 million tonnes, latest Climate Snapshot data, July 2019-June 2020). The Guideline should recognise the importance of this contribution, and work with local councils to identify how benefits can accrue to local communities and the region. It is estimated that the New England REZ will attract $10 billion worth of investment and generate power worth over $30 billion.

Recommendation: replace the first two objectives with:

- Support the development of a sustainable solar industry in NSW that will generate widespread benefits for local communities as well as the whole of NSW, while having minimal environmental impacts and providing lower-cost renewable power.
- Ensure best practice community engagement.
- Provide a clear, consistent and responsive policy framework that encourages industry to consult with the local community and local councils, enabling suitable sites to be selected for projects, and avoid or reduce the likelihood and extent of land use conflicts and environmental and social impacts.

1.3.1. Renewable Energy Zones

The draft New England North West Regional Plan discusses the infrastructure required for REZ and also that the REZ should aim for *"a balance between attracting investment and considering the interests of the community.*"

The costs of infrastructure can be excessive, amounting to many millions of dollars, e.g. maintaining roads that serve regional areas. The community's interest would not be well served if large scale solar developers did not contribute their fair share of the costs, commensurate with the value of development.

When there are many more expressions of interest for developments in a REZ than available capacity, good planning requires that applications are assessed on all aspects of the development, including benefits and value to the community, so that the best ones can be chosen according to their environmental soundness, visual amenity and community benefits, as well as commercial considerations.

Recommendation: include the advice in the New England North West Regional Plan that REZ should aim for *"a balance between attracting investment and considering the interests of the community*" and that developers should contribute their fair share of the costs of maintaining infrastructure commensurate with the value of the development. The Guidelines should also mention that, when there are many more expressions of interest than available capacity, applications should be assessed on their environmental soundness, community benefits and visual amenity, so that those with the greatest merit and value to both NSW and the local community can be chosen.

3. Community and stakeholder engagement

Armidale Regional Council's draft ***Community Engagement and Benefit Sharing for Renewable Energy Projects Policy*** states: "*Armidale Regional Council expects developers of energy projects to deliver authentic community engagement that goes beyond compliance level requirements and seeks to actively involve community members in the design and decision-making process of new developments. Engagement should start early in the site feasibility stage and continue through the entire life of the project, including decommissioning. As a host community of a NSW Renewable Energy Zone (REZ), Armidale Regional Council seeks to strategically guide development to maximise community benefit, engagement and create positive lasting outcomes in a manner which minimizes cumulative impacts of multiple new energy developments, for both the community and investors alike.*"

Best practice engagement, such as that described above, helps create win-win-win outcomes that benefit the developer, the local community and, by generating clean, renewable energy that should drive down power prices, all of NSW.

Recommendation: The Guideline should describe and recommend best practice community engagement (including establishing Community Consultative Committees) to ensure that the resulting developments benefit the local community and so create harmony and widespread community support.

4.2 Site Selection

Table 1 (Key factors to be considered during site selection) states that "Siting of solar energy infrastructure should avoid important agricultural land (Section 5.2) ... The compatibility of a solar energy project with existing agricultural land uses should also be considered including whether the project can be co-located with existing uses." It would be helpful to mention examples of agricultural operations that can co-exist with solar farms, e.g. agistment for sheep grazing and horticulture.

5.4.1. Infrastructure contributions and Voluntary Planning Agreements

Recommendation: The larger the project, the greater its impact on the environment and the local community. Consequently, the cap of $450,000 on section 7.12 levies is inappropriate and should be removed. As implied by their name, Voluntary Planning Agreements are voluntary, so should be left to the discretion of the developer and the local council. It is inappropriate for the Guideline to limit or constrain them.

5.4.2. Benefit sharing and agreements

Recommendation: The Guideline should note the win-win outcome of local communities supporting developments from which they will benefit. Consequently, all projects should have benefit-sharing agreements based on a levy of at least 1% of the capital investment value (CIV) of the project. The levy should be paid into a fund administered by the local council with the help of a community consultative committee.

5.5. Decommissioning and rehabilitation

As stated in the Guidelines: *"Land must be rehabilitated and restored pre-existing use, including the pre-existing land and soil capability class if previously used for agricultural purposes."*

Recommendation: The financial assurances (that the Guideline recommends should be dealt with in commercial arrangements outside of the planning system) should include appropriate bonds and rehabilitation funds similar to those applied to extractive industry projects.

From:	Barker, Leigh
To:	DPE Energy and Resources Policy Mailbox
Cc:	Kaitlyn Lieschke; Matt Riley - Planning; Australian Energy Infrastructure Commissioner
Subject:	Australian Energy Infrastructure Commissioner - Submission to Draft Large-Scale Solar Energy Guideline [SEC=OFFICIAL]
Date:	Friday, 25 February 2022 4:19:04 PM
Attachments:	220225 - AEIC - Submission to NSW Revised Large-scale Solar Energy Guide....pdf National Wind Farm Commissioner 2020 Annual Report - 31 March 2021 - FIN....pdf Landholders Agreement Matters to Consider - Australian Energy Infrastruc....pdf

Good Afternoon

Please see attached our Office's submission on the Draft Large-Scale Solar Energy Guideline.

We look forward to arranging a time with you to discuss further.

Regards

Leigh Barker
Office of the Australian Energy Infrastructure Commissioner
PH: 1800 656 395 I PO Box 24434, Melbourne VIC 3001
D: (03) 9960 7303 I M: 0409 095 450 I www.aeic.gov.au

OFFICIAL

25 February 2022

Matt Riley
Director, Planning and Assessment
NSW Department of Planning, Industry and Environment
Locked Bag 5022
PARRAMATTA NSW 2124
via email: energy.resourcespolicy@dpie.nsw.gov.au

Dear Mr Riley

Re: NSW Government: *Draft Large-Scale Solar Energy Guideline*

The Office of the Australian Energy Infrastructure Commissioner welcomes the opportunity to provide feedback on the NSW Government Draft Large-Scale Solar Energy Guideline.

The Australian Energy Infrastructure Commissioner fulfils a national, independent role in Australia's energy sector and responsibilities include:

- facilitating the handling of complaints from concerned community residents about planned and operating wind farms, solar farms (5 MW or more), energy storage facilities (1 MW or more) and new large-scale transmission projects
- identifying and promoting best practices for industry, government and related agencies to adopt with regard to the planning, operation and governance of such projects, and
- improving information access and transparency about proposed and operating projects, and relevant government and industry information more broadly.

Our Office appreciates the opportunity to provide input into the draft guidelines. Our overall recommendations can be found in the Commissioner's 2020 Annual Report to the Federal Parliament, available at: https://www.aeic.gov.au/publications/2020-annual-report.

We would be pleased to arrange a meeting with you and your colleagues to discuss our detailed observations and recommendations.

In particular, the key topics we would like to explore further with you include:

- ***Community and stakeholder engagement*** – Section 3 of Appendix A (pages 34-38) of our 2020 Annual Report includes a number of observations and recommendations for government and industry proponents in relation to community engagement.
- ***Site selection*** – there may be opportunities to refine the process of project site selection, including introducing a top-down integrated approach, licencing for prospectors, consideration of pre-approval requirements for grid connection, avoiding areas that are in close proximity to significant landmarks, such as World Heritage sites, National Parks etc. For further information regarding site selection, see Section 8 of Appendix A (pages 57-60) in our 2020 Annual Report.

- ***Decommissioning, disposal and rehabilitation*** – in particular, we would encourage that permit conditions and landholder agreements provide certainty and clarity in managing and funding asset end-of-life decommissioning and land rehabilitation responsibilities. There is also an emerging need to ensure solar farm assets can be properly disposed of or recycled (e.g. disposal and recycling of solar panels). Funding of solar farm decommissioning costs may need a structured trust fund, or other type of security, in order to minimise risk to landholders in the event of proponent default. For further information, see Section 1 of Appendix A (pages 22-30) on host landholder matters in our 2020 Annual Report and also our Guideline '*Considerations for Landholders before entering into Commercial Agreements*', available at: https://www.aeic.gov.au/publications/considerations-landholders-entering-commercial-agreements

- ***Safety and emergency management*** – Our Office strongly recommends a transparent process to report safety incidents at renewable energy facilities. Section 7 of Appendix A (pages 53-57) of our 2020 Annual Report includes a number of observations and recommendations on safety and emergency management, including a number of proactive measures to improve bushfire and emergency management plans and procedures.

- ***Expert Reports*** – our Office considers that assessment or expert reports submitted by proponents, such as hydrology reports and soil erosion and sediment control plans, should be reviewed and assessed by an independent auditor before adopting the report. For further information, see Section 6 of Appendix A (pages 51-53) on expert assessments in our 2020 Annual Report.

- ***Visual Amenity impacts*** – we agree that that the introduction of a visual assessment framework will be useful in providing some key parameters for assessing visual amenity impacts for affected neighbours and communities. Our Office notes that there can be some challenges in mitigating visual impacts from solar farms – for example, proposed vegetation screening may not be effective for several years and, in some cases, the screening can 'block out' the positive amenity of the broader landscape view.

- ***Setback distances*** – Section 5 of Appendix A (pages 43-50) of our 2020 Annual Report includes several observations and recommendations on setback distances for various infrastructure, including solar arrays and powerlines connecting the solar farm to the grid. This includes recommendations for setback distances from residences, roads, property boundaries and townships.

Further information

For reference, we have included a copy of our 2020 Annual Report and also our Landholder Guideline that have been referred to in the above comments.

Thank you again for the opportunity to make a submission to this review. We look forward to discussing these matters with you and your colleagues in further detail.

In the meantime, if you have any questions about this submission or require additional information, please contact us via email at aeic@aeic.gov.au or on 1800 656 395.

Sincerely

Andrew Dyer
Australian Energy Infrastructure Commissioner

Office of the National Wind Farm Commissioner

Annual Report

to the Parliament of Australia

ANNUAL REPORT
Year Ending: 31 December 2020

Office of the Australian Energy Infrastructure Commissioner

30 April 2021

The Hon Angus Taylor MP
Minister for Energy and Emissions Reduction
Parliament House
CANBERRA ACT 2600

Dear Minister

Re: 2020 Annual Report of the Office of the National Wind Farm Commissioner

Pursuant to the National Wind Farm Commissioner's Terms of Reference, I am pleased to provide the 2020 Annual Report to the Australian Parliament on the activities of the Office of the National Wind Farm Commissioner.

This report covers the Office's activities for the period of 1 January 2020 through to 31 December 2020. We again include a number of observations about the governance, development and operation of wind and solar farm projects along with recommendations for consideration.

This is the final report issued as the National Wind Farm Commissioner as the role title is now known as the Australian Energy Infrastructure Commissioner.

I look forward to discussing the report with stakeholders in due course.

Sincerely

Andrew Dyer
Australian Energy Infrastructure Commissioner

PO Box 24434, Melbourne VIC 3001
1800 656 395
www.nwfc.gov.au

ISBN: 978-1-922125-91-0

Disclaimer

CONTENTS

COMMISSIONER'S REVIEW

Introduction

The Office of the Australian Energy Infrastructure Commissioner is pleased to deliver the Commissioner's fifth annual report to the Australian Parliament, which covers the Office's activities for the period of 1 January 2020 to 31 December 2020.

The Commissioner is independent and reports directly to the Minister for Energy and Emissions Reduction.

Our key roles are to:

- facilitate the referral and resolution of complaints received from concerned residents about proposed or operating wind farms, large-scale solar farms (5 MW or more) and energy storage facilities such as large-scale batteries (1 MW or more)
- provide and promote greater transparency on information related to wind farms, large-scale solar farms and energy storage in Australia, and
- identify and promote best practices related to the planning, development and operation of renewable energy projects, including standards and compliance, complaint handling procedures and community engagement.

There are no formal powers associated with the Commissioner's role. The Commissioner relies on effective relationships and the co-operation of a wide array of stakeholders to facilitate the complaints handling process and the identification and adoption of best practices recommendations.

The Year in Review

2020 was a challenging year, with the global outbreak of the COVID-19 pandemic affecting how we lived and worked for much of the year. While tremendous progress has been made in containing the virus outbreaks in Australia, we expect 2021 to still be a cautious journey ahead.

For our Office, it was business as usual. Most of the year we worked from home-based offices, heavily utilising video conference platforms and satellite image tools to conduct our duties. We have a national responsibility and were already well accustomed to working with community members and stakeholders using electronic mail, video-conference and teleconference facilities.

However, our ability to undertake site visits was significantly curtailed and remains a challenge in 2021 while the possibility of unforeseen state border closures, enforced with very short notice, remains.

Large-scale renewable energy capacity has continued to grow in 2020. We understand that at least 21 large-scale renewable projects were commissioned during the year, including five large-scale wind farm projects and 16 large-scale solar farm projects, with a further 76 large-scale projects in construction or awaiting commissioning at the end of the year.

The Clean Energy Regulator (CER) has reported that, since January 2016, more than 19 GW of renewable energy projects are either generating power or in the project pipeline, including 12,599 MW of accredited projects, 3,342 MW of projects that are now committed, and 3,238 MW of projects still awaiting financial close.

We received 163 new complaints during the year, more than double the number of complaints received during 2019 and the highest total number of complaints per year since the inception of the Office.

The Office has now received a total of 524 complaints since commencing in November 2015.

Consistent with recent years, the majority of complaints received during 2020 were in relation to proposed wind farms (including projects under construction), with only eight complaints relating to operating wind farms. We received no complaints about solar farm proposals or energy storage projects during the period.

Many complaints were a result of community concerns arising from new proposals. In particular, wind farm sites proposed within existing forest plantations across Queensland, Victoria and Tasmania have generated specific community concerns to be addressed. Other types of complaints prevalent in 2020 related to commercial agreements, visual amenity impacts, statutory planning processes and ineffective community engagement. The analysis of complaints received throughout 2020 is available on pages 7-14 of this report.

Despite the travel restrictions, the Office also continued to participate in community meetings, including Community Consultative Committee meetings and Council meetings, to discuss various local issues and how they can best be addressed. We continued to maintain and grow our large and active network of stakeholders and we continue to be invited to engage with various groups to share our best practices advice regarding community engagement and complaint handling. Further information on the Office's stakeholder engagement and advocacy activities are discussed in pages 15-19 of this report.

Finally, this report includes a synopsis of some of the key reforms and issues that the Office has identified and been engaged in during 2020. These include legislative and regulation reforms being implemented as a result of our recommendations and advocacy, in particular related to wind farm noise regulation and compliance.

We have also identified and raised concerns regarding work place safety as a result of a sharp increase in incidents over the past year. Our efforts have resulted in a much more transparent approach by industry to immediately share safety incident alert data, along with root cause analysis and corrective actions, across all industry members.

This transparency should vastly improve industry's ability to swiftly take steps to prevent repeat incidents, as well as make safety focussed improvements to work practices through to equipment design. We have also built relationships with relevant workplace safety regulators to help ensure they are well informed and engaged with industry.

It is always pleasing to see such reforms and changes being introduced – evidence that our role and small team is making a material, constructive impact.

The Year Ahead

On 26 March 2021, the Minister announced that our role would be further expanded to include new, large-scale transmission projects and, consistent with our broader remit, changed our name to the Australian Energy Infrastructure Commissioner.

Projects include HumeLink, Project EnergyConnect, Marinus Link, Western Victoria Transmission Network Project, and Victoria to New South Wales Interconnector West. We look forward to working with that sector and affected community members, utilising our experience and best practices acquired from our work in the renewable energy generation sectors.

There have been several state and federal policy announcements in recent times relating to renewable energy. These include the release of the Australian Government's technology investment roadmap, Tasmania's 200% renewable energy action plan, Queensland's 50% renewable energy target along with Renewable Energy Zone (REZ) announcements in Victoria, NSW and Queensland. These initiatives will very much drive the agenda in 2021 and beyond and we are already well engaged in many of the programs.

The Commissioner is also a current member of various governance and reference groups, including:

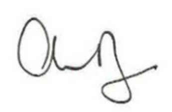
- NSW Government Currandooley Bushfire Coronial Inquiry Working Group

- Western Victoria Transmission Network Project stakeholder reference group
- Standards Australia - EL-048 Technical Committee Wind Energy Generation Systems
- NSW Government Renewable Energy Zone Reference Group, and
- Humelink Transmission Reference Group.

The Office will continue to play an important role for communities and residents affected by new and operating projects, while maintaining a strong relationship with industry, governments and other stakeholders. The Commissioner looks forward to continuing to assist in resolving complaints, promoting best practices and increasing transparency within the large-scale renewable industry during this period of rapid change.

As of writing this report, we have returned to our office in Melbourne after approximately twelve months of working from home. We will carefully monitor ongoing impacts of COVID-19 restrictions with anticipation of re-commencing interstate site visits and face-to-face meetings with stakeholders during this year.

Finally, we would like to take this opportunity to thank all of our stakeholders for continuing to work effectively with us throughout what has been a difficult year dealing with the various challenges of the COVID-19 pandemic. We look forward to providing you with our continued support and assistance throughout 2021.



Andrew Dyer
Australian Energy Infrastructure Commissioner

OVERVIEW

Background

The National Wind Farm Commissioner is an independent role established in October 2015 by the then Minister for the Environment, the Hon Greg Hunt MP.

The role's creation was initiated by Recommendation 5 of the 2015 Senate Committee on Wind Turbines Interim Report. The Commissioner commenced the role in November 2015.

In October 2018, following a review by the Climate Change Authority, the role was extended for a further three years from the initial period and was expanded to include large-scale solar farms and energy storage facilities.

On 26 March 2021, the Minister for Energy and Emissions Reduction announced a further expansion to the role, with the inclusion of new large-scale transmission projects and changing the title of the role to the Australian Energy Infrastructure Commissioner.

The Commissioner's Terms of Reference as at 31 March 2021 are available at Attachment B and on the Commissioner's website at:

www.nwfc.gov.au/about

The finances for the Commissioner's office are managed through the Department of Industry, Science, Energy and Resources and are reflected in the Department's annual report.

Who We Are

The Commissioner is supported by a small team provided by the Department of Industry, Science, Energy and Resources. This team comprises an Executive Officer, a Complaints Officer and an Administrative Assistant.

Office Location and Contact Details

The Office of the National Wind Farm Commissioner (now known as the Australian Energy Infrastructure Commissioner) is located in Melbourne's central business district. The Office can be contacted via:

Toll-free telephone:	1800 656 395
Email:	nwfc@nwfc.gov.au
Post:	Australian Energy Infrastructure Commissioner PO Box 24434 MELBOURNE VIC 3001

COMPLAINT MANAGEMENT

Complaint Management Process

A primary function of the Commissioner's Office is to receive and refer complaints from concerned community members about operating and proposed projects and, via a voluntary process, help facilitate resolutions where practical. Information relating to the Office's complaint handling activities are detailed in this report.

Many of the complaints received can be complex, taking time to research and resolve. The Office's complaint management process has been designed to help ensure that the Office functions effectively, managing each complaint received appropriately.

It should also be noted that the Office's procedures treat a complaint from a residence as ***one*** complaint. The complaint may contain a number of issues and may involve a large volume of correspondence with the Office over long periods of time. The Office will record ongoing correspondence in the complainant's file as further information about that complaint. If the complainant lodges a complaint about a substantive new issue or a different project, a new complaint may be established and recorded by the Office.

Complaints Handling Policy

The Office's Complaints Handling Policy outlines the procedure for receiving and handling complaints. Complaints initially received by the Office are classified as an 'enquiry' and may be formally 'accepted' and progressed by the Office once sufficient information, including written consent to share information, has been provided by the complainant.

The Office is also guided by the Information Handling Policy, which outlines what information the Office collects, how this information may be disclosed as well as information on confidentiality and privacy.

These policies are available on the Commissioner's website at www.nwfc.gov.au/about

Complaint Activity

From the period of 1 January 2020 to 31 December 2020, the Office received a total of 163 complaints. The breakdown of the complaints received are as follows:

- eight matters were received relating to three operating wind farms
- 122 matters were received relating to 18 proposed wind farms
- 33 matters did not specify a particular project or development, and
- no complaints were received in relation to solar farms or energy storage developments.

From the Office's inception in November 2015 through to 31 December 2020, the Office has received a total of 524 complaints, comprising:

- 78 matters relating to 17 operating wind farms
- 356 matters relating to 58 proposed wind farms
- six matters relating to five proposed solar farms, and
- 84 matters that did not specify a particular project or development.

Of the total of 524 complaints received by the Office as at 31 December 2020, 500 of those complaints had been closed. The remaining 24 complaint matters are at various stages of the complaint handling process.

Proposed Wind Farms versus Operating Wind Farms

Figure 1 below provides information on the number of complaints the Office has received in relation to proposed and operating wind farms for the period of 1 January 2020 to 31 December 2020. Proposed wind farms are those which are at either the planning stage, have been approved by a state or local planning authority or are under construction – but not yet fully commissioned at the time the complaint was registered.

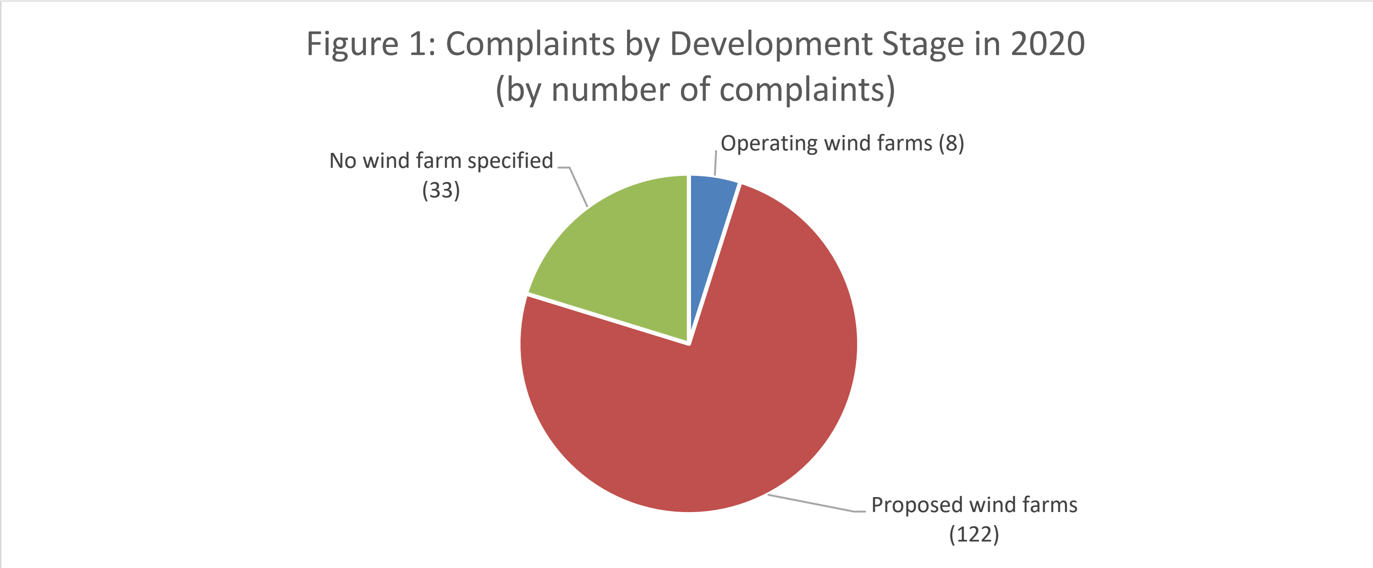
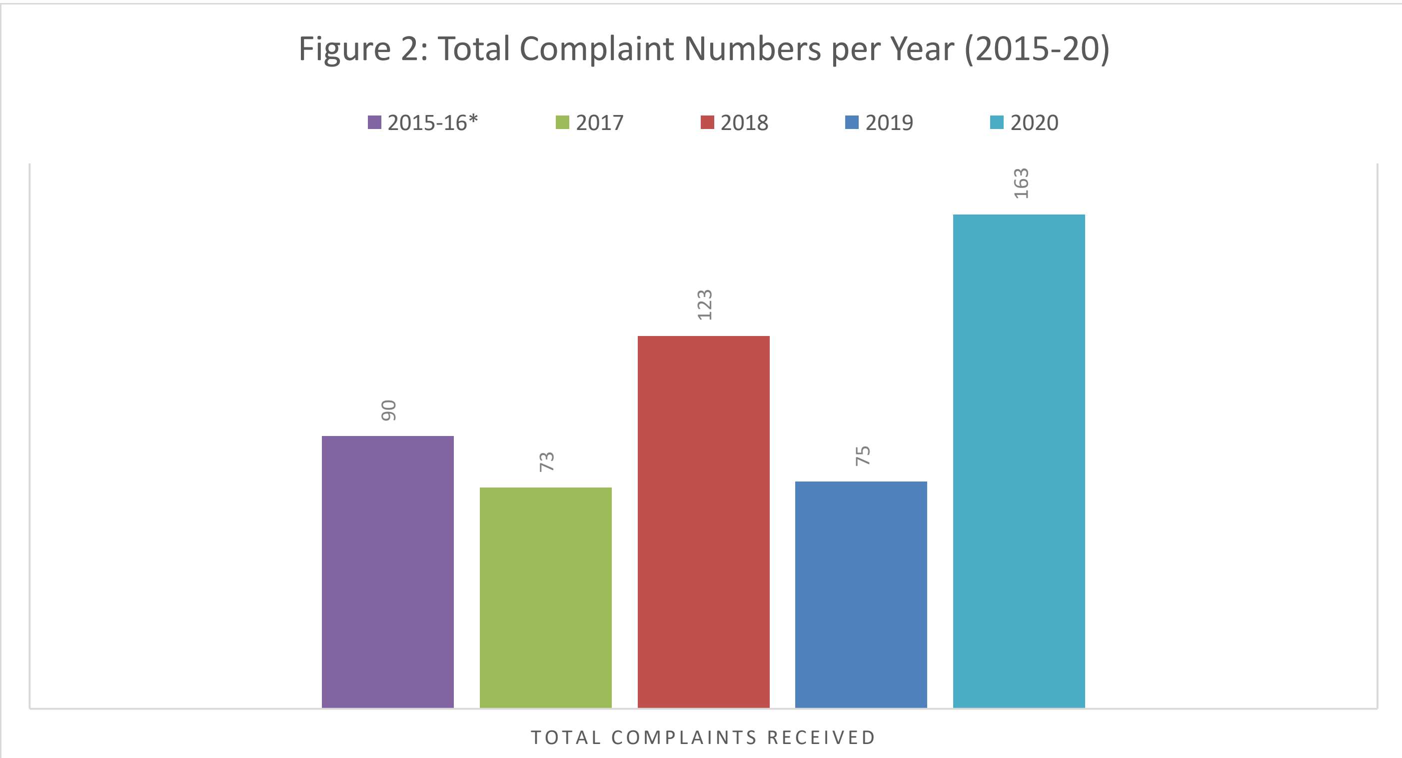
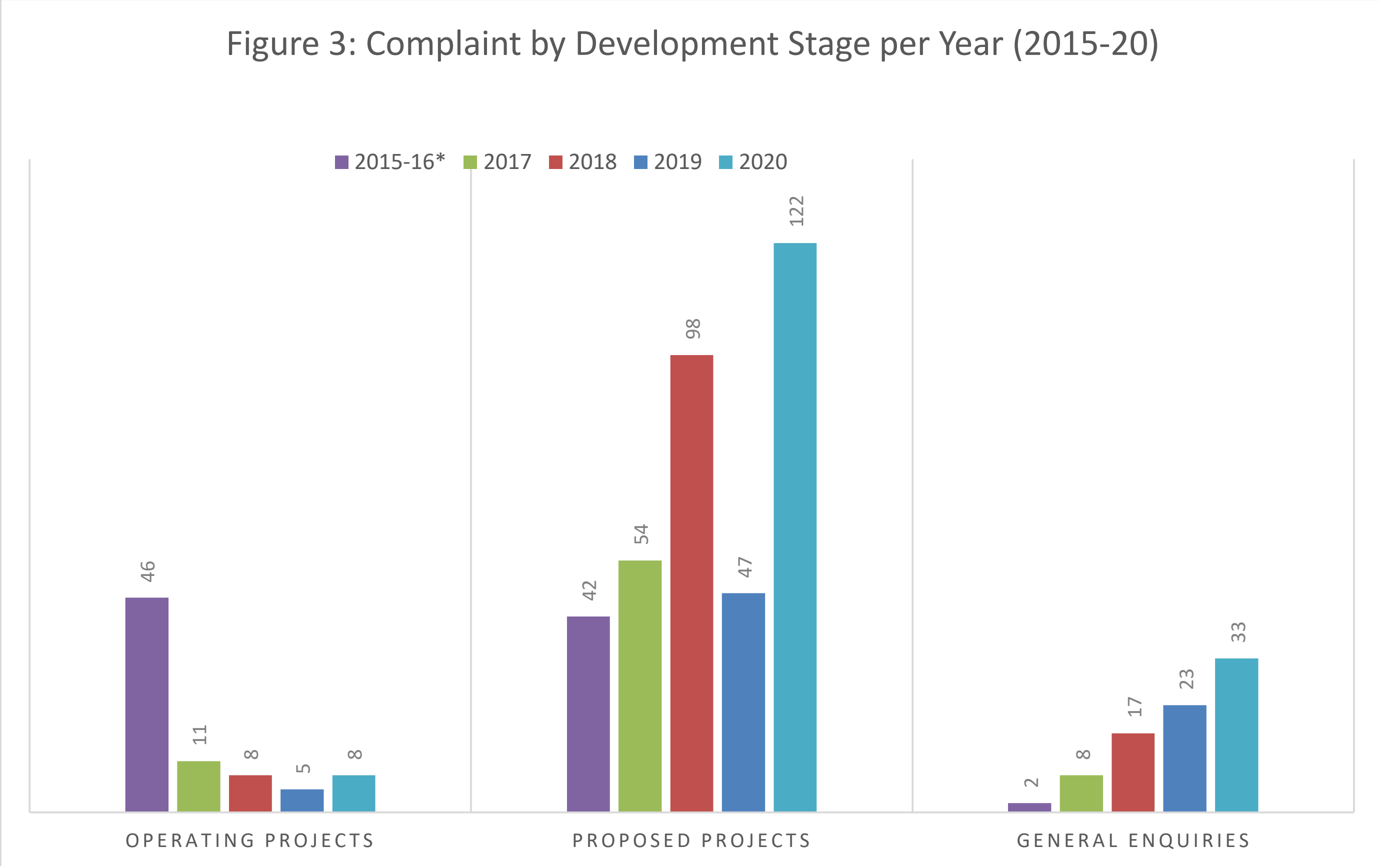


Figure 2 and **Figure 3** below provides comparative data on the number of complaints the Office has received in relation to proposed and operating wind and solar farms for each calendar year since the commencement of the Commissioner's role in November 2015.

Figure 2 illustrates the high level of complaint activity during 2020, being more than double the number of complaints than received during 2019 and the highest total number of complaints per year since the inception of the Office. **Figure 3** also indicates the ongoing trend of complaints about proposed projects remaining relatively high compared to operating wind farms. The increase in general enquiries across each year also indicates the ongoing value of the Office as an independent, reliable source of factual information.





2015-16 – refers to data collected from inception of the Office on 1 November 2015 up until 31 December 2016

Operating wind farms – overview 2015-2020

Figure 4 below provides information on the location of all complaints relating to operating wind farms by state, from the period of the Office's inception on November 2015 up to 31 December 2020.

The majority of complaints about operating wind farms are based in Victoria, although this is likely to reflect 'legacy' community issues resulting from older wind farm projects in the state, as well as projects located where the energy grid system was traditionally designed to service relatively dense regional populations.

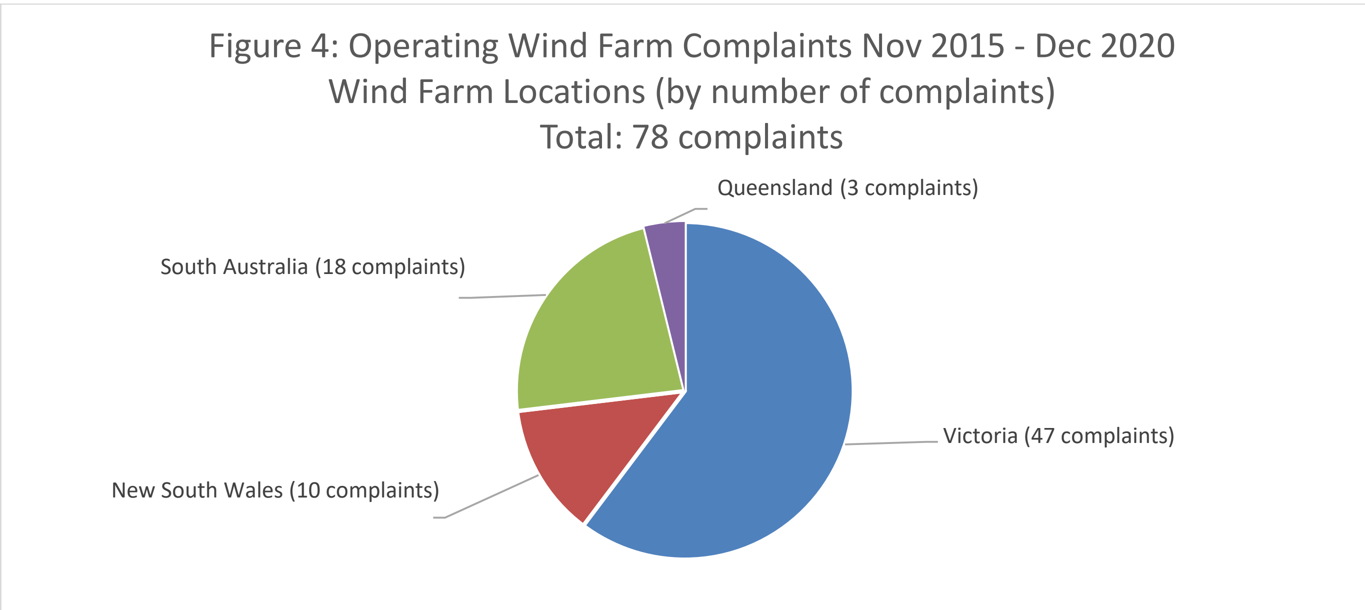
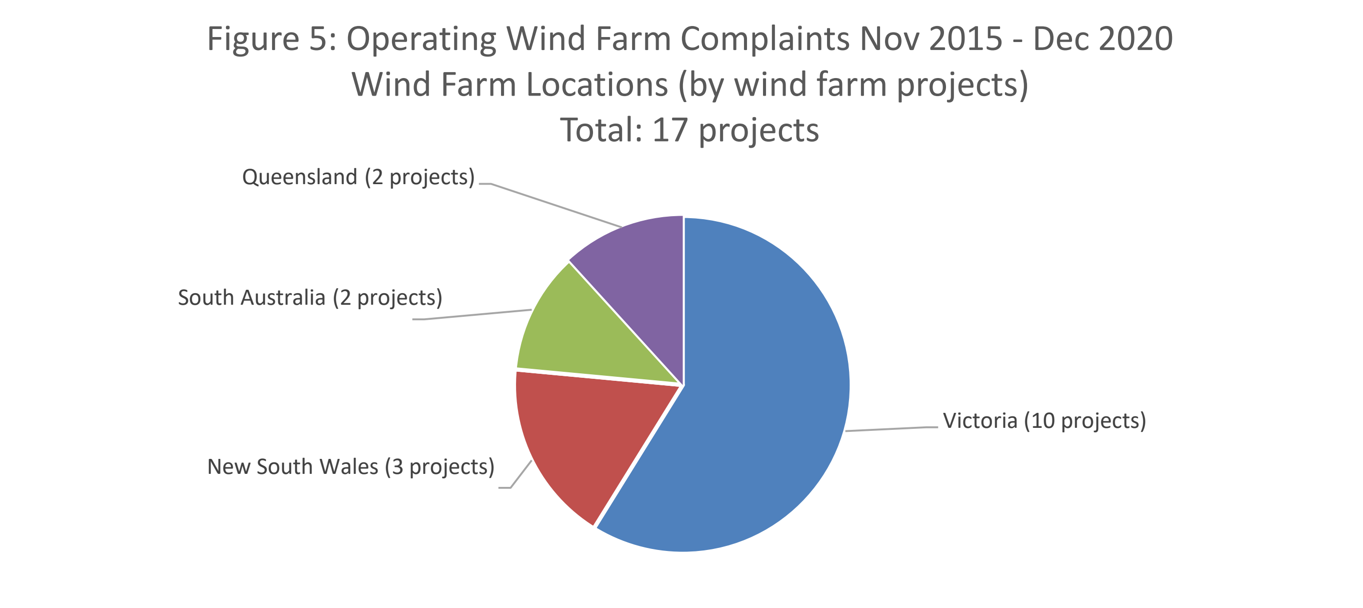


Figure 5 below provides information on the number and location of all operating wind farms, by state, for which the Office received complaints from the period of the Office's inception up to 31 December 2020. As outlined above, the majority of operating wind farms that the Office has received complaints about are located in Victoria.



Proposed wind farms – overview 2015-2020

Figure 6 provides information on the number of complaints about proposed wind farms, by state, for the period of the Office's inception in November 2015 through to 31 December 2020. **Figure 7** also provides information on the location of proposed wind farms, by state, for which the Office has received complaints from the period of the Office's inception up to 31 December 2020.

While the Office has received complaints from all states in which wind farms have been proposed, the majority of these complaints have been about proposed projects in Victoria.

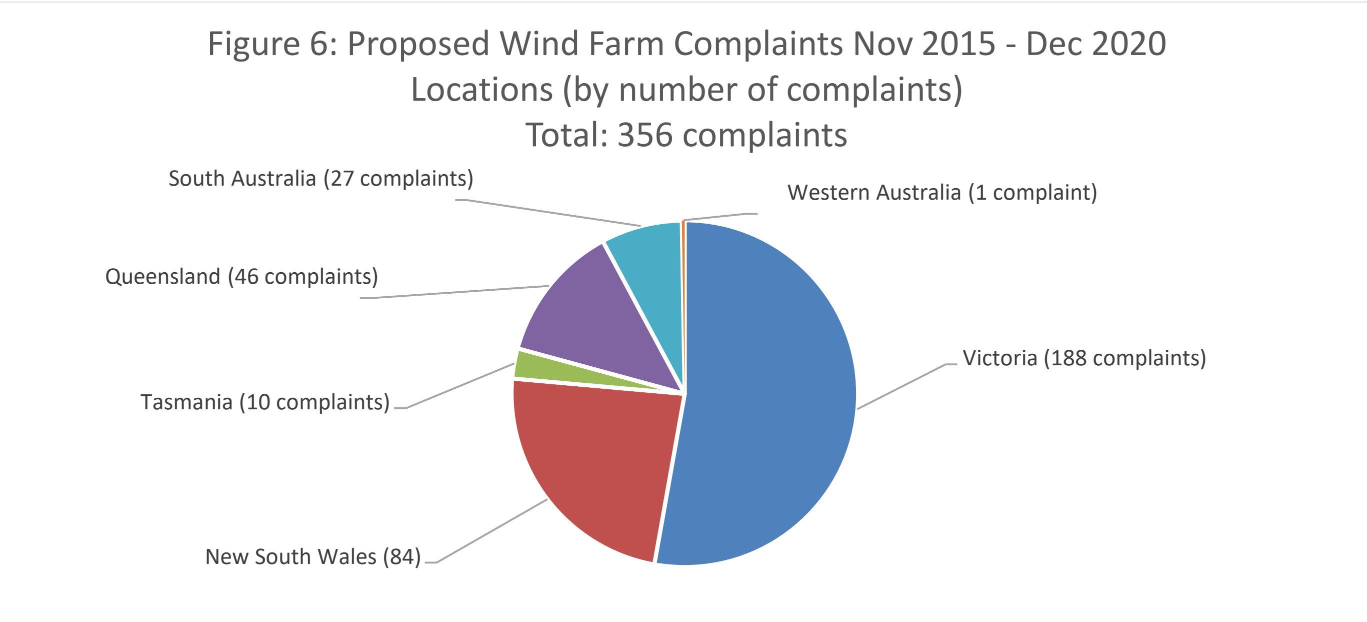
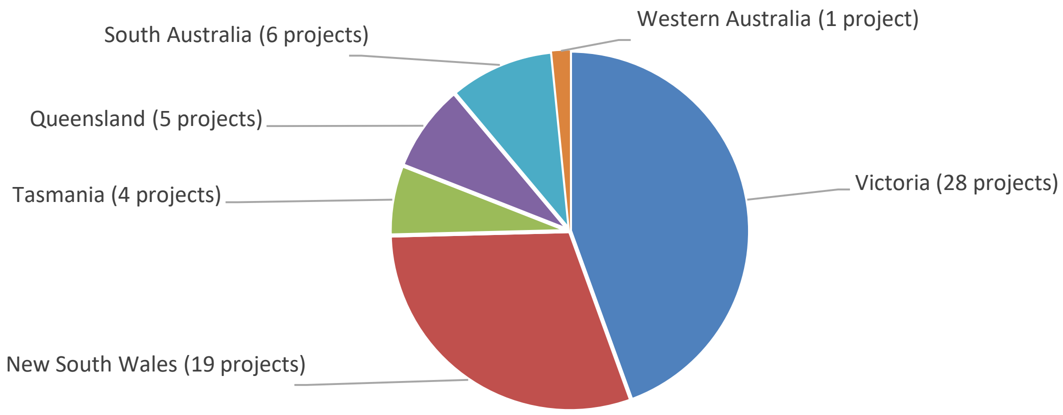


Figure 7: Proposed Wind Farm Complaints Nov 2015 - Dec 2020
Locations (by wind farm projects)
Total: 63 projects



Operating wind farms in 2020

From the period of 1 January 2020 to 31 December 2020, the Office received eight complaints in relation to three operating wind farms. As at 31 December 2020, five of these complaints were recorded as closed and the remaining three complaints are at various stages of the complaint handling process.

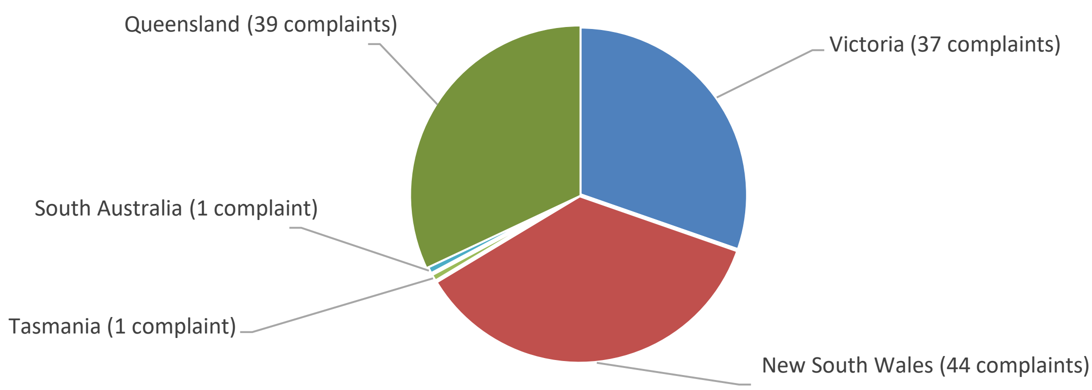
Six of these complaints related to two operating wind farms in Victoria and the other two complaints were in relation to one operating wind farm in Queensland.

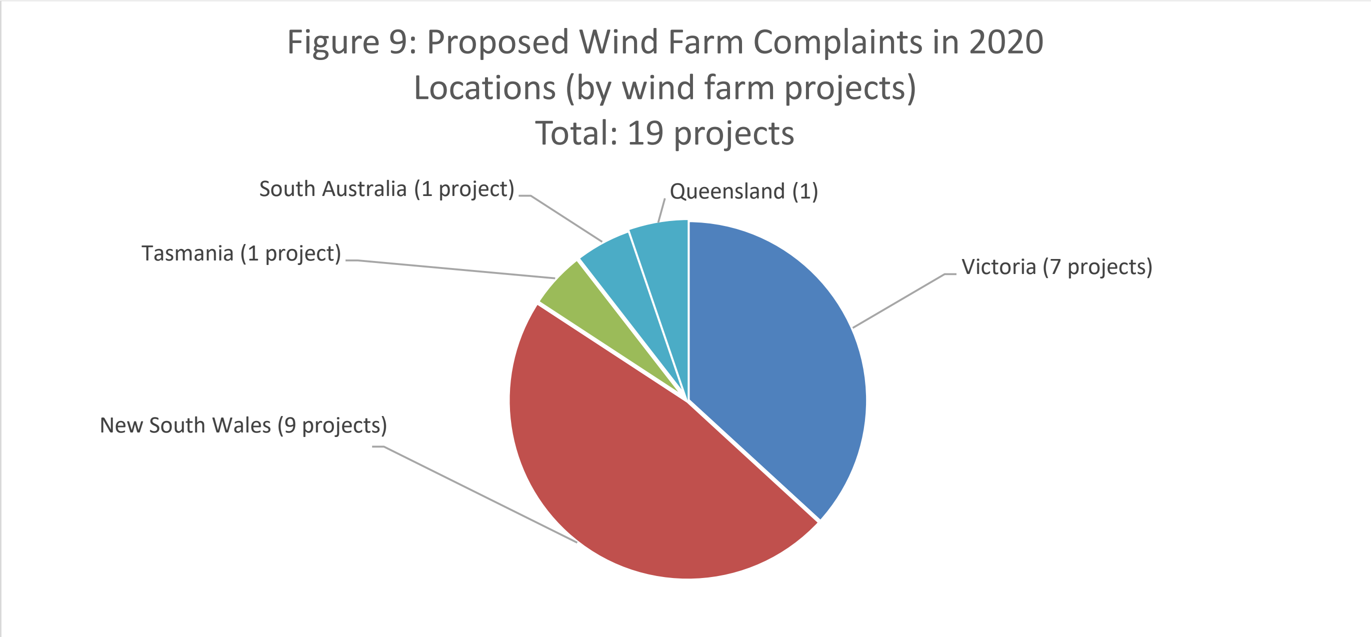
Proposed wind farms in 2020

From the period of 1 January 2019 to 31 December 2020, the Office received 122 complaints in relation to 19 proposed wind farms. As at 31 December 2020, 104 of these complaints were recorded as closed and the remaining 18 complaints are at various stages of the complaint handling process.

Figure 8 below provides information on the number of complaints about proposed wind farms, by state, for the period 1 January 2020 to 31 December 2020. **Figure 9** also provides information on the location of proposed wind farms, by state, for the period 1 January 2020 to 31 December 2020. Further detail and analysis in relation to these complaints is available on page 13.

Figure 8: Proposed Wind Farm Complaints in 2020
Locations (by number of complaints)
Total: 122 complaints





Solar farms and energy storage – overview 2018-2020

Since the Commissioner's role was expanded to include solar farms and energy storage in October 2018, the Commissioner has received a total of six complaints about five proposed solar farms. As at 31 December 2019, all of these complaints were closed and no further complaints were received in 2020. The Office has not received any complaints about proposed or operating energy storage developments.

It should be noted that some complaints received have been in relation to proposed projects that could be considered hybrid renewable projects which include wind, solar and/or energy storage facilities. In these cases, where the complaint matter is specifically in relation to the wind turbine component of the proposal, the complaint has been recorded as a wind farm complaint.

Resolutions and Closure in 2020

As at 31 December 2020, 500 of the 524 complaints received since the inception of the Office have been closed, with 24 complaints remaining open at various stages of the Office's complaint handling process.

151 complaints were closed during the period of 1 January 2020 to 31 December 2020, including 12 complaints that were lodged with the Office prior to 1 January 2020.

The majority of complaint matters were resolved in 2020 by the provision of relevant information to the complainant. This included providing factual information addressing the concerns raised or facilitating an introduction for the complainant to the appropriate contacts at the respondent organisation.

In other, more complex matters, the Commissioner worked closely with the respective parties to reach acceptable resolutions, including making specific recommendations to these parties for consideration.

Some complaint matters were closed after complainants withdrew their complaint or did not otherwise progress their complaint. This included closure of matters after a complainant would not to provide consent to share information with respondent parties or did not provide sufficient information for the Commissioner to assess the merits of the complaint. There were also a small number of matters closed which included situations in which further efforts would be unlikely to result in a resolution.

Key observations on complaint handling and issues raised in 2020

Figure 10 on page 14 provides comparative data on the types of complaint issues raised with the Office and the number of times the type of issue has been raised by complainants.

Some key observations include:

- The complaint data reflects a busy year for complaints and complaint handling, with the Office receiving more than double the number of complaints in 2020 compared to 2019.

- The small number of complaints received about operating projects could indicate that once a project is operating and construction activities have concluded, many of the concerns raised about the project prior to operations have either been resolved or did not eventuate. In some cases, it could also indicate a judgement by complainants that once a wind farm is operating, the opportunity to resolve the complaint through material changes to the project is unlikely.

- These outcomes highlight the critical importance of effective community engagement and complaint handling during the development and construction phases of the project. Conversely, there are examples when poor community engagement has led to organised opposition that has subsequently successfully resulted in a project being stopped or delayed via the planning or legal system.

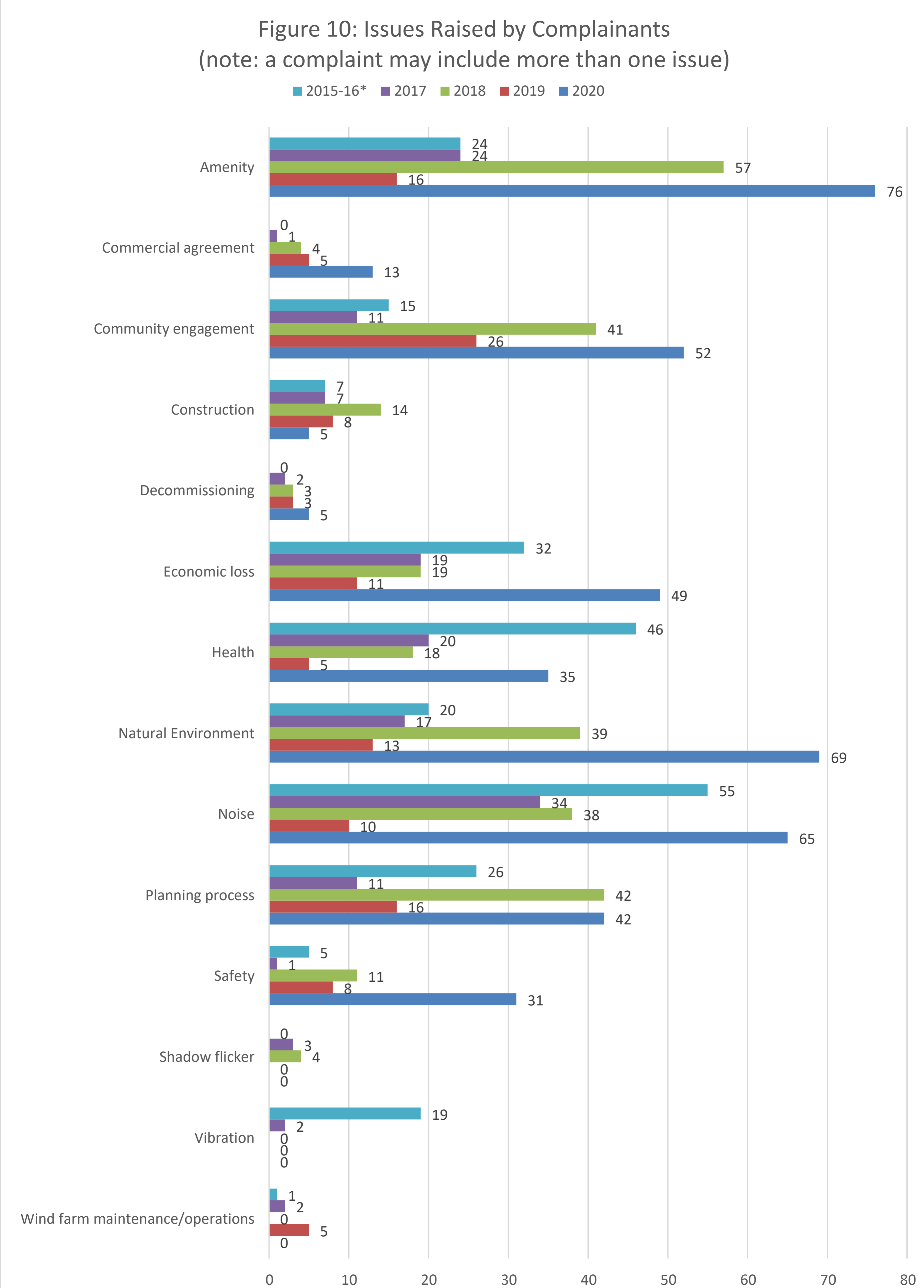
- While the breakdown of complaint issues in 2020 appears to indicate an upward trend in a number of issues raised throughout 2020, it should be noted that the Office received significantly more complaints in 2020 than in previous years. Given that eight complaints were received about operating wind farms and 122 were received about proposed wind farms, the vast majority of issues raised by complainants about health, noise, vibration, shadow flicker and economic loss in 2020 relate to concerns about proposed projects.

- A large number of complaints received by the Office relate to recently proposed projects located in commercial forest plantations. This is a first for Australia and may bring with it some new types of concerns around visual amenity, bushfire risk and environmental concerns.

- The higher complaint numbers also appear to be consistent with the increase in project development activity, with 76 large-scale projects remaining under construction by the end of 2020. Complaint issues being raised in relation to projects under construction predominantly relate to commercial agreements, disruption (vehicle movements as well as dust and noise), visual amenity, planning processes and effective community engagement.

- Complainants are now increasingly taking their complaints directly to the proponents, often because of the Commissioner’s work with proponents to improve their complaint handling procedures and transparency.

- Proponents are also seeking suggestions from the Office as to how they might handle specific complaints. This is a very effective approach to efficient complaint handling and resolutions as well as helping to build the relationship directly between the complainant and the proponent, noting that a dissatisfied complainant can always raise issues directly with the Commissioner.



2015-16 – refers to data collected from inception of the Office on 1 November 2015 up until 31 December 2016

STAKEHOLDER ENGAGEMENT

The Commissioner continues to work directly with a range of stakeholders to resolve systemic issues, complaints, provide briefings and identify needs that can be met through best practice guidance and other information. Key stakeholders include concerned and supportive community members, industry representatives, federal, state and local governments as well as experts engaged by the industry or other organisations.

The Commissioner also maintains collaborative relationships with stakeholders to encourage the adoption of best practices to address systemic issues and has engaged with stakeholders to reach positive outcomes, both for the affected individuals and facilitating improvements to governance frameworks.

Communities and residents

Despite the ongoing constraints of lockdowns and travel restrictions related to COVID-19 throughout 2020, the Commissioner continued to participate in a variety of events and meetings with community groups, Community Consultative Committees (CCC) and other liaison groups as well as committee and local government meetings, via videoconferences or other remote arrangements.

Project site visits

Since the inception of the Commissioner's role, the Commissioner has visited a total of 67 project sites (see Tables 1 and 2 on the following page). The site visits provide the opportunity to meet with concerned residents as well as directly experience the operation of the wind farm and/or the affected area. In a number of cases, largely due to complaint handling activities or ongoing systemic matters, some wind farm locations have been visited multiple times.

Industry

Throughout 2020, the Commissioner has continued to maintain a strong focus on proactively engaging with the large-scale renewable energy industry on a wide range of matters, including approaches to best practice community engagement, complaint handling and transparency of information.

The Commissioner's meetings and presentations have been crucial in proactively addressing potential community concerns in relation to particular projects or emerging issues. Ongoing engagement with industry stakeholders has been invaluable in gaining an understanding of current practices and standards as well as identifying areas where further improvements could be made by the industry.

The Commissioner has also maintained useful relationships with industry associations such as the Clean Energy Council and the Australian Wind Alliance, which has been valuable in engaging more widely with the industry on systemic and emerging issues.

Examples of activities that the Commissioner undertook in 2020 include:

- ongoing presentations and meetings with representatives of the Clean Energy Council's Wind Directorate and Utility Scale PV Directorate to discuss industry updates and best practice approaches
- meetings with stakeholders in relation to new government regulatory and policy announcements such as renewable energy zones and planning amendments
- introductory consultations with a range of new proponents to provide guidance on social licence matters and discuss new proposals and project pipelines
- appointments with various industry and developers to review projects and discuss the Commissioner's updated 2019 Annual Report recommendations, and

Table 1: List of 61 wind farm sites visited since 2015:

State	Wind farm		
Victoria (23 sites)	Alberton Ararat Bald Hills Cape Bridgewater Delburn Golden Plains Hawkesdale Hepburn	Hexham Lal Lal Macarthur Moorabool Mortlake South Mt Gellibrand Mt Mercer Naroghid	Oaklands Hill Salt Creek Stockyard Hill Toora Waubra Wonthaggi Willatook
New South Wales (16 sites)	Bango Collector Coppabella Crookwell I Crookwell II Crudine Ridge	Cullerin Range Glen Innes Gullen Range Gunning Hills of Gold Jupiter	NSW Energy Cluster Sapphire White Rock Walcha
South Australia (8 sites)	Crystal Brook Hallet Keyneton	Palmer Port Augusta Twin Creek	Snowtown Waterloo
Queensland (5 sites)	Coopers Gap High Road	Kaban Green Power Hub	Mt Emerald Windy Hill
Western Australia (3 sites)	Albany	Denmark	Mount Barker
Tasmania (6 sites)	Musselroe Robbins Island	Jims Plains Cattle Hill	St Patricks Plains Western Plains

Table 2: List of other renewable sites visited since 2018:

State	Solar farm
New South Wales (5 sites)	Jemalong CSP Pilot Plant Parkes Solar Farm New England Solar Farm Walcha Solar Farm Bomen Solar Farm
South Australia	Hornsdale Power Reserve

- ongoing meetings with industry manufacturers to discuss identified potential systemic issues and establish how learnings can be applied to the wider industry.

The Commissioner is also a member of a number of committees and industry reference groups. Further information on this is available below.

The Commissioner will maintain a strong focus on identifying opportunities for improvement as well as supporting industry to ensure that proponents are aware of best practices, affected communities are properly consulted and that project information remains transparent and easily accessible.

Government

The Commissioner continues to engage regularly with federal, state and local governments and parliamentarians to provide briefings as well as promote the adoption of best practices and reforms arising from the Commissioner's observations and recommendations.

The Commissioner maintains an extensive network of government agency stakeholders. As with the Commissioner's industry stakeholders, a large of number of agencies continue to approach the Office for advice on social licence and community engagement matters for new large-scale projects and initiatives, such as Energy Networks Australia, Energy Safe Victoria, Workplace Health and Safety Queensland, WorkSafe Victoria and the Human Rights Commissioner.

In particular, the Commissioner has been approached by a number of government agencies to seek consultation on new policy directives and announcements, such as the Victorian Government's wind farm noise regulation amendments and the newly announced Renewable Energy Zones in New South Wales and Queensland. These consultations provide a positive indication of the ongoing value, experience and reputation of the Commissioner.

The Office also provided numerous submissions on a range of relevant government reviews including regulatory guidelines, policies and processes. Some of these submissions include:

- Australian Government *Technology Investment Roadmap Discussion Paper*
- Australian Government *Independent Review of the Environment Protection and Biodiversity Conservation Act 1999*
- Australian Government Department of Industry, Science, Energy and Resources' *Offshore Clean Energy Infrastructure Regulatory Framework discussion paper*
- South Australian Government *EPA Review of the Environment Protection (Noise) Policy 2007 Discussion Paper*
- Tasmanian Government draft *Land Use Planning and Approvals Amendment (Major Projects) Bill 2020*.
- Energy Security Board's *Renewable Energy Zones* Planning Consultation Paper and Draft Rules
- Draft Tasmanian Renewable Energy Action Plan, and
- Victorian Government *Draft Brolga Assessment and Mitigation Standards for Wind Energy Facilities*.

Committees and reference groups

The Commissioner has participated in various industry and government committees to share best practice approaches and policies as well as address specific issues. The Commissioner is currently an active member of the following groups and committees:

- Clean Energy Council Safety Leaders Forum – convened by the Commissioner to discuss how industry could significantly improve transparency in relation to workplace safety incidents.
- New South Wales Currandooley Coronial Inquiry Working Group – established after a recommendation by the NSW Coroner's Office to apply the lessons learned from the Inquiry to improve bushfire risk mitigation practices in the construction and operation of powerlines connecting renewable assets to the grid.
- Victorian Government Wind Farm Noise Council Reference Group – established to assist the Victorian Government as it implements a new wind farm noise regulation framework scheduled to be introduced on 1 July 2021.
- Western Victoria Transmission Network Project Reference Group – established to provide guidance on community engagement and complaint management for this major transmission infrastructure project
- Standards Australia EL-048 Technical Committee Wind Energy Generation Systems – established to investigate internationally recognised standards as a basis for design, quality assurance and technical aspects for certification.
- NSW Government Renewable Energy Zone Reference Group, and
- Humelink Transmission Reference Group.

The Office will continue to engage proactively with the significant, complex and ever-evolving stakeholder network required for this role.

Universities and Experts

The Commissioner has continued to liaise with experts and university researchers to understand their respective roles in providing advice and research regarding wind farm design, compliance testing and health effects. Where necessary, the Commissioner also consults with experts and researchers to assist in assessing and addressing issues and complaints.

In 2020, the Commissioner undertook the following activities:

- appointments with academics from Flinders University and the University of New South Wales to discuss updates in relation to the progress of research being undertaken by two National Health and Medical Research Council (NHMRC) funded studies regarding wind farms and health, and
- presentations to the Independent Scientific Committee on Wind Turbines, including updates on the Office's activities and the Commissioner's observations and recommendations
- ongoing meetings with expert consultants in relation to a range of topics in order to gain a better understanding of matters that the Office is investigating to promote best practices.

Other stakeholders

The Commissioner's best practice expertise and experience has been of high interest to several other related sectors as they consider these matters.

As a result, the Commissioner has provided presentations and consultations in relation to community engagement, social licence and other matters with groups such as:

- Mineral Resources Council – presentation on community engagement
- Hydrogen Task Force – workshop on community engagement

- Gas Task Force – presentation on community engagement
- NSW Ports – ongoing meetings on logistics, planning and project pipelines
- various large-scale energy planning agencies.

Commissioner's Website

The Commissioner maintains a website which provides a wide range of information about the Office's activities. The website also includes the Commissioner's updated observations and recommendations.

The website includes detailed information on how to lodge a complaint with the Office, as well as the Office's contact details, policies and procedures and other forms that can be used by a complainant.

The website also provides accessible, independent and transparent information about wind farms, solar farms and energy storage projects. This includes links to resources about these industries as well as information on energy generation, health studies, emergency management, planning authorities and guidelines, compliance authority contact details and community engagement best practices.

For industry, the website provides documentation and links to improve transparency of information about wind and solar farms, best practices and complaint handling.

The Commissioner's website is available at www.nwfc.gov.au.

REFORMS AND ADVOCACY

Throughout 2020, the Office undertook a number of initiatives and advocated for a variety of reforms. Some of these reforms and advocacy are outlined below:

- Initiation of a Wind Industry Leaders Forum on safety matters, hosted by the Clean Energy Council. The purpose of this forum was to discuss strategies to improve industry transparency in relation to accidents, hazards and other incidents. Following the Commissioner's presentation at the forum, the industry leaders made a number of commitments including that, effective immediately, the industry will share and be fully transparent about safety incidents, incident root causes and corrective actions.

- Monitoring and exploring issues regarding decommissioning of wind farms, including decommissioning costs, responsibilities, risks and logistics.

- Continuing to advocate for improved oversight of third-party consultant reports following the adoption of the Commissioner's predictive noise assessment and noise testing recommendations by the Victorian Government. This includes assessments relating to matters such as aviation safety, bushfire risk, environmental impacts and traffic management.

- Continuing to work closely with industry and government to review and provide advice for best practice internal complaint handling procedures, including advocating for increased transparency and consistency with international guidelines as well as investigate options and solutions for residents, developers and third-party contractors.

- Ongoing guidance to various state and local government agencies to implement appropriate procedures for handling complaints received about nuisance allegations related to wind farms, particularly in relation to those provided for in the *Public Health and Wellbeing Act 2008* (Victoria) and the proposed reforms in relation to wind farm noise complaints under this legislation.

- Member of the Victorian Government consultative committee advising on reforms to wind farm noise regulation within Victoria, particularly in relation to the scheduled introduction of the General Environmental Duty in 2021 under the Victoria Government's incoming environmental framework.

- Recommendations made through the New South Wales Currandooley Coronial Inquiry Working Group, particularly in relation to fire safety design for private transmission lines that may connect assets such as renewable energy projects to the electricity grid.

- Ongoing consultation as a referral agency for the Clean Energy Regulator's accreditation process for large-scale renewable energy projects.

- Meetings with various state and federal departments and agencies to discuss long-term grid planning and management of cumulative impacts and other community issues across jurisdictions.

- Ongoing meetings with the Clean Energy Finance Corporation in relation to renewable project investments, including update briefings on projects and pipelines.

- Continuing to work closely with a number of wind farm developers to recommend appropriate visual impact mitigation screening solutions and approaches for residences near wind farms.

- Ongoing work with industry members to proactively identify and encourage improvements to their websites, particularly from a community member perspective, including improvements to clarify contact information, project information and updates, how to lodge a complaint to the proponent and their complaint handling process.

- Encouraging increased transparency across the industry by:

- having a greater focus on workplace safety and working with industry to agree to full transparency of reporting on safety incidents going forward
- advocating for improved transparency of information on planning processes and opportunities for public engagement
- regularly updating our observations and recommendations and making these public via our annual reports
- regularly engaging with media outlets, particularly in rural and regional areas, to provide views and insights on matters of local interest.

APPENDIX A: UPDATED OBSERVATIONS AND RECOMMENDATIONS - 2020

In previous Annual Reports, the Commissioner made a number of observations and recommendations regarding the large-scale renewable energy industry. These were derived largely based on direct experiences from handling complaints received, extensive site visits and engagement with a wide range of relevant stakeholders. These observations and recommendations covered many topics, including areas for potential improvement in the planning, governance and operation of the industry.

Our Office continues to receive feedback from stakeholders on these observations and recommendations. Much of the feedback has been very supportive and aligned with the recommendations. Constructive feedback was also received suggesting further refinements and clarifications. Further, many of the recommendations have been duly considered by the relevant stakeholders and numerous recommendations have now been implemented as a result.

The following sections are updates to our 2019 report's observations and recommendations, including additional observations since that report was published. These updates are based on our experiences from handling new complaints, further site visits and stakeholder meetings, as well as incorporating feedback received on our 2019 report.

For consistency, the following sections have utilised the same topic areas and numbering system employed in the 2019 report for ease of reference.

The recommendations detailed below are intended for consideration by the relevant stakeholders. The Commissioner has no formal powers to mandate the implementation of these recommendations. However, the Commissioner looks forward to the ongoing acceptance and adoption of the recommendations in the spirit of continuous improvement within the large-scale renewable energy industry.

Finally, as noted in previous annual reports, the large-scale renewable energy industry is still relatively new in Australia, with the first major wind farm developments commencing in the early 2000's and large-scale solar projects commencing in the last decade. However, these industries have developed rapidly, with a significant acceleration in new projects in the past few years. Opportunities still continue to exist for further improvement in the governance and operation of the industry, such as work place safety, but nevertheless, substantial progress has been made against these recommendations in recent times.

The updated observations and recommendations are also available on the Commissioner's website.

1. Host Landowner Matters

1.1. Observations

Background

Wind turbines and solar arrays are typically located on cleared primary production land owned by a landowner, often referred to as the 'host' landowner. The land's existing use is typically broad-acre agricultural production (for example, livestock or cropping). In general, a relatively small portion of the productive land is utilised for a wind farm's operation, such as turbine siting, access roads and other related assets such as transmission line easements, electrical substations, transformers and meteorological masts. The landowner usually continues to operate the agricultural production activities on the remaining land. By contrast, a solar array consumes most of the land that it resides on, with limited opportunities for co-located farming activities.

There is typically significant disruption during the construction phase of these renewable energy assets and ongoing access to the assets will be required by the operator for normal operations and maintenance.

Payments to Host Landowners

Host landowners for wind farms are typically paid a fixed amount per turbine per year under a long-term agreement (essentially a commercial lease arrangement) that mirrors the life of the wind farm – a term of 25 years with renewal options is common. The fee paid to the landowner may be a flat annual fee per turbine, regardless of size or capacity, or a fee based on the generating capacity of the turbine. The latter arrangement reflects the reality that modern day on-shore turbines have much greater capacity (now in the order of 5 MW - 7 MW) compared with turbines available previously. These changes can result in less turbines being hosted by the landowner than originally envisaged with the smaller capacity turbines. By contrast, host landowners for solar farms are generally compensated on a fixed amount per hectare leased to proponent over a similar long-term leasing arrangement.

Fee pricing can become dated, especially if a landowner has entered into a fixed annual fee agreement. An issue that has emerged in more recent times relates to wind farm agreements that may have been entered into a number of years ago with a fixed annual fee per turbine, where the turbine capacity may have been in the order of 1.5 MW to 2 MW per turbine. However, given the rapid advancement in wind turbine technology, proponents have updated their designs to take advantage of the new, larger scale and more efficient turbines – changing their wind turbine layout to deploy the contemporary technology and requiring fewer turbines to achieve the same energy output.

Many existing agreements did not contemplate the significant change in turbine capacity that has now occurred. As a result, the agreement fee per turbine payable to the landowner (based on the smaller capacity turbine) may not reflect the fee that may be more appropriate for say the much larger 5 MW to 7 MW capacity turbine. Further, the landowner’s payment may be well less than expected due to the reduction in the number of turbines now required. Landowners should check their existing agreements in this regard and also ensure any new agreements have provision to adjust the fees in the event of a turbine capacity increase and/or a reduction in number of turbines, as well as the ability to escalate fees annually with a either a fixed increase or based on the consumer price index.

There can also be a variety of arrangements regarding when the payment of fees to the landowner actually commence and cease. While this is a matter for negotiation between the developer and the landowner, it would appear that a fair and reasonable approach would be for payments to commence no later than the start of project construction and cease no earlier that the completion of decommissioning and restoration at the landowner’s property. Fees may also be payable during the development phase in consideration for the option to use the land that is granted to the proponent by the landowner.

Other fee arrangements/agreements may also be required for electrical substations, batteries, transmission line easements, access to easements, road access, transportation of blades and towers across property boundaries, location of project offices and the like. Landowners hosting these ancillary assets may or may not be wind turbine or solar array hosts, but are integral to the project.

Emerging issues include ‘blade trespass’, where a turbine blade may need to traverse a landowner’s property boundary when being transported around a bend in the road, powerline easements, where the landowner has agreed for a powerline to traverse their property for a one-time fee, and ‘sway easements’, where a powerline may sway over a landowner’s property boundary. The recent increase in blade lengths has increased the possibility of ‘trespass’ occurring. Developers and their contractors need to be cognisant of these types of issues and ensure they have appropriate agreements in place with landowners prior to submitting permit application plans such as the transport management plan or transmission route plan.

Development Process

Potential host landowners are typically approached by a developer very early in the development phase of a potential project in order to obtain the landowner’s agreement to host turbines or solar arrays in the event the project is approved and proceeds. Landowners will typically enter into an initial agreement (often referred to as a ‘License Agreement’) that documents their willingness to host the assets and the commercial arrangements that may be agreed to in the event that the development proceeds to the permit application stage. Generally, these initial licence agreements provide the developer with exclusive rights over the landowner’s property for a defined or undefined period of time. In most cases, the license agreement will need to be replaced with a lease agreement before any form of construction occurs.

It is essential that landowners obtain sound legal and financial advice before signing any agreement with the proponent. Agreements may contain terms and conditions that may not be acceptable to the landowner and the landowner should be provided with the opportunity to negotiate or strike out such clauses.

There is a wide spectrum of developers active in the industry, with a variety of skills, resources, experience and business models. Many developers will progress the project to a stage where it is eligible to secure (or has secured) a planning permit, and then sell the project to another entity that will take the project forward through the construction and operation stages. Currently, developers are not licensed to prospect wind or solar farm projects, nor do they require approval to prospect in a location for a potential project site.

At the initial stage of the development process, it is not uncommon for a developer to propose more turbines or solar arrays than will be finally approved or installed. As a result, the developer often enters into preliminary license agreements with landowners who may ultimately ‘miss out’ on hosting assets or be offered to host a reduced number of assets. Further, even when the final number of wind turbines or solar arrays is confirmed, the planned location of these assets may be further revised, which can also result in landowners hosting less assets, potentially earning less fees than original expectations.

There are many reasons why a proposed project may reduce the number of turbines or solar arrays during the development phase. These may include increases in turbine or solar panel capacity and efficiency, transmission constraints, noise compliance setbacks, environmental and planning considerations and requirements, financial constraints, community or neighbour concerns along with changes to policy, legislation or planning guidelines.

These various scenarios, observed in the Australian industry to date, can create a ‘winners and losers’ situation for landowners that may have had expectations of hosting assets. For instance, a landowner expecting to host say ten wind turbines (and expecting to receive the payments for hosting ten turbines) may become aggrieved if the final approved wind farm has significantly reduced or eliminated the number of turbines to be hosted by the landowner, thereby materially reducing or eliminating the potential income stream to that landowner.

The landowner may not only perceive that they have ‘missed out’ on a significant expected income stream, but may also raise concerns about the potential impacts of turbines located on neighbouring properties, including changes in amenity, audible noise, construction disruption, loss of property value and other effects of the wind or solar farm. The fact that the landowner’s neighbours are hosting turbines or arrays and receiving payments can further aggravate the situation for the landowner that missed out.

This situation can also be exacerbated by developers conducting confidential, individual discussions and negotiations with specific landowners, creating a level of distrust amongst neighbouring landowners and the developer from the outset.

The consequences of these scenarios can be severe, both in terms of fracturing support for the project within the community as well as dividing the community in economic and social terms. Developers need to be mindful of the consequences which may arise from their conduct in landowner negotiations and the magnitude of impact on landowners with regard to changes to proposed solar array areas or the number of turbines and turbine layouts.

There is also a high risk that project prospectors, who may not have fully considered the implications of these scenarios, inadvertently conduct themselves in a manner that can result in long-term resentment to large-scale renewable developments within local and wider communities where the project is proposed. While these actions may lead to difficulties in relation to the success of the specific project, they also have the potential impact of creating difficulties for other project developers who may be undertaking development of neighbouring projects in the region. At times, these situations have brought and still have the potential to bring the large-scale renewable industry into disrepute.

The Commissioner has observed some successful methods by developers of working with landowners that have ultimately missed out on hosting some or all of the expected assets. Such methods recognise the landowner's long-term engagement and commitment during the project's development. Observed solutions include making a level of payment to the landowner that may be based on a range of parameters, including the number and type of assets that the landowner had been originally expecting to host.

Host Agreements

A host landowner agreement is essentially a commercial lease. Considerable time and money can be spent by developers in creating draft landowner agreements, which in turn should be reviewed by the landowner and their solicitor before negotiating and executing. Both industry and landowners may benefit from a standard agreement document being produced and available for use that is fair and reasonable, complete and consistent with the relevant laws – similar in concept, as an example, to the Law Institute of Victoria's *Lease of Real Estate (Commercial)*.

Some landowner agreements observed could be clearer in a number of aspects. Agreements should provide clarity on a wide range of day to day matters, including which party is responsible for paying rates, land taxes, emergency services levies and the like. The landowner agreement also needs to be clear on termination provisions and the responsibilities regarding decommissioning of the project's (i.e. tenant's) assets.

Landowner agreements are not limited to hosting wind turbines or solar arrays – they may also be required to allow easements for high voltage transmission corridors, private powerline routes to connect the power station, substations, construction facilities, meteorological masts as well as construction and operational access roads for the project. Careful consideration of the approach and fairness to landholders in negotiating these additional agreements should also be required of the developer. As discussed earlier, landowners should also ensure they seek suitably qualified legal and financial advice before entering into any agreement.

There may also be innovative opportunities for landowners and other community members to have an ownership stake in the project, which could be in the form of a community-owned wind farm through to equity or debt participation in the project's commercial ownership structure. It is understood that there are some examples of these approaches in Australia as well as in other overseas jurisdictions such as Europe.

Construction

The construction period can be a time of significant disruption for the landowner, with potential long-term effects. Typical issues can range from management of gates – gates being left open during construction activities can quickly lead to unplanned migration of livestock, often with challenging consequences – through to the impact of new roads and trenches being built throughout the landowner's property.

Firstly, construction itself can be a messy activity, particularly for wind farms. There is significant amount of civil works, components waiting to be assembled, large trucks and equipment moving around and a large number of construction staff requiring temporary office and kitchen/bathroom facilities. Construction typically consumes a material portion of the land area – a much greater area than when the project is completed. It is advisable to plan for the removal of any livestock or ceasing farming activities during the construction phase. Landowners should also be aware that extra land areas will be required in the event that major components of a wind turbine need to be replaced during the operating and maintenance phases of the project.

Landowners should take the opportunity to visit an actual wind or solar farm site under construction and experience first-hand the extent of the works and impacts on the land.

A common frustration for landowners can be last minute changes to the location and routing of internal roads and underground cabling. Project contractors and sub-contractors may inadvertently select a different route to the one that had been agreed to with the landowner, causing an unexpected loss of pasture or cropping capacity.

Internal road construction in hilly and ridge terrain may lead to large roadway cuttings and embankments that can make it difficult or impossible to move livestock around the remaining paddock areas.

Best practice gate management is to design the road access and fencing in such a way to minimise degradation to farming land as well as minimise or eliminate the need for livestock gates. Project roads should also be designed to minimise the need for 'cut and fill' and vegetation removal, using the natural landscape wherever possible.

A construction project typically has multiple contractors and sub-contractors. It is not always clear who the landowner should contact to resolve issues as they inevitably arise during construction. Developers should ensure there are clearly defined points of contact for landowners to raise and resolve issues during construction, as well as the ability to escalate concerns that remain unresolved. Regular meetings between the developer and the landowner before and during construction can also provide a forum to discuss and resolve the inevitable changes and issues that may arise.

Developers should also be proactive and transparent with landholders regarding the status of the project during the development and permitting phase and consult with landholders on any planning amendment submissions that may affect the landholder and/or local community.

Outgoings

The addition of a wind or solar farm (or related assets) to a rural property is likely to incur increases in outgoings such as Council Rates, Land Taxes, Insurances and other levies. For instance, a landowner may not be aware that primary production land may be re-assessed as industrial use land once turbines or panels are installed, may attract increased valuation rates, increased levies and may no longer be exempt from land tax. As discussed earlier, landowner agreements should be precise and clear on which party is responsible for the cost and payment of outgoings and any increase in the outgoings due to the project. Ultimately, the landowner, as the landlord, is usually liable for the payment of outgoings in the event the project operator defaults.

Approaches to calculate and levy items such as council rates, land taxes and other levies appears to be ad-hoc across various state jurisdictions. The lack of a consistent approach may result in a number of consequences, from revenue leakage through to surprises to developers in unforeseen levy charges. Some actions to clarify these matters are being taken, such as the NSW Valuer-General policy *Valuation of Land Used as a Wind Farm* (New South Wales Government, June 2019) but there may well be opportunities for tighter and consistent processes to correctly calculate, levy and collect these outgoing payments as a result of the deployment of wind turbines, solar arrays and other associated assets on the land.

Case law should also be monitored on these topics. A recent case, *AWF Prop Co 2 Pty Ltd v Ararat Rural City Council (judgment date – 16 December 2020)*, in the Supreme Court of Victoria, provides clarity around the valuation methodology for land and capital improved value of land that is occupied by wind farm assets.

Decommissioning

At the end of the project's operating life, the clear expectation of all stakeholders is that the wind or solar farm will be decommissioned and all turbines, arrays and other infrastructure will be removed from the property, with the property returned to its original condition – to the extent that can be done.

Most, if not all, planning permits provide that these responsibilities to 'make good' rest with the project owner (i.e. the tenant). However, in the event of default or breach of the agreement by the project owner, the liability for decommissioning ultimately may rest with the landowner. Further, the landowner typically does not have title or ownership of the project's assets and, as a result, may be unable to recover the costs of any decommissioning activities from selling the assets remaining on the property. Project operators/owners may also change many times during the life of the project.

From a landowner's perspective, it is imperative that any commercial agreement to host assets and the related infrastructure clearly sets out the responsibilities for decommissioning and restoring the site and also provides the mechanism for security of the funding to pay for decommissioning.

A landowner may therefore also wish to seek ongoing evidence that the project owner has the capacity to fund the decommissioning activity and that such funds are properly set aside securely for that purpose. Examples that could be considered include bank guarantees, a sinking fund, a trust fund or a deposit held by the landowner. The Australian Government's recent discussion paper on a proposed framework for regulating offshore renewable energy infrastructure proposes that developers lodge a decommissioning plan and decommissioning bond as a licence requirement.

While there are no documented examples of costs to decommission a contemporary wind turbine or solar farm in Australia, some published decommissioning plans have calculated costs that are approximately $400,000 per turbine. This cost could increase for larger turbines and could range up to $600,000 per turbine or more.

To put these costs into perspective, the fees earned for hosting the turbine for 25 years could be in the range of $250,000 - $625,000 (depending, typically, on the turbine capacity and when the wind farm commenced operations). It is therefore possible that the costs to decommission a turbine could be equal to or greater than the total income generated for the landowner over the 25 year lease period.

Some proponents are offering to deposit decommission funding into a trust fund, but typically not commencing until year 20 of the project life. There are a number of risks with the timing of such an approach. It would be much more acceptable, and at less risk to the landowner, for the developer to commence funding the decommissioning trust fund from commencement of operations.

We are about to enter a period where, for some of the initial wind farm projects around Australia, decommissioning activities will commence in the next few years. There will likely be increased concerns about this topic, particularly from host landowners. At a minimum, there needs to be clarity surrounding who is responsible for decommissioning, who pays and how those funds are secured to protect the landholder from default.

Powerline Easements

We received a number of complaints during 2020 from landowners that had agreed to allow an easement on title (or had bought land where the previous owner had agreed) for the purposes of installing a private powerline that would connect the power station to the main power grid.

Landowners typically receive a one-off payment from the proponent for allowing the easement, unlike a wind or solar farm host, who receives an annual payment.

If the land is sold, the purchaser 'inherits' the easement and the prospect of a powerline being built and operated on the land – and may often be surprised when the powerline contractor arrives at the property to commence works.

There are a range of emerging issues to address here, including fairness of the easement agreement and easement creation documents, the amount and method of compensation, the need for access agreements if the landholders' land needs to be traversed to access the easement areas and appropriate disclosures of the easement and any agreements to a purchaser of the land.

1.2. Recommendations

1.2.1. The developer should ensure that landowner expectations are properly managed from the outset of negotiations and that potential host landowners are made fully aware of the risks of potential reduction in turbines or solar arrays and relocation of these assets during the long development process life-cycle.

1.2.2. License agreements that enable the developer to have the right to lease the landowner's property should have fair and reasonable provisions, including provisions for reasonable payments to be made to the landowner during the term of the agreement and the ability for the landowner to terminate the agreement if the project has not met expected milestones after a reasonable period of time. Prospective milestones set out in the agreement should have clearly stated expected time frames and dates for those events – such as submission of permit application, financial close, commencement of construction works and expiry of planning permit.

1.2.3. Where practical, developers should consider discussing the proposed project and negotiating agreements with all potential host landowners together as a group in an inclusive and holistic manner, rather than individual discussions with landowners.

1.2.4. A standard template lease agreement with consistent commercial terms and conditions should be considered by developers and supported by industry and the relevant legal association in each state.

1.2.5. Further to Recommendation 1.2.3, developers should consider offering some level of payment to all contracted host landowners if the project proceeds, regardless of final allocation of assets on individual properties.

1.2.6. Host landowner (i.e. 'lease') agreements should be fair, reasonable and written in plain English. The landowner should have access to and obtain appropriately skilled legal and financial advice before entering into any agreement. The New South Wales Government's *Wind Energy Guideline for State Significant Wind Energy Development* (New South Wales Department of Planning, December 2016) provides some discussion on this topic, particularly within Attachment B of the publication. NSW Farmers' Federation have also produced a *Renewable Energy Landholder Guide* (GHD Pty Ltd, updated in 2019) covering a range of relevant topics related to host landowner agreements. Specific areas of agreements requiring clarity in landowner lease agreements may include:

- fees payable to the landowner during the project development stage (pre-permit), financial close stage (post-permit), construction, operational and decommissioning stages
- timing of payment of fees and due dates for payments

- escalation of fees during the agreement, such as a fixed annual increase or CPI increase, and method of calculation
- considerations if the project is cancelled or materially delayed
- considerations if the project scope materially changes, particularly if the changes result in negative impacts for the landowner
- variations to fees in the event of changes to turbine layout, turbine specifications, turbine capacity and number of turbines or solar arrays to be hosted
- agreed internal road and other infrastructure locations (cabling, construction offices, substations, transmission lines etc.)
- arrangements for use of additional land during construction and major maintenance activities
- process for making changes to location and routing of project infrastructure to the landowner’s property (e.g. access roads, cabling) and responsibilities for maintenance of such infrastructure
- any creation of easements that may be required
- access agreements required for accessing easements via a landowner’s property
- arrangements in relation to removal of ancillary infrastructure and the rehabilitation of disturbed land after the completion of construction works, such as replacement of soils over underground cabling or trenches
- responsibility for costs and payment of additional council rates levied on the landowner as a result of the project
- responsibility for costs and payment of additional land taxes levied on the landowner as a result of the project
- responsibility for costs and payment of additional emergency services or other levies as a result of the project
- required insurances to be taken out by the project operator in respect of the landowner
- required insurances to be taken out by the landowner in respect of the project
- additional insurances that may be required to be taken out by neighbours to the project (such as increased liability insurance)
- responsibility for the costs and payment of the various insurances
- landowner’s responsibilities in regard to renting out the property and/or residence(s) to a third-party tenant
- sale or transfer of the land by the landowner
- any restrictions on further development on the property
- provisions in the event of subdivision of the property

- term of the agreement, options for renewal of the agreements and termination provisions by the parties
- assurance provisions to protect the landowner in the event the project defaults (such as a deposit or bank guarantee)
- decommissioning provisions, responsibilities of the parties and arrangements to ensure funding is assured and protected
- remedies available to the landowner in the event of default by the developer, and
- key contacts at the developer for the raising and escalation of issues and process for handling potential breaches of agreement.

The above items could be set out in a standard template of a commercial lease agreement that is managed and maintained by an appropriate legal, industry or government body. Finally, landowners should be provided with an opportunity to visit a relevant project that is under construction to experience first-hand what is involved.

1.2.7. Councils and state jurisdictions should examine and audit current processes in place for the re-rating of properties that host wind and solar projects as well as related infrastructure and clarify how those properties are valued for the purpose of calculating land taxes and council rates. A similar activity should be undertaken for the calculation of applicable emergency services and other levies. The process and calculations should be transparent to relevant stakeholders and be subject to audit and be auditable.

1.2.8. Other landowner agreements (such as agreements for transmission line easements, easement access or road access) should also be negotiated and finalised with the landowners in a fair and reasonable manner, with appropriate consultations engaging affected landowners and neighbours in determining the final approach and routes to be taken.

1.2.9. Developers may wish to consider other forms of commercial engagement with landowners (as well as neighbours and community members) that may allow for equity and/or debt participation in the ownership of the project.

1.2.10. The project's construction plan, transportation plan and overall project design should be developed in close consultation with the landowners and designed so to respect the landowner's need to be able to continue primary production operations during and following construction where applicable. Particular attention should be given to paddock/gate management and the impact of access roads to ongoing farming activities. Key contacts at the developer and/or its contractors should be provided to landowners to allow landowners to raise and escalate issues that arise during construction. Developers should also meet regularly with landowners during construction to discuss and resolve issues as well as keep landowners informed of the project's status.

1.2.11. To ensure that professional conduct and standards are consistently adhered to by project prospectors and developers, state governments should develop mechanisms to promote and motivate best practice behaviour by prospectors – both in terms of preferred site selection for prospecting and the engagement with landowners and community. Some examples include the NSW Government's 'Renewable Energy Zone' (REZ) designations, the Victorian Government's 'VRET' program, ACT's 'Reverse Auction' program and Queensland's 'RE400' program. A further approach would be the accreditation of developers (or adherence to an appropriate code of conduct) this is overseen by an appropriate industry or regulatory body.

2. Neighbour Matters

2.1. Observations

Background

Most large-scale renewable energy projects will have neighbours. Neighbours are residents or owners of the neighbouring properties in proximity to the proposed project, either in adjoining properties or properties very close to the project. There may also be neighbours that are not in direct proximity to the project that could be affected by other related project infrastructure, such as high voltage power lines and roads used for transport to and from the project.

Neighbours may also include functional facilities, such as an airfield, where a proposed wind farm could have significant impact on the ongoing operation and safety integrity of the facility.

Neighbours can be materially impacted by the development, construction and operation phases of the project. Impacts can include dust, disruptions, road damage, blocked roads, visual amenity, noise, shadow flicker and economic loss – both the concerns in anticipation of these impacts as well as actual impacts once the project commences construction or is operating.

Consultation

While developers have generally engaged and consulted well with potential host landowners, developers have not always understood the importance of consulting and working with neighbours in proximity to a project. Typical complaints that the Office has received from project neighbours is that they were not consulted by the developer and only heard about the project from third parties. Often there is limited evidence to verify the degree and level of consultation and interactions between the developer and neighbours to the project.

Consultation may include a wide range of topics, such as:

- consulting with neighbours on the project's design and layout, especially during the early scoping and design stages, so to enable a fact-based discussion about landscape/amenity impacts
- consulting with neighbours to explain the planning process and opportunities for neighbours to engage in that process
- consulting with neighbours on the process and oversight of specific activities, such as predictive noise assessments, post construction noise testing, environment, aviation, transport management plan, shadow flicker and visual amenity assessments
- advising and consulting on subsequent proposed changes to the project's design, layout and equipment selection
- ensuring background and operating noise testing (for wind farms) is properly undertaken and results are provided in a timely fashion and appropriate format to neighbours
- providing factual information to address questions and concerns raised by neighbours, and
- facilitating site visits for neighbours to existing operating projects to allow the neighbour to experience a completed project farm first-hand.
- alternately, devices such as wind farm noise simulators are available to enable neighbours and other stakeholders the opportunity to experience noise outputs of a wind farm in a wide range of scenarios.

Lack of effective consultation with neighbours can lead to a range of material issues for a project, including conspicuous opposition to the project (and any modifications to the proposed project), formal objections that may lead to planning/approval delays and appeals, legal actions against the project or planning authority, the project (or elements of the project) not being approved as well as widespread negative media coverage about the project and the industry more broadly.

Neighbour Agreements

In addition to more effective consultation with neighbours throughout the life-cycle of a project's development, some developers have introduced the concept of 'neighbour agreements'. These agreements can provide a commercial arrangement between the project and neighbour that recognises the possible impacts of the project on the neighbour and to gain the neighbour's support.

Agreements may also be mandatory to gain a permit approval in the event the neighbour is at a risk of experiencing impacts from the project that exceed permit/standards limits or if they reside within a default setback distance zone.

The content of a neighbour agreement is typically confidential to the parties, but may include one or more of the following:

- annual payments to the neighbour for the life of the project (including payments during the development, construction and operating phases of the project)
- a one-time payment at the commencement of the agreement
- reimbursement of reasonable legal fees incurred by the neighbour for the review of the agreement
- reimbursement for, or provision of, items such as visual screening, insulation, double-glazing, air-conditioning, energy efficiency programs, solar panels, electricity consumption, increased insurance premiums
- reimbursement for any increased insurance premiums levied to the neighbour as a result of any increases to the sums insured for public liability due to the presence of the wind or solar farm
- an option for the neighbour to request that the developer acquire the neighbour's property, and
- ability for a neighbour to terminate an agreement without penalty.

Most neighbour agreements are voluntary and it is up to the developer to propose and negotiate such an agreement with the neighbour. Some developers have designed neighbour agreement payments based on a formula of distance from a residence to the turbine(s) and the number of turbines located within that distance.

The Office has observed some proposed neighbour agreements that contain clauses which may not be fair and reasonable to the neighbour. Such clauses observed include the right for the project not to conform to the permit conditions that would normally apply to the neighbour (including noise levels and shadow flicker), the ability for the developer to terminate the agreement while the project is still operating – either without cause or with questionable cause – as well as clauses that could be construed to restrict the neighbour's right to make a complaint.

Further, some neighbour agreements seek to impose stringent planning restrictions on the neighbour for any new development or construction on the neighbour's property. The Commissioner's view is that these clauses are unnecessary and the neighbour should simply be required to comply with the planning rules and laws of the jurisdiction.

Inclusion of perceived unfair clauses by the developer can significantly impair the ability to negotiate a fair and reasonable agreement, creating distrust and anxiety amongst neighbours towards the proponent.

Similar to host landowner agreements, all parties may benefit from a standard template agreement for ‘neighbour agreements’ that is established and maintained by an appropriate body and available for use by industry.

Visual Impacts and Screening

With the height and span of wind turbines ever increasing, so have the concerns about visual impacts such as impairment of views and shadow flicker.

These impacts are commonly assessed during the planning process. However, due to the heightened concerns held by neighbours on these impacts, it is an area that may require special attention and focus by the developer to ensure that quality assessments are undertaken and there is a high degree of consultation and communication with affected land owners.

Screening of the visual impacts caused by the wind or solar farm by planting trees is commonly proposed by developers to reduce neighbour impacts and may also be a mandatory requirement of the permit. An often cited issue is the predicted length of time for a newly planted tree to grow to provide sufficient screening, bringing into question the effectiveness of such mitigation. It should be noted that Appendix 2 of the New South Wales Government’s *Wind Energy: Visual Assessment Bulletin* (NSW Department of Planning, 2016) outlines a range of potential mitigation measures that may be applied.

Further, the process of conducting visual screening assessments and designing and implementing the program and solutions can be a significant task and results of the program may not meet perceived expectations.

An alternative approach is to provide the neighbour with the option of taking a cash payment in lieu of the screening program, thereby empowering the neighbour to decide how best to apply the funds to address the situation. This approach can also alleviate potential difficulties within a community, for instance if some residents have already, proactively, planted trees of their own accord and may now not be eligible or require screening assistance.

2.2. Recommendations

2.2.1. Developers of projects should, where practical, proactively identify all potential neighbours at the commencement of the development activity and implement an effective, ongoing consultation program with all contactable neighbours throughout the project’s development. While it may vary by project and geography, neighbours affected may include residents and landowners in a proximity range of 0 km to 5 km from potential project asset locations, as well as residents in close proximity to other project related infrastructure, such as power transmission or supply infrastructure. This indicative distance range for consultation may need to be greater in situations where, for instance, wind turbines are proposed to be erected on an elevated ridge.

2.2.2. Key stakeholders in the development of a project (for example, project buyers, planning authorities, investors, debt providers, local councils, regulators) should seek and consider evidence of neighbour identification and effective neighbour consultations as part of any due diligence and approval criteria.

2.2.3. Developers should consider the merits and use of appropriate neighbour agreements as a potential component of its overall neighbour and community consultations and project strategy. If utilised, neighbour agreements should be negotiable, fair and reasonable, written in plain English and the neighbour should have access to and obtain appropriate legal and financial advice before entering into any agreement. Standard agreements should not restrict the neighbour from being able to raise issues and concerns about the project, including subsequent proposed changes to the project design. Neighbours should be able to make complaints about the project and not be subjected to conditions that exceed normal planning standards and permit requirements. There may be existing operating projects where a retrospective neighbour agreement should be considered. Developers may, alternately, opt for a broader community support model that benefits a wider group of community members that may not include specific neighbour agreements.

2.2.4. Screening solutions proposed by developers should be realistic and effective. If trees are proposed, trees should be planted in a timely fashion and well maintained to provide effective visual screening within a reasonable timeframe. Other screening solutions, such as structures or shutter blinds, should also be considered when proposing and negotiating a visual screening agreement. Neighbours may also prefer a cash payment option in lieu of the developer designing and installing the screening solution.

2.2.5. The developer should recognise that some neighbours may have been potential host landowners for the project's initial design and should take the time to understand the neighbour's history of involvement with the project. Developers should document all conversations and interactions with neighbours and maintain such records in an appropriate system for future reference. Equally, neighbours who have been approached by developers to offer an agreement should also ensure that they have documented all offers and agreements presented to them.

2.2.6. Neighbours should be appropriately represented in any project-related committees, such as Community Consultative Committees and Community Engagement Fund Committees, to help ensure that neighbours have a voice, as well as the opportunity to be positively engaged with the many and various aspects of the project across the community.

3. Community Engagement

3.1. Observations

Background

Effective community consultation and engagement is essential for large-scale renewable energy projects to gain widespread support and earn the 'social license' to operate within the community. To be effective in community engagement, it is vital to actually 'engage the community' and involve the community wherever possible in the design and execution of programs related to the project.

Conversely, poor or no community engagement can allow misinformation and community opposition to a project to gain momentum – which can ultimately lead to projects not proceeding as a result of planning objections through to endless delays from lengthy and costly legal actions against the project.

The level of community engagement by developers can vary widely across projects observed to date. A key observation is that initiating project developers (who secure the landholders and permits, then 'on-sell' the project to a long-term developer or operator) may not invest appropriate time and resources into community engagement or neighbour relations to be effective. These more limited efforts can result in lower levels of community support and more divided communities, compared with projects where the project developers appropriately focus on effective community engagement from the very start of the development activity.

Community Committees

In some jurisdictions, such as New South Wales, the planning guideline framework has provided for an early and continuing focus on community engagement, including the establishment of a Community Consultative Committee (CCC) that is maintained throughout the life of the project. Further, feed-in tariff arrangements such as those established by the ACT and Victorian Governments, place a significant weighting on selecting developers and projects that have proposed and demonstrated effective community engagement programs, subscribing to community engagement as a high priority.

Many projects also establish Community Engagement Funds, funded by the developer, to support a wide range of initiatives that benefit the local community. In some cases, such funds are a condition of the permit approval, but largely these are voluntary arrangements proposed by the developer.

Committees such as CCC's appear to be most effective when there is an independent chair and an appropriate balance in the committee membership, with chair and committee appointments being made by an independent body where practical. Committees can play a vital role in the provision of factual information about the project, identifying and resolving issues that arise that require multi-stakeholder cooperation to resolve and dispensing with inaccurate perceptions about the project and related events.

Communications

The quality of and information provided by project websites vary from project and/or developer. In general, there is more work to be done by developers to provide up-to-date websites with clear transparency of information about the developer, the project, current news, how and who to contact in the organisation, how to make a complaint and access the complaint process procedure – along with access to all relevant project documents. While most projects and developers now maintain effective project websites, some project websites remain difficult to find, are out of date or lack sufficient information and easy navigation.

Media relations and using media, such as local newspapers, to convey factual information and updates about the project can be an extremely effective way to communicate with the broader community. Conversely, poor media relations and/or attracting the attention of mainstream and national media that report negatively about the project, can be hugely detrimental.

Coordination

Some regions of Australia are experiencing increased clustering of proposed and approved projects, which may result in multiple projects infiltrating and 'surrounding' communities. The concept of Renewable Energy Zones, while largely beneficial to opening new areas for projects, may also have this unintended consequence.

As a result, there is both the need and opportunity for individual project developers to communicate more effectively with each other and better coordinate engagement with the broader affected community. These activities could range from combined community engagement and communications initiatives by developers through to coordination of construction programs to minimise cumulative impacts on residents and townships.

Developers should also be aware of other key infrastructure projects that may be taking place within the region and ensure that project activities and schedules are planned and coordinated to minimise impacts to communities.

Guidelines

Several community engagement publications have been issued or updated in recent times, including publications by the Clean Energy Council and the Victorian Government. These guidelines are very useful resources to assist developers plan, prepare and execute effective engagement programs.

Community engagement plans are now also required in some planning permits as a prerequisite condition. Other stakeholders may also mandate the requirement for a well-designed and executed community engagement plan.

Overall, there continues to be a wide range of opportunities for developers to further broaden and improve their community engagement. Suggestions gained from our observations of various practices across the industry are listed below.

3.2. Recommendations

3.2.1. The developer should ideally commence and invest early in community engagement – well before the commencement of the permit approval phase. An acquirer of a project still in development should conduct detailed due diligence on the extent and effectiveness of community engagement activities undertaken by the existing developer, prior to finalising purchase of the project, and be prepared to make the necessary investments in community engagement going forward.

3.2.2. The developer should proactively identify and establish effective working relationships with key community stakeholders, including stakeholders that may be opposed to the project (including organised groups that are opposed to the project).

3.2.3. The developer should, in consultation with the responsible authority and the community, consider establishing a CCC (or equivalent) with an appropriate charter and membership (noting that in some jurisdictions, a CCC may be mandated). The CCC Chair should, where practical, be a respected and representative member of the community at large as well as independent of any direct impact or beneficiary of the proposed project. Ideally, the CCC should meet monthly during critical stages of the project's development, approval, construction, post-construction testing and initial operations.

3.2.4. Many developers provide a range of information and education opportunities for community members to better understand the benefits and impacts of wind or solar farms as well as address any questions and concerns raised. Initiatives to consider include:

- establishing a 'shop front' in the community town centre that provides project/permit information, a map and model of the project, information about wind and solar farms and an ability to address questions or concerns raised by community members
- providing an informal channel for community members to ask questions, for example, by utilising a social media platform, and provide feedback about the project, and be able to do so anonymously, if required
- providing opportunities for community members to visit operating projects and/or projects under construction
- providing access to a wind farm noise simulator to demonstrate wind farm noise to community members, enabling participants to experience simulated noise scenarios
- maintaining an easily found, up-to-date project website with full transparency on contacts, complaint process, project details, the project's current status along with planning permit details and documentation
- briefing local members (federal, state and local government) on the project and providing them with timely updates and information
- developing effective relationships with local media and providing the media with factual information to assist their reporting of the project and any perceived or real impacts

- providing information sessions about the project, as well as about wind farms and/or solar farms more generally, at convenient locations for community members, including presentations from key stakeholders, to compliment regular project newsletters and updates
- ensuring transparency for employment and contractor opportunities that arise from the project's construction and operational phases
- publishing the minutes, where applicable, of CCC (or equivalent) meetings and allowing observers to attend CCC meetings, and
- understanding and assessing the impacts on local accommodation and catering during construction. Opportunities may exist for developers to construct accommodation which may, in turn, be utilised for long-term accommodation for people in need of housing arrangements. It is also essential that contractors pay invoices and accounts on time that may be rendered for accommodation and meals/catering consumed by construction workers.

3.2.5. The developer should establish a formal complaints/enquiry process, including a system to record and manage complaints, as well as provide a transparent register of complaints/enquiries information (note: actual complainant details can be masked for privacy). The complaints process should ideally commence at the initial stage of the development activity, to allow community members to formally raise concerns and have those concerns addressed in a timely, consistent and transparent manner, and continue on throughout the life of the project.

3.2.6. The developer (and CCC if it exists) should consult widely and communicate effectively and extensively on the proposed construction and related transport plan. The developer should also ensure appropriate restoration and 'make-good' actions are in place to remedy damage that may occur and seek, where practical, to leave local infrastructure in the same or better condition than prior to the construction. The developer should also proactively provide communications during construction using all forms of relevant channels, such as text messaging, to advise community members in advance of impactful activities. Where more than one construction project is occurring in the same area, collaboration should occur between the projects to proactively identify and resolve issues, such as constrained supplies such as gravel, tradespeople, accommodation, meals as well as road access issues.

3.2.7. Further to Recommendation 3.2.6, the developer may wish to seek out opportunities to help facilitate improvements to other related community/local infrastructure. Initiatives could include improving mobile phone coverage, utilising the 'imported' project workforce to help upgrade local facilities (such as parks, playgrounds) and other practical activities which could benefit the overall community for years to come.

3.2.8. Local council(s) should proactively engage with the project and community, clearly communicating the council's level of support for the project as well as its role in facilitating and promoting effective community consultation and project compliance. Council should participate in any CCC or equivalent. If there are multiple large-scale infrastructure projects located within a council's jurisdiction, it would be advisable to appoint a council liaison resource(s) to coordinate relations and issue resolution between council, community members and developers.

3.2.9. Where possible, the developer should engage staff locally (or relocate them locally) to lead community engagement activities and respond to community concerns and complaints.
The developer should also seek to hire local tradespeople, contractor staff and suppliers where practical.

3.2.10. Once a project is in operation, the developer should continue to proactively provide information and updates about the project as well as provide opportunities for the community to visit the project site (such as an 'open day').

3.2.11. The developer should consider establishing and maintaining a community engagement fund and ensure there is appropriate community involvement in the governance and management of the fund. In some jurisdictions, such a fund is mandated. The fund should allow for appropriate opportunities for community originated submissions to obtain funding for project proposals. Prioritisation of funded projects that may be of benefit to those community members more directly affected by the presence of the project should be encouraged. The community fund should clearly include and benefit community members that live in proximity to the wind or solar farm rather than only supporting projects related to a regional centre.

3.2.12. Developers may wish to consider providing offers for community members to become shareholders in the project, which can provide a practical sense of ownership within the community. Developers may also decide to offer beneficial arrangements to community members such as reduced/subsidised electricity bills, gift cards for use at local vendors or other practical benefits to the local residents within the immediate community.

3.2.13. Stakeholders to the project, including the responsible authority, council, bankers, investors and regulators, should seek relevant evidence of both the project's community engagement plan and outcomes from the plan's execution as input to decisions or requirements that the stakeholder may wish to place on the project and developer.

3.2.14. Industry bodies, such as the Clean Energy Council (CEC) and the Renewable Energy Alliance (REA), should continue to promote effective community engagement and publicly recognise individuals and organisations achieving excellence in positive community engagement outcomes. Appropriate priority should continue to be given to this topic when designing industry forum programs.

3.2.15. State governments can continue to play a key role by prioritising the promotion of effective community engagement in projects. Examples include initiatives such as community engagement plans as a key selection criterion for eligibility to be awarded state government 'feed-in tariff' programs as well as utilising formal permit conditions to mandate preparation, endorsement and execution of the plan.

3.2.16. Project developers should ensure that all contractors, sub-contractors and other project stakeholders are aware of their responsibility to engage well with the community and minimise community impacts. If there are multiple infrastructure development projects occurring within a region, developers should also be aware of potential cumulative impacts to a community and should liaise with local councils and other developers to proactively plan to avoid or minimise unnecessary impact on the community.

4. Planning Permits – Time Limits and Scope Changes

4.1. Observations

Background

Once approved, a project planning permit is typically granted for a period of five years. The developer then has that period of time to fulfil and complete the various plans and assessments required by the permit in order to commence construction of the project, consistent within the permit conditions. It is quite common that construction is not completed within this five-year period (or even commenced), where the developer then applies for an extension or renewal of the permit.

There have been numerous cases of projects where the permit has been extended or renewed for further periods, often with significant changes to the project's design due to the ongoing technological evolution of wind turbines and solar arrays.

Elongated Time Frames

As a hypothetical example, design and development activities for a proposed wind farm may have commenced in the 2001-2002 timeframe, submitting a planning permit in 2003. In 2005, an approved planning permit with a five-year expiry term may have then been issued to the wind farm. If construction of the wind farm had not commenced or been completed by the time the approved permit expired in 2010, upon request by the developer, the planning authority may have then approved the permit to be renewed for a further five years until 2015, with the renewal approval usually based on some minor level of commencement of the project, such as a shed or a roadway.

Changes in turbine technology may lead the developer to modify the wind farm's design and layout, typically requiring preparation and submission of a planning amendment application for approval. This process may further delay the project from commencing construction, requiring yet another planning permit extension out to say 2020. By this time there are no guarantees that the project will be completed by the permitted timeframe, resulting in a further possible permit extension beyond 2020.

Therefore, it is feasible that a period spanning 20 years or more can occur between the original prospecting at the wind farm site, permitting approvals and the wind farm being constructed.

Delays between the time of obtaining a permit approval for a wind farm and the actual commencement of construction works can occur for a variety of reasons. Typical reasons include undertaking and obtaining approval for the various reports and plans required by the permit prior to construction commencement, changes in turbine selection and turbine layout (which may be a consequence of issues uncovered by fulfilling the permit conditions), delays in obtaining financial close and changes in government policy.

These lengthy timeframes for a wind farm project are significant and can raise a number of issues for consideration, including:

- Standards, such as noise standards, which may change during this lengthy timeframe of the development process. For example, at the time of initial project development and permit approval, the project and permit conditions may have been based on the NZS 6808:1998 noise standard. Although the standards may have been revised in the ensuing period, the project and permit will still be based on the 1998 standard, rather than the updated NZS 6808:2010 noise standard – even though the wind farm may have been built more than 15 years after the initial project's permit approval and well after the more recent noise standard came into effect.

- Setback distance policies (the minimum distance between a wind turbine and a residence) can also vary over time. As an example, a number of Victorian wind farms with still current, renewed permits have no default minimum setback distance provisions as the original permit was approved in the previous decade. Prior to 2011, there were no default minimum setback distance requirements in Victoria. In 2011, a 2 km setback distance was introduced. The current default setback distance on Victoria is 1 km.

- Changes in standards and planning guidelines for renewable energy projects could therefore conceivably take many years from the time they are introduced to when they are written into planning permits for proposed projects.

- Technology, such as wind turbines, may also change over the project timeframe. The original project design and permit conditions may have been based on turbines of a certain energy capacity (for example, the original proposed turbine may have been 1.5 MW, whereas the developer now wishes to deploy 4.5 MW turbines) with changes to physical size dimensions (for example, higher turbine hub and tip heights and longer blade diameters). As a result, the developer may decide to take advantage of the new technology and propose to change their turbine selection during the elongated time period. This change may potentially alter a number of material characteristics and impacts of the wind farm, including turbine layout, visual amenity, noise and shadow flicker. Such changes will likely result in the need for a formal modification (or endorsement) to the planning permit, re-opening the proposed wind farm to potential objections and community concerns about the proposed changes.

- Further, there are consequences and impacts as a result of the significant increases in wind turbine dimensions, such as on transport routes and vegetation clearance along roadways – often leading to the need for a planning modification and/or landowner negotiations along the route. The modification process may well reignite original debates and issues with the project, and add further delays to project start or completion.
- The transport plan itself also needs to be holistic and be carefully planned and mapped from port to project, requiring appropriate consultation with all relevant stakeholders that have jurisdiction along the proposed route. This consultation will need to be repeated if there is a change to the route and/or the impacts on related matters such as vegetation clearance and property access.
- The current requirements on the developer to qualify for the ability to request a renewal of the permit for a further period may be minor relative to the total project scope (for example, the building of a simple shed or road access to the site) so to demonstrate some level of commitment to construct the project. These relatively minor works, when compared to the total proposed project, may be viewed as not substantial enough to demonstrate that the project has materially commenced within the permitted timeframe nor obligate the project in a way that it has no choice but to proceed.
- The community affected by the wind or solar farm (including host landowners and neighbours) can be subjected to very long periods of uncertainty as to whether or not the project will proceed. This uncertainty can affect a range of individual landowner and stakeholder decisions as well as discourage or prevent other potential development within the project's planned footprint and surrounds.
- Community engagement may also not be sustained by the developer over long periods of uncertainty and may deteriorate during the elongated time frame.
- During an elongated development cycle, other projects may have been subsequently planned and/or constructed in the area, which may result in possible unforeseen cumulative impacts for nearby residents and the broader community.

Precedence

Depending on the jurisdiction, a developer may not need to assess potential impacts on a dwelling that is yet to be constructed, even though the dwelling has a valid, current planning permit and building permit. In effect, the layout of a potential wind or solar farm may take precedence over existing planned dwellings, resulting in the possibility of the planned dwelling being too close to turbines to meet noise limit criteria and other setback requirements.

It would seem reasonable to expect that a legitimate proposed dwelling, that has proper and current permits in place, needs to be considered as a potential dwelling for project planning purposes, where the dwelling permits are already approved and in place prior to a wind farm permit application being submitted.

If the dwelling is subsequently not constructed and/or the permits expire, then the developer may choose to adjust the wind farm design accordingly.

Further, once a development is approved or constructed, persons wishing to build a dwelling or infrastructure within proximity of the wind farm should have their plans referred to the developer to check whether the dwelling is within the compliance criteria for matters such as noise and shadow flicker.

Other Infrastructure

In some jurisdictions, planning permits are not required for transmission and other associated infrastructure to connect the power generator to the grid. This lack of review and oversight can lead to a wide range of community issues related to the design, routing and installation of the transmission line and related assets. The prospect also exists for duplicative assets separately connecting each generator to the grid, with no mandatory requirement to seek consolidation of the transmission infrastructure so to minimise community impact and promote a more efficient use of capital.

Responsible Authorities

In general, state governments are the designated responsible planning authority for large-scale renewable projects. However, some exceptions exist. For example, Tasmania's responsible authority for approval of wind farms is currently local government (although there are some proposed planning reforms which may change this framework). Queensland's planning scheme also has delegated large-scale solar farms to local government as the responsible authority, as was the case in Victoria until recent changes.

Given the skills, resources and expertise required to properly assess and manage the planning process for these large-scale energy assets, it is strongly preferred that state governments retain responsibility for the planning process and approvals, along with compliance enforcement. Further, council may avoid decision-making by simply declining the proposed project, resulting in an appeal to the appropriate state planning and environment court or tribunal, adding further delays and costs in the process.

4.2. Recommendations

4.2.1. A wind or solar farm planning permit should only be renewed for one further term as a maximum, unless there are exceptional circumstances that have caused a delay in commencement. Approval of permit renewals (or extensions) should require the developer to demonstrate the likelihood of the project commencing and being completed prior to the end of the requested/approved renewal or extension period.

4.2.2. Requests for material changes to a project's proposed design and technology need to be scrutinised through an appropriate and rigorous process by the responsible authority. The process should be transparent to all stakeholders and include re-assessments of key impacts such as noise, visual amenity, environmental considerations, aviation, transport route, transmission requirements, shadow flicker and construction impacts. Planning amendment applications for material changes should be subject to public exhibition and the ability for community members to raise concerns and objections.

4.2.3. The responsible authority should be able to reasonably introduce and apply current/updated planning guidelines, applicable standards and updated permit conditions when assessing a request to renew/extend a permit or when approving a planning permit amendment. For example, a developer seeking to renew a permit issued on 1 January 2017, expiring 31 December 2021, should be required to comply with any contemporary guidelines and standards currently in force that could be reasonably expected to be complied with, as such the developer should prepare the renewal submissions in accordance with the contemporary guidelines and standards.

4.2.4. Evidence of ongoing community engagement for the project should be submitted to the responsible authority when seeking a renewal approval or permit modification request.

Submissions should include evidence of current community consultation efforts with regard to any proposed changes in the project design and layout subsequent to the original permit approval.

4.2.5. In considering a renewal/extension or permit amendment application, the responsible authority should assess any compounding effects of other proposed or constructed wind farms in the vicinity with respect to residents who may experience cumulative effects that may be exacerbated by the proposed wind farm that is seeking permit renewal or amendment approvals.

4.2.6. Further to Recommendation 4.2.5, the responsible authority should assess the impacts of any other planning approval requests or confirmed approvals in the vicinity that have arisen subsequent to the project's original permit approval when considering the permit renewal/extension application. These could include dwellings that had legitimate planning approvals prior to the project's original permit being approved that have subsequently been built and are inhabited.

4.2.7. In the event that the project is seeking a renewal/extension of the permit period to allow a commenced project further time for construction completion, the responsible authority needs to be fully satisfied that material construction has already commenced and provide extensions only for the period where it would be reasonably expected for the remaining construction to be completed. For example, the project should have reached financial close and commenced actual construction of wind turbines or solar arrays. A roadway or shed should not be considered as commencement of material construction.

4.2.8. State governments should consider including relevant questions for prospective rural property purchasers to ask about potential wind or solar farms, in the vicinity of the property, in any due diligence 'checklist' that may accompany a contract of sale or vendor statement document.

4.2.9. Planned dwellings within proximity to a proposed wind or solar farm that have existing, approved and current planning and building permits, should be treated and assessed as an existing dwelling by developers when preparing and submitting permit applications. Planned dwellings that subsequently are not constructed within the specified time limits and/or have expired permits, can be removed as a constraint to the planning layout. See also recommendation 4.2.10 regarding development plans subsequent to a project planning permit being approved.

4.2.10. Neighbours to projects, where the project is in either development or in operation, should be allowed to submit development plans to the responsible planning authority for new development on their property, such as a dwelling or a shed. Development proposals within at least 1.5 km of a proposed or operating wind turbine, should be referred to the wind farm developer by the responsible authority for consultation and to verify impact levels of the wind or solar farm at the proposed neighbour's development site. Development proposals in locations where the project is likely to exceed prescribed standards and limits may require written agreements to be reached between the neighbour and the project before the neighbour's development can be granted final approval by the responsible authority.

4.2.11. Transmission lines, substations and other related electrical infrastructure should all be subject to and require an appropriate planning permit, ideally as part of the overall permit for the project. Careful consideration should be given to the design and routing of the powerline. Developers should collaborate wherever possible to optimise use of shared transmission facilities. Relevant governance bodies (transmission planning, electrical safety, road safety, local councils etc.) should be properly consulted on the planning application and exercise their oversight responsibilities accordingly.

4.2.12. State governments are best placed to be the responsible authority for large-scale renewable energy and storage projects. Local governments have a very important role to play in the planning process, road access, community engagement, construction and operation of the project, but should not be burdened with the overall planning and compliance responsibilities.

4.2.13. Developers should provide evidence that they have landowner consent for the development application and any subsequent planning permit amendment applications. If the developer is declaring they have obtained such consent, the declaration should be subject to an audit.

5. Governance and Compliance of Standards and Permit Conditions

5.1. Observations

Background

The design and governance of large-scale renewable energy projects relies on a range of standards and various compliance mechanisms to monitor and enforce those standards.

Standards are often set and maintained by the responsible authority (for example, a state planning department or environment department) and there are a variety of arrangements in place for enforcing compliance with the standards. Standards may be ‘borrowed’ from other jurisdictions (for example, Victoria uses the New Zealand (NZ) noise standard, the NSW noise standard is based on the South Australian standard), set by the planning function or set by the state agency responsible for environmental management and regulation.

Enforcement of standards and permit conditions also varies by jurisdiction and the type of standards. Generally speaking, there are no proactive compliance audit regimes in place – rather, compliance relies on authorities receiving and investigating complaints or alleged breaches of permit or license conditions. The pathway to make a compliance complaint or allegation again varies by jurisdiction and type of complaint – in some cases the state environmental regulator can receive and investigate noise or environmental complaints, in other cases it may be a local council, state planning department or the relevant Australian Government department.

Compliance Complaints

It is often unclear to community members where or who they should lodge a complaint to regarding compliance. Planning permits may not always clearly state the accountability and responsibilities with regard to compliance oversight, nor may they prescribe a process for handling potential or actual non-compliance. Further, local councils and state planning functions may not have the necessary skills and expertise to handle and investigate a compliance complaint. Federal agencies, such as the Clean Energy Regulator, rely on a clear understanding of the responsible compliance authority and the authority’s advice if the Regulator is to consider acting on allegations of non-compliance or breach of a law.

Interpretation and Consistency of Standards

Borrowed standards can also be difficult to administrate or enforce if a protocol has not been developed for the local jurisdiction. As an example, the NZ noise standard (used in Victoria and Tasmania) has a concept of low and high amenity areas for determining the appropriate noise limits for a wind farm. Victoria’s planning scheme does not define such areas, making it difficult to interpret and apply the NZ standard ‘as is’ in the Victorian context (see *Cherry Tree Wind Farm Pty Ltd vs Mitchell Shire Council – VCAT – P2910/2012*).

Issues have also arisen regarding the application of tonal noise penalties provided for in the NZ standard. The application of the standard is open to interpretation in that regard, and Victoria/Tasmania must rely on interpretations from New Zealand court proceedings to clarify the standard's application. This can be a difficult matter to resolve, particularly in the event the interpretation has also been a topic of debate in New Zealand itself (see *Decision of Hearing Commissioners re Palmerston North City Council v New Zealand Windfarms Ltd* – November 2017).

Typical standards and permit requirements relevant to a project's development and operation can include matters such as audible noise, shadow flicker, visual amenity impacts, setback distances, environmental matters related to flora and fauna, vegetation clearance as well as noise and dust levels during construction.

Noise Standards

Noise standards relating to wind farms currently vary by state. For example, the wind farm noise limit standard in Victoria and Tasmania is 40 dB(A)* measured outside the residence. South Australia varies between 35 dB(A)* and 40 dB(A)* based on the location of the wind farm, Western Australia is 35 dB(A)*, New South Wales is 35 dB(A)* and Queensland's standard is 37 dB(A)* during the day and 35 dB(A)* during the night. The approach to measuring the noise emitted from a wind farm can also vary by project and jurisdiction which can lead to debate over the veracity of the noise assessment results.

The World Health Organization's (WHO) noise guidelines released in 2018 recommended a 45 dB (Lden) limit for wind farm noise, as measured outside the residence, to prevent negative effects on sleep and health. However, the report noted the lack of research or evidence available to conclusively support this new guideline limit. Previous WHO guidelines were based on an inside measurement limit of 30 dB(A), although it can be difficult and intrusive to carry out wind farm noise testing inside a residence, particularly over a long period of time.

Current noise standards therefore rely on the effects of attenuation of the noise by the residence structure and would assume that a noise level of say 40 dB(A) measured outside the residence should be less than 30 dB(A) measured inside, based on an expected attenuation in the order of 10-15 dB(A). This attenuation may be greater if the windows are closed and the residence is of solid construction and well insulated, however, the effective attenuation may be less if windows are open and/or construction and insulation of the residence is less robust.

Issues can also arise where a wind farm is tested for noise and the result exceeds the limit by a marginal amount, for example 40.2 dB(A) against a limit of 40 dB(A). The Commissioner's understanding is that the 0.2 dB(A) difference would not be discernible by the human ear and is the result of the complex mathematical calculations that assess multiple noise data points. There may be some merit in allowing for a small, reasonable tolerance level to avoid wind farm's unnecessarily being in technical breach of compliance.

Debate continues as to whether or not a low frequency standard should also be introduced, such as a dB(C) and/or dB(G) weighting. The prevailing argument to date is that the 'A-weighted scale', which has been designed to replicate the human ear's sensitivity to noise, accommodates a sufficient proxy for low frequency noise – noting that low frequency noise can be difficult to detect at levels that would breach threshold targets.

However, based on complaints received, the possibility remains for annoyance for some people living in proximity to a wind farm and perceiving low frequency noises or vibrations while inside their residence. More work is still required to determine whether or not the noise or vibration source in question is the wind farm or some other source. The Office's complaint data has seen a significant reduction over time

* or background noise plus 5 dB(A), whichever is the greater amount. Measurements of A-weighted sound pressure level are generally taken on the basis of LA90, 10-min.

from complainants citing concerns about low frequency noise or vibrations emanating from operating wind farms.

There may be other sources of noise as a result of the project's operation, in particular noise that would emanate from the electrical infrastructure, including power substations, transformers and back-up generators. The impact of such noise sources should be assessed during the design phase and tested for compliance during any post-construction noise testing.

The Independent Scientific Committee on Wind Turbines has derived a suggested wind turbine noise limit of 35 dB(A) (LA90,10-min) to ensure minimal annoyance. This suggested limit approximately equates to a LAeq,10-min of 37 dB(A) or a Lden of 43 dB(A).

Setback Distances

A setback distance (also known as a 'veto' distance) is a default distance that, if a residence (dwelling) is within that specified distance from a proposed infrastructure, such as a wind turbine or solar array, the resident can either veto the asset or enter into a commercial agreement with the developer to allow the asset to be sited within the setback distance limit.

Setback distances from an asset to a residence also vary across states. For example, Victoria originally had no setback distances for wind turbines, then introduced a 2 km setback distance in 2011 and subsequently amended it to 1 km in 2015. Queensland has a setback distance of 1.5 km, while the New South Wales framework is based on a merit assessment of each project against the criteria and performance standards in the framework. Western Australia has recently recommended a 1.5 km setback in their *Position Statement: Renewable Energy Facilities* (Western Australian Planning Commission, March 2020). Turbines can be closer to a residence than the default setback distance, however typically require an agreement to be reached between the resident property owner and the developer.

Current setback distances for wind turbines have been predominately set based on legacy turbine dimensions and expected outcomes from noise standards. As a rough rule of thumb, a 40 dB(A) noise contour should be just less than about one kilometre from the turbine(s), whereas 35 dB(A) noise contour is typically less than 1.5 km from turbines, although these distances can vary with topography and terrain. Turbines installed during the last decade have mostly been at tip heights in the order of 150 metres and around 2 MW to 3 MW in capacity.

New projects are now proposing turbines with tip heights in excess of 220 metres and capacity of up to 6 MW or more per turbine. Improvements in turbine design have mitigated the noise effects and, generally speaking, the noise contours have not materially changed for these larger turbines, despite increased hub and tip heights as well as generating capacity. However, there may well be effects of increased visual amenity and shadow flicker impacts that may give rise for a need to revisit current set back distances and increase them accordingly.

While setback distances are typically based on the distance from the wind turbine to the residence, there may also be circumstances where the distance of the turbine from the neighbour's property boundary should also be a consideration. Such circumstances could include the potential effect of wind turbines on animals such as horses, driving distractions on nearby roads or other situations where turbines may impact neighbouring properties due to their proximity to land use activities on a property.

The British Horse Society recommends a minimum setback distance from wind turbines to horses of 200 metres or three times the blade tip height – whichever is greater – on the basis that horses could potentially react to noise, blade rotation and shadow flicker impacts from wind turbines (see the Society's *Wind Turbines and Horses – Guidance for Planners and Developers*, 2015). The Society's report notes that, while there have been anecdotal reports of livestock such as horses being impacted by turbines, no formally recognised studies have established demonstrable causality.

Upper Lachlan Shire's Development Control Plan specifies that turbines shall not be located within a distance of two times the tip height of a turbine from a formed public road or a non-involved property boundary. For example, a tip height of 150 metres would require a setback of 300 metres from a road or property boundary according to these guidelines (see *Upper Lachlan Development Control Plan 2010*, page 93).

Further, there is the possibility of a turbine blade 'dropping' or being 'thrown' from the turbine while in operation. The Commissioner is aware of five such events in Australia in recent times. As discussed in further detail in Section 9 (Health and Safety), the Commissioner facilitated meetings with industry to discuss wind farm safety incidents, agreeing to adopt measures to ensure full transparency and sharing of incident information across the industry. Corrective actions and mitigation strategies are in the process of being implemented to avoid future incidents, however these recent events also support the need for a setback distance from roads and boundary fences in the order of 200 metres to allow for a safety margin in the event of a blade drop or blade throw.

Electrical infrastructure required for the project, such as transmission lines, may also cause a change in visual amenity for community members. Consideration should be given for those impacts and setback distances as they may also be appropriate to mitigate visual amenity loss and noise issues arising from the infrastructure.

Shadow Flicker

Consideration should also be given to the current standards for wind turbine shadow flicker. A typical standard at present is a limit of 30 hours of shadow flicker per year at a resident's external window or garden area. This standard, used across Australia, has been sourced from shadow flicker standards developed and used in Europe, where setback distances to residences are typically less restrictive. At, say, a 1 km distance from a turbine, the residence would be very unlikely to receive 30 hours of actual shadow flicker.

A more appropriate standard in the Australian context may be no more than a total 15 hours of actual shadow flicker per year at a residence and no more than 30 minutes of shadow flicker should be experienced on a given day. Neighbours experiencing (or likely to experience) shadow flicker that is annoying should also be provided with the opportunity for having visual screening installed. To date, shadow flicker complaints have been minimal.

Harmonisation of Standards

The opportunity exists for a clearer framework of standard setting and enforcement of standards, whereby there is independence in the setting and enforcement of standards from the planning function. Such independence allows for increased community confidence in the objectivity of setting standards and assessing compliance. It also allows the relevant independent agency to acquire and maintain the appropriate skills and expertise to fulfil its standards and compliance responsibilities.

The opportunity also exists for increased harmonisation of key standards across state jurisdictions, such as noise, visual amenity, shadow flicker and setback distances, providing a consistent approach and expectations for governments, industry and the community. Consistency across the states will not only provide a more equitable outcome for residents potentially affected by projects, but may also result in the additional benefit of driving improvements in the technology across the entire market based on the more stringent, while appropriate, standard.

While there may be a number of ways to address these issues, best practice appears to be assigning responsibility for the setting and compliance oversight of environmental-related standards with the state environmental regulator, while the application of the standards to specific projects rests with the state or local government planning authority. The current arrangements in place in New South Wales and South Australia generally reflect practices along these lines.

While standards and categories of standards for wind farm projects is reasonably mature, more work is required to detail the equivalent set of planning and environmental standards for solar farms.

Deemed Compliance

Finally, once a wind or solar farm commences operations, it may not have achieved formal compliance of all conditions until all of the post-construction compliance testing has been completed and accepted. Typically, formal post construction testing, such as noise testing of a wind farm, can only commence once all turbines are operating. The testing itself may take up to 12 months to complete and report. There may be a period of two or more years where the wind farm is partially or fully operating but is yet to be confirmed as compliant.

A project may therefore effectively be assessed as compliant in some jurisdictions, even though post-construction assessments have not commenced or been completed, relying on the predictive assessments undertaken prior to construction. There may be an opportunity to introduce more formal processes to properly clarify the 'deemed' compliance period and then clearly state when a project is confirmed as compliant (once all the required post-construction testing is complete) and the timeframes for when that must occur.

The interim period of compliance uncertainty can cause a range of community concerns, particularly at, say large wind farm projects that may have a two year plus construction cycle followed by a 12-month post-construction testing/reporting program.

Anecdotally, some wind farms have been described as being 'not non-compliant' when unable to confirm compliance with required permit conditions, highlighting the difficulty of declaring a wind farm to be 'non-compliant' when its default status is compliant. Again, it may be appropriate to consider that a wind farm is deemed to be operationally compliant during the construction, commissioning and testing periods, but ongoing compliance is subject to final confirmation by the responsible or regulatory authority after compliance testing is completed.

From the Commissioner's observations, one solution to this issue is for a wind farm to be licensed by the appropriate environmental regulator. Under this scenario, the wind farm would need to confirm and maintain its compliance with the applicable license and permit conditions or risk losing its license to operate in the event of unrectified material breaches of the license and/or permit conditions. The license conditions could include conditions to be met during the period prior to post-construction testing, particularly with regard to handling abnormal or mechanical noise issues that can arise.

Measurement approaches for measuring compliance with the standards can also vary between projects and jurisdictions. Given the extraordinary number of variables to be measured, consideration needs to be given to the consistency of measurement, calculations and reporting for assessing environmental measures such as noise and flora and fauna impacts when setting permit or license conditions.

For example, there is much scope for variability when selecting the noise data points to be included in a noise compliance assessment and determining the 'line of best fit' for those set of noise data points – such variances could mean the difference between compliance or otherwise when assessing the results of a noise testing program. Section 6, which follows this section, discusses the merits of an independent audit regime to check the accuracy and integrity of environmental assessments, such as noise.

5.2. Recommendations

5.2.1. State governments should review and clarify their arrangements for the setting of and maintaining environmental standards, along with the arrangements for oversight and confirmation of compliance with those standards. It is preferred that the department(s) or agency setting and maintaining the various standards is independent of the department or agency responsible for planning and applying those standards.

5.2.2. The compliance authorities for a project should be clearly defined, transparent, accessible to the community and able to receive and investigate allegations of compliance breaches. Where compliance oversight currently rests with local government, appropriate support and resources should be made available to the council/shire to enable them to effectively perform their compliance and investigative responsibilities, including being equipped with the appropriate policies and procedures to handle alleged breaches of permit/license compliance and/or laws.

5.2.3. Based on the outcome of the review outlined in Recommendation 5.2.1, state governments should consider whether the current arrangements are appropriate, effective and consistent with best practices for the independent development, maintenance, compliance management and governance of environmental standards applicable to wind and solar projects.

5.2.4. In considering the above recommendations and possible reforms, the potential roles of an appropriate independent, state based, standards and compliance agency (such as a state environmental protection or regulatory authority) could include responsibility to:

- Set and maintain the environmental standards applied to wind and solar farms, including setback distances, noise, shadow flicker, visual amenity, flora and fauna, environment and heritage (noting the role of the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* with regard to Matters of National Environmental Significance including protected flora and fauna), along with specifying the methods and procedures for measurement of the prescribed standards.

- Review planning applications for projects and recommend/require permit conditions related to the environmental standards. Environmental standard conditions in permits should clearly state the process for how the measurements are to be undertaken and reported as well as provide the opportunity for peer review of the process, calculations and results.

- Provide or facilitate peer review and audit of expert reports, including review of testing and modelling programs, submitted by the developer related to permit requirements (see also Section 6).

- Where appropriate, license the facility once it is constructed and issue and monitor license conditions for the operation of the asset that may be subject to review and renewal. State governments should also receive and review regular reporting against those licence conditions from the project operator and may withdraw licences in the event of unrectified material breaches of applicable license and permit conditions.

- Receive and investigate complaints related to environmental standards, including alleged breaches of non-compliance with permit requirements or relevant laws.

- Confirm as required the compliance or non-compliance of an operating project with regard to environmental standards, related permit conditions and relevant laws.

- Report material breaches and investigations to the Clean Energy Regulator and other relevant agencies.

- Liaise with other agencies (e.g. Civil Aviation Safety Authority, Australian Government Department of Agriculture, Water and the Environment) on assessments and compliance matters that involve such agencies.

5.2.5. Planning permits (and/or applicable licenses) for projects should clearly state:

- The oversight organisation(s) or person(s) accountable for determining compliance of a project with its permit (and/or license) conditions, both at post-construction and ongoing operational stages.
- The process and contact details for lodging a complaint or alleged breach of permit (and/or license) compliance.
- The process to be followed if an operating project is found to be non-compliant with one or more of the permit (and/or license) conditions.
- A requirement for the developer or operator to publish transparently, on the project website, the process and contact details to make a complaint or alleged compliance breach to the designated oversight organisation.

5.2.6. During the period between the commencement of a project's commissioning/operation and the completion of any required post-construction assessments, the project could be designated to be in 'provisional' or 'deemed' compliance, pending the results of the assessments. In this scenario, a project can only move from 'provisional compliance' status to being confirmed as 'compliant' once the responsible authority has confirmed it is satisfied that the project is compliant as a result of any post-construction assessments. While the project is in 'provisional compliance' it is deemed to be compliant. Once a project has completed its post-construction assessments and confirmed to be compliant by the responsible authority, ongoing compliance is then overseen by the designated agency or responsible compliance authority. For the avoidance of doubt, a project that has been constructed in a way that is consistent with the requirements of any predictive assessments would be deemed compliant unless proven otherwise.

5.2.7. If a project's facilities are deemed by a responsible authority to be in an unrectified material breach of compliance, the project should be required by the responsible compliance authority to cease operating or curtail the non-compliant facilities until compliance is achieved.

5.2.8. The Federal Government could review the compliance enforcement powers and actions that may be taken by the Clean Energy Regulator in the event of a suspected or confirmed unrectified material breach of compliance, including the Regulator's ability to directly take punitive actions against a non-compliant project.

5.2.9. Governments should consider reviewing the primary standards across all jurisdictions for noise limits and setback distances. The following relate to wind farms only:

5.2.9.1. Based on current observations and the findings of the World Health Organization, it would appear that an appropriate level for a consistent wind farm noise limit would be 35 dB(A)[*], measured outside of the residence. Noise standards that specify 'high' and 'low' amenity noise level limits must have clear guidance that define where those limits are applicable.

5.2.9.2. Applied penalties for specific noise conditions such as tonality and special audible characteristics continue to be set at 5 dB(A), however such noise complaints should also be assessed on a subjective and reasonableness test by an approved, independent expert. Protocols should be developed and in place to clarify interpretation of 'borrowed' noise standards from other jurisdictions.

5.2.9.3. A default setback distance of 1.5 km between a residence or dwelling and the nearest turbine (note: for turbines with a tip height of 200 metres or greater, a greater setback distance may be more appropriate to accommodate increased visual amenity impacts).

[*] LA90, 10-min; or background noise plus 5 dB(A), whichever is the greater amount

Local topography, existing trees and vegetation as well as terrain need to be also considered when applying any default setback measures.

5.2.9.4. In addition to a setback distance between a turbine and a residence, a minimum setback distance of 200 metres (as measured at ground level from the centre of the tower or 150 metres from the extended horizontal blade tip, whichever is the greater) and a neighbour's boundary fence line or public road carriageway, should also be considered to mitigate potential safety risks.

5.2.9.5. In relation to proposed transmission lines, a transmission line that is less than 220 kV should have a setback distance of 100 metres from a residence, while a powerline that is 220 kV or greater should have a setback distance of 200 metres. Transmission lines should also be set back from public roads, with the suggested setback distance of the transmission line towers measured as the tower height plus 20 metres.

5.2.9.6. Consideration should be given to setback distances between a wind farm and a materially populated township or city boundary. A distance of 5 km may be appropriate to preserve amenity and provide some flexibility for planning growth of the township (note – consideration of reducing these suggested setback provisions may be appropriate in the case of a small-scale, community-supported and owned wind energy facility).

5.2.10. The noise assessment design and compliance testing conditions should include assessment and testing of the project's electrical infrastructure (transformers, substations, back-up generators etc.) and noise levels from these sources need to be compliant with the applicable standards.

5.2.11. A setback distance between a residence and other infrastructure associated with the project, such as transmission lines, should also be considered to help alleviate visual amenity impacts and noise considerations. This would include a setback distance between a residence and major transformer or generation infrastructure, such as a terminal substation. Where possible, transmission infrastructure should be placed underground and/or well away from residences and road reserves. If this is not possible, a minimum setback distance of 100 metres between a rural residence and powerline infrastructure should be considered in planning guidelines for powerlines of 66 kV or greater.

5.2.12. Power poles installed in the road reserve must comply with relevant standards and guidelines for setback distances from the carriageway, comply with any road safety requirements and road safety barrier specifications, and pole locations must be pre-approved by the responsible authority.

5.2.13. Consideration should also be given to the current standards for wind turbine shadow flicker. A typical standard at present is a limit of 30 hours of shadow flicker per year at a resident's external window or garden area. A more appropriate standard could be no more than a total 15 hours of actual shadow flicker per year at a residence and no more than 30 minutes of shadow flicker should be experienced on a given day. Neighbours experiencing (or likely to experience) shadow flicker that is annoying should also be provided with the opportunity for having visual screening installed.

5.2.14. Final siting adjustments for turbines during construction ('micro-siting') should be limited to a distance of no more than 100 metres from the approved site location, be no closer to a residence (or property boundary as per Recommendation 5.2.7) and be properly documented, including the reasons for the change. Micro-siting of a distance greater than 100 metres should require written approval from the responsible authority.

6. Use and selection of Experts

6.1. Observations

The design and approval of a proposed wind or solar farm relies heavily on third-party consultants (or 'experts') to prepare a range of reports including assessments related to noise, visual amenity, shadow flicker, aviation, flora and fauna, hydrology, vegetation and various other environmental assessments.

Experts are selected and paid for by the developer. The expert reports are typically included with the developer's planning permit submission to the responsible authority when seeking approvals for the project. Many of the assessment reports rely on complex calculations or results from predictive computer modelling. These reports also rely on assessing the project against standards that are not always clearly defined.

The accuracy of the assessment reports and recommendations is therefore highly dependent on the quality and precision of the assumptions used, correct application of calculations, the integrity of computer modelling applications, the accuracy of the data used and the skills of the expert in interpreting the output of the resulting analysis.

Once the wind or solar farm is built, experts are then engaged to carry out any required post-construction assessments. These assessments, and resulting reports, utilise actual data from the operating project, however may still rely on assumptions and modelling to collect and analyse the data and to then present in a format to support the conclusions.

It is very common practice that experts engaged to perform the design and predictive assessments during the planning phase are the same experts engaged by the developer to perform the post-construction assessments. Developers may also often use the same experts on multiple projects, establishing long-term relationships between the parties.

The selection and use of the same expert in both the design and then post-construction phases of a project may give rise to perceived or real conflicts of interest between the developer and the expert, as well as client expectations effectively placed upon the expert to confirm the project's compliance.

As a hypothetical example, an acoustician engaged to assess a proposed wind farm's design for compliance with the noise standard – is then engaged to assess the constructed, operating wind farm to confirm compliance with the noise standard. The expert acoustician may then be placed in a difficult situation if the acoustician discovers some aspects of the operating wind farm are potentially non-compliant, particularly if those areas of non-compliance may be a result of errors or assumptions made in the acoustician's predictive assessment. Enormous pressure could be placed on the expert acoustician to measure and/or interpret the post-construction operating noise data in such a way that would demonstrate compliance, rather than non-compliance, of the operating asset.

Expert reports submitted to the proponent and, in turn, submitted by the proponent to the responsible authority and other relevant agencies, would be assisted greatly if such reports were subject to an independent audit carried out by an accredited independent audit.

There is certainly scope for a clearer separation between the experts used for the predictive assessments during the design/application stage versus the experts used for the post-construction assessments of a project, along with the inclusion of independent audits of the expert's reports. A more rigorous process would yield a range of material benefits, including minimising costly expert errors during the assessment phase, minimise or eliminate perceived or real conflicts of interest and give all stakeholders greater confidence in the integrity and reliability of the expert's advice and reports.

Best practices that has been observed are as follows:

- A suitably qualified expert be appointed by a developer to carry out the relevant predictive assessment as required for the planning application. The appointed expert must be free of any real or perceived conflicts of interest and/or declare any potential conflict of interest and advise how it will be managed.

- Before submitting the project's design or planning application, an independent, accredited auditor is appointed to scrutinise and review the expert's assessment/design report. The auditor's report and findings/recommendations are provided to the developer, the developer's expert, the responsible planning authority and other relevant agencies for the subject matter (e.g. Civil Aviation Safety Authority, Country Fire Authority, Environment Protection Authority, Australian Government Department of Agriculture, Water and the Environment, local Council etc.).

- Once the project is constructed, a different expert (that is, different and unrelated to the 'predictive assessment' expert) be appointed to carry out required post-construction compliance assessments, as specified by the planning permit or equivalent instrument.

- The post-construction compliance report is then reviewed by a different independent, accredited auditor (that is, different to the auditor of the 'predictive assessment' report) to confirm the accuracy and integrity of the post-construction report. The auditor's findings/recommendations are issued to the developer, responsible authority and other relevant agencies.

- Project compliance is confirmed once the responsible authority is satisfied with the findings of the experts, accompanied by unqualified audit reports.

These additional steps and appropriate separation of experts and auditors will go a long way to facilitate confidence for all stakeholders in the significant decisions that are made on the basis of expert reports. The process will also provide better protection for industry from very costly errors and risks of subsequently being found to be non-compliant.

This type of approach for noise assessments was piloted, on a voluntary basis, at a proposed Victorian wind farm. In applying a more conservative approach than the initial assessment, the process found that a material number of turbines at that wind farm were at risk of breaching compliance if deployed as planned. Early identification of these issues allowed the proponent to adjust the operational design and parameters accordingly to ensure compliance – before construction commenced.

The Victorian Government has now formally adopted the accredited noise assessment auditor framework for all new and modified wind farm planning permits. Other states have implemented or are considering implementing variations on the above. In some cases, industry proponents have also adopted some or all of these best practices, even if not required, to ensure integrity and accuracy of the expert reports they are relying on. The practice of utilising a different expert to undertake the post-construction compliance testing program is also being increasingly adopted by industry and recommended by auditors.

In addition to noise assessments, other expert disciplines that have led to material issues in recent times included aviation safety assessments, measurement of turbines from dwellings and vegetation clearing assessments for transportation routes. Errors and/or omissions in those assessments lead to either significant project cost overruns or cancellation of the project as a result.

Finally, it is expected that these reforms will increase the market opportunities for additional experts and auditors as well as help facilitate growth of skills and firms in the relevant disciplines.

6.2. Recommendations

6.2.1. Given the heavy reliance on advice and assessments provided by experts in a project's design, planning, construction and compliance decision-making, qualified experts used for assessment engagements should be ideally selected from an accredited panel or list. The panel or list could be maintained by the relevant responsible authority (or environmental regulator). Alternately, the panel or list could be maintained by a relevant industry body or association.

6.2.2. To ensure independence and remove any real or perceived conflicts of interest, the expert organisation (or expert) selected to perform post-construction compliance assessments of a project should be a different expert organisation (or expert) to the one engaged for the design and predictive assessment planning phases of that project.

6.2.3. Expert reports, assessments and techniques used for planning submissions, such as the predictive noise assessment, should be reviewed and assessed by an independent auditor, appointed or accredited by the responsible authority and/or relevant regulator. Further, expert reports prepared with respect to post-construction compliance should also be reviewed and assessed by a different, independent auditor, also appointed or accredited by the responsible authority and/or relevant regulator.

6.2.4. The appointed independent auditors (refer to Recommendation 6.2.3) should be suitably qualified, experienced and accredited, have the ability to assess the integrity and accuracy of the expert's report and be able to identify and confirm compliance or non-compliance with the relevant permit conditions and/or prescribed standards.

6.2.5. Planning permit approval processes should carefully take into account the advice of independent auditors and/or referral agencies, such as CASA, before deciding on whether to approve a project. Where appropriate, designated authorities (e.g. the relevant road authority), may be deemed to be a statutory referral agency, whereby their advice and recommendations must be adhered to by the responsible planning authority.

7. Complaint Handling and Emergency Procedures

7.1. Observations

Complaint handling

Wind and solar farms are typically required to establish a complaint handling procedure, together with supporting systems and processes, to comply with planning permit conditions. It is also common sense that the project is able to properly receive, investigate and resolve complaints as part of normal facility operations and effective community engagement.

Complaint handling procedures are generally required to be submitted and endorsed by the responsible authority. However, currently, requirements for complaint procedures are often limited to noise and construction complaints only. In many cases, limited guidance is provided in permit conditions as to the process, scope, requirements and standards that the complaint handling procedure should adhere to.

While many projects are likely to be compliant with the requirement to submit and have an endorsed complaint handling procedure, our observations have been that a number of projects (or proponents) have not published the procedure or communicated the procedure to the community. This lack of transparency can make it difficult for community members to know how to make a complaint and the process by which they should expect their complaint to be handled.

It is pleasing to see that many projects have adopted the Commissioner's suggestions, making their complaint handling procedures transparent and available and demonstrating compliance with their processes for complaint handling. However, there are still further opportunities for proponents to ensure they are following their own documented procedures when handling complaints and avoid situations including:

- projects not following their own published procedure for handling complaints
- projects failing to internally escalate the complaint for review when the complaint has not been resolved
- multiple complaints from a resident about the same issue or issues – with no visible action being taken by the proponent to investigate or resolve
- a lack of rigour or process in complaint investigations and poor clarity in correspondence to the complainant
- complaints remaining open when they should have been closed, and
- a lack of clarity regarding next steps in the complaint handling process – leading to numerous complaints that remain unresolved and/or not closed.

There is also a wide range of project complaint handling procedures in place that vary by proponent and project, often resulting in a mix of consistency in the quality and effectiveness of the procedures. Also, project operators may possess varying degrees of complaint handling skills. As such, there continue to be further opportunities to improve the capability of staff and effectiveness of the industry's complaint handling procedures.

The Commissioner has successfully encouraged a number of developers and operators to voluntarily publish their complaint handling procedures on their project website. Many proponents have now complied with this request. Some proponents have also revised their complaint handling procedures as a result of discussions with the Office. The Commissioner continues to make suggestions to improve existing complaint handling procedures to the many industry members who have sought assistance from the Office. Proponents also often seek assistance from the Office on suggestions for handling specific complaints that they may be dealing with.

Noise considerations

While objective measures and standards are used to determine compliance with noise restrictions, it is also evident that there is further scope to investigate complaints relating to noise emissions from turbines and other infrastructure. In assessing noise-related complaints, the objective 'tests' currently in place do not necessarily capture the tonal character of noise emissions that a complainant may be experiencing. For instance, maintenance or operating issues with infrastructure (such as a turbine or a substation transformer) may lead to harmonic frequencies that produce a harsher tone to the human ear. While this is not typically represented in noise assessment data, contemporary noise measurement or recording devices can be used to indicate that the tonal character of a particular noise emission may reasonably be considered to be disturbing or offensive to a complainant.

Other events can cause abnormal noise annoyance from wind turbines. These include loose bolts, whining gearboxes, lack of greasing of the rotating nacelle causing a screeching noise during the yaw breaking process and lightning strike of a blade tip (piercing a hole in the turbine blade that causes a high-pitched whistling sound). These situations require a rapid response to a complaint and it is in everyone's interest that the asset be repaired and the noise emission rectified.

Permit requirements and complaint avenues

Following the Commissioner's discussions with the relevant Minister and Department, the Victorian Government moved quickly to introduce additional permit conditions related to complaint handling procedures and transparency based on the Commissioner's initial observations and recommendations. It is understood that these additional conditions have been applied to both new, renewed and modified planning permits issued for wind farms in Victoria.

There may also be other avenues for complaints to be lodged by residents in proximity to a project. In Victoria, complaints about 'noise nuisance' can currently be lodged with local government under the *Public Health and Wellbeing Act 2008 (Victoria)*. Councils should be fully aware of their responsibilities under this Act and ensure they have appropriate documented procedures to receive and handle complaints in the case they are lodged under this legislation. Further, the *Environment Protection Amendment Act 2018 (Victoria)* is expected to come into force in 2021 and may provide additional options for residents to raise complaints about 'unreasonable noise' and allege breaches of the general environmental duty that is central to the legislation.

Victoria has also initiated changes to wind farm noise regulation, moving investigative responsibilities from local councils to the state-based Environment Protection Authority, effective 1 July 2021. These new arrangements are similar to the regime that has been in place in New South Wales since 2013. Victoria has also passed legislation to exclude wind farms from the nuisance provisions of the *Public Health and Wellbeing Act 2008* (Victoria), effective 1 July 2021. Going forward, community members in Victoria can lodge noise complaints about operating wind farms to the wind farm operator, the EPA, our Office or in pursuit of a breach of compliance legal action in the judicial system.

Finally, industry bodies such as the CEC may have a key role to play in leading the development and promotion of consistent, best practice complaint handling models and procedures for the renewable energy industry that can be adopted by industry members, configured for their specific operations.

Emergency procedures

The Commissioner has also observed opportunities for clearer protocols to be put in place between project operators and emergency response agencies, in particular as they relate to ground and aerial firefighting, the ability to direct a rapid shutdown of assets, such as wind turbines, activating aviation safety lighting, and the positioning of turbine blades during the shutdown to minimise the obstacle's interference with aircraft (the preferred position being a 'Y' shape, with one blade aligned with the turbine tower, also known as the 'rabbit ear' position).

Not all turbine manufacturers or specific turbine models, have the ability to remotely lock the turbine blades into the ideal position for safe aerial firefighting. Some blades will continue to drift with the wind, further increasing the risks to pilots and reducing the workable airspace between turbines for planes to fly and drop retardants.

Other potential obstacles to aerial firefighting, such as meteorological masts, radio towers and powerlines may also exist around the project site and pilots need to be well aware of this infrastructure. A consistent standard for the visible identification of meteorological masts should be considered and adopted into planning guidelines and aviation safety assessments.

Turbines equipped with aviation safety lighting should ensure there are procedures in place to quickly activate the lights during a bushfire or fog event to increase transparency of those obstacles to pilots. Ultimately, pilots will need to make their own assessments and decisions about whether it is safe to fly in and amongst a wind farm, based on the weather, smoke, fog, wind conditions and any other relevant considerations or constraints.

7.2. Recommendations

7.2.1. Planning permit conditions for wind and solar farms should stipulate that the complaint handling procedures should support all types of complaints raised about the project and also meet minimum best practice standards for complaint handling procedures (such as the *Australian/NZ Standard for Complaint Handling – AS10002:2014*). The developer should implement appropriate systems and processes to support the procedures and maintain an appropriately detailed complaint register.

7.2.2. Planning permits should include a condition requiring the endorsed complaint handling procedure and the complaints register to be published on the project's website. The website should include a toll-free number and an email address to contact the project operator to make an enquiry or complaint. Developers should also proactively implement these provisions from the very commencement of development as part of best practice transparency and community engagement.

7.2.3. Planning permits should include a condition requiring that the endorsed complaint handling procedure be followed and complied with by the proponent. Failure to comply could be deemed as a material breach of permit compliance.

7.2.4. The responsible authority should have the powers and capability to enact and audit a project's complaint handling activities and complaints register to monitor compliance with the endorsed procedures and the planning permit conditions.

7.2.5. The complaint handling procedure and the project operator should have the capacity to accommodate handling of urgent or emergency complaints. These complaints may be related to safety issues as well as unacceptable environmental impacts, such as damage to a turbine caused by external events such as lightning strike or mechanical failure resulting in unacceptable noise emissions. The project operator should respond immediately, on-site, to assess, address and rectify such issues. While objective measures and standards may be in place for assessing matters such as noise emissions, a subjective, reasonableness test should also be applied when assessing environmental conditions, such as abnormal noise emissions, tonality, special audible characteristics and low frequency noise.

7.2.6. Complaint handling bodies such as developers, local councils, state governments and compliance authorities should ensure their complaint handling procedures are relevant for wind and solar farm matters. Further, complaints need to be closed out at the appropriate time with the complainant being advised accordingly.

7.2.7. For extreme emergency conditions, such as a bushfire or flood, the project operator should have appropriate controls, protocols and procedures in place, consistent with the emergency response requirements, to ensure the assets can be rapidly shut down. Power network operators should be aware that the wind or solar farm capacity may need to be shut down quickly in the event of an emergency event.

7.2.8. Projects should also work closely with the relevant firefighting (and/or emergency services) agency to review and agree on protocols and procedures to be followed in the event of an emergency.

7.2.9. The project should also use appropriate marking devices to ensure transparency of other aerial obstacles such as meteorological masts, radio towers and powerlines in consultation with the firefighting agency. Material obstacles should require planning permits. If the obstacle is a risk to aviation safety, a referral should be made to CASA and the obstacle should be assessed as part of the overall aviation impact assessment.

7.2.10. Wind turbine design standards should be reviewed in light of their capability to remotely position and lock turbine blades in the event of a bushfire. Developers should strongly consider selecting turbines that conform to this standard going forward. There would also be a strong advantage if turbines were delivered with the capability to install aviation lighting even if this is not a permit requirement or intended for use under normal conditions, as the capacity to quickly and remotely activate safety lighting on turbines may assist greatly in the event of any bushfire or other emergency.

7.2.11. The industry peak body (CEC) should continue to provide leadership to the industry by developing and promoting best practice standards for complaint handling, along with community engagement and quality assurance of member companies. The CEC could also encourage or mandate (via a code of conduct) that its industry members voluntarily publish their project's complaint handling procedure and contact details, and that members are properly trained and skilled in effective complaint handling.

7.2.12. Policies and procedures for handling noise and other environmental complaints lodged with government agencies, including local councils, should be in place where the possibility exists for complaints to be made either as an alleged breach of compliance and/or under other governing legislation, such as the Victorian *Public Health and Wellbeing Act 2008* and the *Environment Protection Amendment Act 2018*. Overlapping legislation may well need to be adjusted to avoid unnecessary duplication of process and the prospects of vexatious complaints and litigation.

8. Site Selection

8.1. Observations

Background

The selection criteria for a potential site for a proposed project may be based on a range of factors including the available wind or solar resource, proximity to existing transmission infrastructure, potential for securing landowner arrangements and other approved development in the area.

Current transmission infrastructure was originally designed and built many years ago based on the location and availability of the then existing energy resources (such as coal, gas, hydro) which, at that time, did not envisage the significant shift to large-scale renewable resources such as wind and solar energy. These relatively new resources are often optimally (in all other respects) best located in different geographies and often well away from existing grid infrastructure.

Prospecting developers are not generally restricted in initiating a new project on a particular site and almost always pursue sites that are very close to existing transmission infrastructure. Developments often commence by prospectors initiating discussions with adjoining landowners at a transmission optimal site to seek their agreement to host the project. However, because existing transmission infrastructure is often located near communities, lifestyle dwellings and primary producers, prospective and developed wind and solar farms are more likely to be located in areas that will cause friction with non-involved neighbours and communities.

Site impacts

The Commissioner's experience to date indicates that there is a much higher likelihood of community issues and concerns to contend with when a proposed or operating wind or solar farm is located near or amongst more populated areas. Often, the more populated areas correlate with the proximity and availability of transmission infrastructure, however, they can also result in a very large number of neighbours who will reside in close proximity to multiple turbines or solar arrays.

Further, there may be multiple proposed (and/or existing) projects in a given area, with the potential for residents to be 'surrounded' by wind turbines and/or solar arrays if such projects proceed. These scenarios could lead to a range of compounding issues for residents including noise, visual amenity and potential economic loss. Other complications may occur if project construction timeframes overlap, placing enormous pressure on local resources and infrastructure, in addition to the usual annoyances such as construction noise, traffic, road damage and dust.

There can also be other severe cumulative effects during construction of more than project in a specific locality, placing enormous pressures on roads, resources (such as gravel), meal providers, accommodation and skilled tradespersons.

Based on our complaint handling experiences, the Commissioner has found that locating wind turbines on the top of hills or ridges, while optimum for capturing the wind resource, can have greater impacts on visual amenity, may lead to specific noise and shadow flicker scenarios for residents in the valley beneath and may have other associated impacts on the community. Access roads for hill and ridge wind farms can also be obtrusive and significantly damage and constrain the remaining available farming land in the area.

Conversely, there appear to be minimal issues raised to date about wind farms that are located on large land holdings, or on flat or slight to moderate undulating land and sites that are well away from neighbours and towns (noting comments made earlier regarding landowner and neighbour agreements in subsections 1 and 2).

Location, capacity and availability of accessible transmission lines remains a significant challenge for the renewable energy industry. A number of more recently completed projects have discovered, upon connection to the grid, that there is insufficient available capacity in the existing transmission line for the project's generational output to be delivered – resulting in significant curtailment of the generation capacity of the project. In particular, a number of large-scale solar projects have experienced this situation, as these projects tend to be in more remote locations in order to capture the solar resource. Again, it may be prudent for developers to engage early with AEMO and transmission operators to ensure that the planned project's output can be fully accommodated.

Optimising site locations

There may be opportunities to select and prioritise wind and solar energy projects in the current pipeline based on an increased likelihood of acceptance of the project by the surrounding community. With the increase in development and construction costs, the ongoing grid connection issues and the declining value of large-scale generation certificates, not all projects in the development pipeline are expected to go ahead. There is an opportunity to select projects that meet other key parameters, including economic and regional development goals, while also selecting sites that are optimal from a community impact perspective.

Recent state and territory government initiatives, such as the identification of Renewable Energy Zones (REZs) in New South Wales, Queensland and Victoria as well as the VRET Program (Victoria), Reverse Auction Program (ACT) and Renewables 400 (Queensland) have enabled governments to become involved in selecting projects that are located in more optimal sites. These programs also provide a level of control to mandate community engagement programs through to ensuring minimal or no cumulative effects from neighbouring projects. Upgrades to the grid system at a national level may also provide opportunities to explore new locations for renewable projects.

REZs may need to contend with the issue of cumulative effects as developers concentrate their efforts in the REZ geography to leverage the transmission hub that is to be established. REZ administrators have the opportunity to license or select developers/projects that are most likely to achieve community acceptance as well as not create cumulative effect issues as an unintended consequence of a REZ.

Given that existing projects have most likely already selected optimal sites for their location, management and selection of appropriate new sites from remaining site options may become more difficult. A more ‘top-down’ approach to selecting projects, together with appropriate long-term planning and augmentation of the grid, should assist greatly in managing this challenge going forward.

8.2. Recommendations

8.2.1. State/territory and local governments should consider assessing proposed wind and solar energy projects on a wider range of criteria (including ability for power output to be transmitted and consumed, the suitability of a location from a community impact perspective and the degree of community support) and then prioritising projects for approval or progression accordingly. ‘Reverse auction’ feed-in tariff schemes such as the schemes deployed by the ACT, Queensland and Victorian governments, could be an example of how to prioritise and incentivise projects to be developed in preferred locations. These schemes can also promote best practice community engagement. Visual amenity guidelines such as the *Wind Energy Visual Assessment Bulletin for State Significant Wind Energy Development* introduced in New South Wales in 2016 can also restrict development in more populated areas, including assessing the acceptability of multiple wind farms in a given location.

8.2.2. State and local governments may also consider other criteria in assessing and prioritising wind and solar energy projects, including economic development and the ability to both support regional and industry development through improved local electricity supply and infrastructure in regional communities. Appropriate zoning for renewable energy development and overlays for clarifying where it would be appropriate or not appropriate to build and operate projects should also be considered.

8.2.3. Prospecting for new wind and solar farm development sites could be subject to an ‘approval (or license) to prospect’ requirement issued by the responsible authority before formal prospecting commences. The approval to prospect a specified potential site would be granted on a range of criteria, including the suitability of the proposed site, alignment with the State’s renewable energy zone strategy, transmission capacity/availability as well as the credentials of the developer and key personnel. See also Recommendation 1.2.10.

8.2.4. As part of the assessment suggested in Recommendation 8.2.1, the responsible authority should have processes in place to obtain and verify clear evidence of the developer’s consultations with affected landowners and residents and be able to assess the likelihood of strong community support for the project.

8.2.5. Once an approved project has materially commenced construction, the responsible authority may need to check other approved projects in the area which are yet to commence construction, to ensure any compounding effects on residents, including noise, shadow flicker and visual amenity, have been properly considered in those applications/permits. If necessary and where reasonable, the responsible authority should also have the ability to require a modification to the approved planning permit and layout of those projects that have not already materially commenced construction. Background noise levels should exclude any noise contribution from a neighbouring operating wind farm for the purposes of applying the noise standard.

8.2.6. State governments should publish and maintain a map of all operating and proposed wind and solar farms, including the location of the project, location of wind turbines or solar arrays, the status of the project (proposed, permitted, in construction or operating) as well as information about the project’s design, including number and size/rating of wind turbines or solar arrays and information about the proponent.

8.2.7. State governments, in conjunction with the appropriate Australian Government departments/agencies and the Australian Energy Market Operator (AEMO), should review current and planned transmission infrastructure to ensure it allows for new large-scale renewable generation facilities to be connected in the most optimal locations for renewable resources. AEMO's Integrated System Plan has identified a number of potential renewable energy zones that provides insight and direction transmission planning. The resulting new and/or augmented transmission infrastructure needs to be planned, built and commissioned and in place in a timely manner. If state government REZ programs are executed well, they should address this recommendation along with the major backbone grid deployments currently in plan.

9. Health and Safety Matters

9.1. Observations

Health

Much has been and continues to be written and researched on the topic of wind farms and health effects. Debate continues around the world as to whether a wind farm causes physiological harm to residents living within its vicinity.

In 2016, the NHMRC announced the funding of two research studies into wind farms and health. One study is focused on the effects of audible wind farm noise on sleep and is led by Professor Peter Catcheside at Flinders University. The other study is focused on measuring the effects of infrasound impacts on humans and is led by Professor Guy Marks at the University of New South Wales.

In addition, in late 2015, the Australian Government established the Independent Scientific Committee on Wind Turbines to provide advice on a range of matters including wind farm noise levels and the relationship to health effects.

A number of complaints about wind farms received by the Office included references to health impacts as a result of wind farm operations. Health conditions cited in complaints include sleep disturbance, headaches, ear-aches, 'pounding' in the ears, tinnitus, tachycardia, high blood pressure, sight impairment, diabetes, chest-tightening, nausea and general fatigue. The complainants generally state that such conditions are caused by audible noise and low frequency noise, including infrasound, along with vibration sensations allegedly attributable to the operation of nearby turbines. In some cases, complainants have stated that some health conditions are persisting even when the turbines are not operating.

Numerous invitations have been extended to complainants to provide evidence of their medical conditions. Complaints regarding health concerns received by the Office have, in the main, provided only anecdotal evidence regarding stated health issues and perceived causality. It has therefore been difficult to form an opinion on whether or not the stated health conditions reported by complainants are valid and, if valid, whether or not the health conditions are possibly a result of the wind farm's operations or from some other known cause.

The Office will continue to handle complaints, with supporting evidence, from community members regarding potential health effects from operating wind farms. Since the Office has commenced, 78 complaints about operating wind farms have been received. These complaints relate to 18 operating wind farms out of a total of more than 100 operating wind farms across Australia. Of these 78 complaints, approximately half of the complainants cited concerns about health impacts from the operating wind farms. Of these, a very small number of complainants agreed to work with the Office and provide evidence of the stated health issues. In all of these cases, the root cause of the stated health issue was not attributable to the wind farm.

Further, in 2020, only eight complaints about operating wind farms were received whilst the clear majority of complaints received have been about proposed wind farms. On the basis that a wind farm has to be built and operating before it could possibly cause a physiological health effect, the potential cohort of potential physiological health complaints is very small.

It should also be noted that, for the last three years, the Office has not received any complaints regarding allegations of vibration sensations being caused by a wind turbine’s operation. The Office’s findings could not confirm any actual evidence of vibrations at a residence with causality from a turbine, findings which are consistent with advice received on this topic from Flinders University. The Office’s complaint data further substantiates these findings.

It is possible that stated health conditions that exist may be as a result of other known causes not related to the wind farm’s operations. Of material concern is the potential situation whereby a resident may fail to seek and obtain appropriate medical advice and treatment for a treatable health condition, due to the possibly incorrect assumption that an operating wind farm is the perceived cause of the condition. For example, if a resident is experiencing sleep difficulties, they may be advised by their general practitioner (GP) to consult a sleep specialist for a proper diagnosis of the root cause and advice on treatment to remedy the condition. If the GP’s advice is not followed, the cause of the condition may persist unnecessarily.

Health conditions may also arise as a result of stress, annoyance or anxiety related to the presence of an operating wind farm or concerns about the potential effects of a proposed wind farm. Further, uncertainties in relation to whether a proposed wind farm will actually proceed (a period which may extend for several years) may also contribute to stress and anxiety. Again, affected residents may need to seek appropriate medical treatment for these ancillary health conditions as well as seek ways to resolve their concerns.

In November 2019, the South Australia Supreme Court handed down its decision in relation to the proposed Palmer Wind Farm. The Court concluded that claims that the turbines would cause sickness and health issues for residents were unsubstantiated. Of note, the objectors did not provide sufficient evidence of causality from any expert medical witness. The Court’s finding has been consistent with the Commissioner’s observations and recommendations based on actual complaint experience.

The Office will continue to monitor relevant decisions that explore evidence about wind farms and health in consultation with the Independent Scientific Committee on Wind Turbines, such as the guidelines issued by the World Health Organization in 2018, as well as hearing outcomes, such as the Palmer Wind Farm decision and the Administrative Appeals Tribunal decision in *Waubra Foundation v Australian Charities and Not-for-profits Commission*. The Office will also monitor and continue engagement regarding any results of the NHMRC funded studies (which are expected to publish in late 2021 or 2022) and the work of the Independent Scientific Committee on Wind Turbines. We will continue to assess any further evidence gathered through complaint handling activities.

The Office has also observed the need for clearer, streamlined legislation that provides a balance of protecting the community while also providing a degree of certainty for the proponent. In Victoria, complaints made under the *Public Health and Wellbeing Act 2008 (Victoria)* have utilised the nuisance provisions under the Act to allege that wind farms are creating a ‘noise nuisance’, even when a wind farm has been deemed compliant with its permit conditions. Councils should have in place clear procedures for investigating and determining whether or not a wind farm is causing a noise nuisance under the Act.

Safety

There have been an increasing number of safety related incidents occurring in relation to large-scale renewable projects.

Some of these incidents have resulted in serious injuries to project workers, while others had the potential to inflict severe impacts on personnel and asset safety. A number, but not all incidents have been reported to the relevant workplace safety regulator.

Further, while some incidents remain under investigation to determine the root cause analysis, other incidents may have not been subject to the same rigour of process.

Examples of recent incidents that the Office is aware of include:

- Turbine blades falling to the ground during operations (three incidents in Victoria, one in NSW and one in WA)
- A construction worker’s hand being severed while cleaning a concrete pump at a wind farm site (NSW)
- Roll-over of blade transportation vehicles on public roads (Tasmania and Victoria)
- Blade transportation vehicles colliding with power lines or other infrastructure (Victoria)
- Blade transportation vehicles colliding with other moving vehicles (NSW)
- Roll-over of on-site cranes (three incidents in Victoria)
- Workers falling from significant heights inside wind turbine towers (NSW and Tasmania)
- Inability for emergency responders to quickly locate injured worker on site (Tasmania)
- Workers involved in vehicle accidents to or from the project site (Tasmania)
- Fires allegedly caused by connecting transmission lines (NSW)
- Inappropriate or illegal use of firearms causing damage to transmission lines and turbines (Victoria).

Given the seriousness of these incidents and the potential increase in new incidents as the industry grows, along with the growth in scale and size of equipment, the industry and the broader community would benefit greatly from an industry convention and forum that encourages:

- Full transparency of material safety incidents to the industry body as soon as they occur
- Reporting of the incident to the relevant workplace safety regulator (even if no injuries occur)
- Ensuring that a proper investigation is conducted that determines the actual root causes of the incident
- Sharing the results of investigations so that other industry participants and regulators can learn from the experience and assess their own exposures and risks to a similar incident
- In the event of systemic or mechanical or operational failure, ensuring that other affected operators are aware and can take specific corrective actions on their fleet
- More broadly, implement corrective actions as necessary across industry that arise from recommendations as a result of incident investigations
- Facilitate a culture of continuous improvement and zero harm across the industry through transparency and proactive actions.

These important matters have been raised and discussed with the leaders of the industry and our Office looks forward to improvements in both transparency of incident information along with an improved safety record for the industry as a result.

Finally, large-scale renewable projects do not currently require a building permit as the structures do not correlate to the existing National Construction Code. Therefore, the regular checks and balances provided for by a building permit, that are in place when building say a 50-storey building, are currently not present when constructing a fleet of 280 metre tip height wind turbines. The rationale for excluding large-scale renewable power stations from needing a building permit needs to be re-assessed to determine whether a revision is appropriate.

9.2. Recommendations

9.2.1. Federal and state governments should continue to assess the outcomes of research into wind farms and health, including outcomes of the two NHMRC funded wind farm health studies and findings of the Independent Scientific Committee on Wind Turbines. Environmental standards, such as noise standards, should be monitored and reviewed in line with any recommendations arising from these programs.

9.2.2. Residents living in the vicinity of an operating or proposed wind farm that are experiencing health conditions should be encouraged to seek appropriate medical advice to properly diagnose and treat any health-related conditions accordingly. GP’s receiving patients from wind farm locations should maintain an awareness of wind farm and health matters through bodies such as the Australian Medical Association and assist patients in understanding the need for appropriate testing, diagnosis and remedies for the presented health conditions or concerns.

9.2.3. Medical practitioners who identify potential causational links between a patient’s health condition and their proximity to the operation of a wind farm should report such incidences in an appropriate way to the relevant professional body, association and/or government agency.

9.2.4. Residents who are experiencing unacceptable noise levels from a wind farm should be encouraged to report such incidents to the wind farm operator, the compliance authority and/or the appropriate regulator to initiate the appropriate investigation and resolution of the noise incidents.

9.2.5. Residents lodging health-related complaints with the Office should assist with providing and sharing any evidence regarding their stated health conditions and any medical assessments that identify possible causality of the wind farm as a contributor to the health conditions.

9.2.6. State governments may need to identify and address potential overlapping regulations and/or legislation with regard to noise emissions from a wind farm and ensure clear procedures are in place to handle, investigate and resolve such complaints raised under the various avenues.

9.2.7. The large-scale wind and solar industry commit to being a leader in workplace safety and will share and be fully transparent about safety incidents, incident root causes and corrective actions. The CEC can play a major role in ensuring and facilitating such information sharing with industry participants and safety regulators.

9.2.8. In light of the risks involved in constructing and maintaining large-scale renewable infrastructure, state and federal governments should give due consideration to introduce a requirement for such projects to obtain a building permit.

GLOSSARY

A-weighted scale	A scale that is applied to instrument-measured sound levels to replicate the relative loudness perceived by the human ear.
Amenity	The visual impact a wind farm has on the landscape.
Australian Government	The Government of the Commonwealth of Australia (also referred to as Federal Government).
Australian Wind Alliance (AWA)	A not-for-profit organisation that supports the wind energy industry in Australia, with the objectives of boosting regional economies and reducing pollution and greenhouse emissions.
Clean Energy Council (CEC)	The peak not-for-profit organisation supporting the clean energy industry in Australia. The CEC represents a range of clean energy sectors and works with governments and other organisations to promote the industry.
Community Consultative Committee (CCC)	A CCC is a membership that is set up to facilitate consultation between wind farm developers, the community, local councils and other stakeholders that may be involved in the development phase or operation of a wind farm.
Community Association	A non-government association of participating members of a community who facilitate representative community engagement in the development process.
Community Engagement	The consultative process of wind farm developers supporting the participation of community members in the development process.
Commercial Dispute	An issue regarding the contractual goods or services of a wind farm whereby financial compensation has been sought by a party (for example, a host or a neighbour).
Complainant	One or more resident(s) from a residence who has contacted the Office for the purpose of making a complaint.
Concerned Resident	A person who resides in a dwelling within proximity to a proposed or operating wind farm facility, who holds concerns about potential impacts of the proposed or operating wind farm and may make a complaint to the Commissioner.
Construction	The stage in which the wind farm including access roads is being built. The construction stage may last a number of years.
dB	Decibels, a measurement unit used to describe the level or intensity (loudness) of a sound.
dB(A)	A-weighted decibels, a measurement unit that used to express the relative loudness of sounds in air as perceived by the human ear.
dB(C)	C-weighted decibels, a measurement unit that is used to measure low-frequency noise.
dB(G)	G-weighted decibels, a measurement unit that is used to measure to infrasound.
Economic Loss	The potential negative economic impact that a proposed or developed wind farm may have on a particular community or individuals within a community. This is typically the loss or perceived loss of property values or business within proximity to a proposed or operating wind farm.
Expert	A person who has special skill, knowledge or authority in a particular field of study.
Health	General physical or mental condition of a concerned resident.
Hz	Hertz, a unit which measures the frequency of sound waves, perceived by the human ear as pitch. The typical range of human hearing is 20-20,000 Hz.
Industry Association	An organisation founded and funded by businesses and other parties that have an interest in the wind energy industry.
Industry Member	Employee or other party who is involved as a member of an industry association.
Infrasound	Sound that is lower in frequency than 20 Hz or cycles per second, the ‘normal’ limit of human hearing.
Independent Scientific Committee on Wind Turbines	An independent, multidisciplinary, expert group established in 2015 by the then Minister for the Environment, the Hon Greg Hunt. The Committee was primarily established to investigate and provide advice on the potential impacts of sound from wind turbines on health and the environment.
$L_{A90,10min}$	The A-weighted sound pressure level, obtained by using the fast time-weighting, that is equal to or exceeded for 90% of a 10 minute time interval. The values for individual 10 minute time periods are highly variable and a function of the hub height wind speed. The actual value for a particular hub height wind speed is determined by best fitting a polynomial function of hub height wind speed, which can be up to fourth order, to the individual 10 minute time period $L_{A90,10min}$ values when the wind turbines are operating. It is corrected to remove the effect of the background noise by subtracting a background noise function determined in the same way when the wind turbines are not operating.

	For example, for a particular hub height wind speed, the $L_{A90,10min}$ function determined as described above must be less than the greater of 35 dB and the background noise function determined as described above plus 5 dB.
Micro-siting	The process whereby the specific location of a wind turbine is determined.
National Health and Medical Research Council (NHMRC)	An independent statutory agency and expert body that promotes the development and maintenance of public and individual health standards. NHMRC provides research funding and development of advice, drawing upon a broad range of resources.
Natural Environment	The land, water, biodiversity, flora and fauna and the naturally occurring ecological processes that may be impacted by the development or operation of a wind farm.
Neighbour	A resident of a property that is within close proximity to wind farm turbine/s, but does not host the turbine.
NZS 6808:1998	A recognised standard in New Zealand introduced in 1998 that provides methods for the prediction, measurement and assessment of sound from wind turbines. This standard was based on the United Kingdom 1996 Energy Technology Support Unit (ETSU) report *The assessment and rating of noise from wind farms* (ETSU-R-97, 1996). However the New Zealand standard introduced the L95 measurement used to describe background sound in New Zealand. The standard limit was 40dB, with a ‘background +5 dB’ variable. This standard was used for all wind farms in New Zealand until the introduction of the 2010 standard and was also adopted in Victoria prior to 2010. This standard is now succeeded by NZS 6808:2010.
NZS 6808:2010	A recognised standard in New Zealand introduced in 2010 that provides methods for the prediction, measurement and assessment of sound from wind turbines. This standard succeeded the 1998 version (NZS 6808:1998). While the 1998 version was introduced prior to significant wind farm development in New Zealand, a number of technical refinements and incremental enhancements were included in the 2010 standard. Notably, the standard also provided for a more stringent ‘high amenity noise limit’ in special local circumstances.
Ombudsman	Appointed authority to assist the public by investigating and resolving complaints on a specified issue.
Planning Process	A local, state or Federal Government process to determine whether a proposed project will be approved.
Responsible Authority	The planning authority responsible for the project from a planning/approval/compliance perspective.
Safety	The potential for the wind farm to cause danger, risk or injury to residents of a community within proximity to a wind farm. May include issues such as sleep deprivation, fire hazard, or any personal well-being.
Shadow flicker	The shadow cast by the sun over the rotating blades of a wind turbine that results in a rotating shadow affecting neighbouring properties.
Supportive Member	A member of the community that is in favour of a proposed or operating wind farm, including persons who reside in a dwelling within proximity of a proposed or operating wind farm
Terms of Reference	The specifications that outline the scope and limitations of the Office of the National Wind Farm Commissioner. See Appendix A.
Vibration	The oscillatory motion of an object or parts of an object. One of its possible causes is infrasound from a wind turbine.
Wind Farm Maintenance/Operations	Related to the ongoing process of ensuring the upkeep of the wind farm turbines for the life of the project.
Wind Turbine	Device with at least one moving part called a rotor assembly, which is a shaft or drum with blades attached, which is used to convert the wind’s kinetic energy into electrical power.

APPENDIX B – UPDATED TERMS OF REFERENCE 2018-21

National Wind Farm Commissioner Updated Terms of Reference 2018-21 (revised March 2021)

The role of the National Wind Farm Commissioner will now be known as the Australian Energy Infrastructure Commissioner. The Government has also agreed to expand the role to include new major transmission projects.

The Commissioner will work collaboratively with all levels of government, scientists, experts, industry and the community to resolve complaints from community members about proposed and operational wind farms, large scale solar farms (5 MW or more), storage facilities, such as large scale batteries (1 MW or more) and new major transmission projects.

The Commissioner will refer complaints about wind farms, large scale solar farms, storage facilities and new major transmission projects to relevant authorities and help ensure that they are properly addressed.

The Commissioner will lead efforts to promote best practices, information availability, and provide a central, trusted source for dissemination of information.

The Commissioner, supported by the Australian Government Department of Industry, Science, Energy and Resources will report to the Minister for Energy and Emissions Reduction and provide an Annual Report to the Australian Parliament on delivering against these Terms of Reference.

The Commissioner's role will not duplicate or override the important statutory responsibilities of other jurisdictions, such as those relating to the planning and approval of wind farms, large scale solar farms, storage facilities and new major transmission projects.

The Commissioner is to draw on the work of the Independent Scientific Committee on Wind Turbines.

In 2018, the role of the Commissioner was extended for a period of three years, until October 2021. The role will be re-evaluated by the Australian Government prior to that date.

Considerations for Landholders before entering into Commercial Agreements

Version 1.2 – October 2021

About this document

This document has been prepared by the Australian Energy Infrastructure Commissioner. It is intended for use as general background information and considerations for landholders who may be reviewing commercial agreements to host renewable energy infrastructure on their property.

This guideline has been developed based on the Office's experience and understanding in observing and handling these matters, as well as the observations and recommendations that are set out in the Commissioner's Annual Report to the Australian Parliament (available on the Commissioner's website at www.aeic.gov.au).

The Office of the Australian Energy Infrastructure Commissioner does not guarantee the accuracy, reliability, currency or completeness of the content in this document and its content does not necessarily reflect the views of the Commissioner. Landholders are strongly encouraged to seek independent legal or financial advice before entering into any commercial agreements.

About us

The Australian Energy Infrastructure Commissioner is an independent role appointed by the Australian Government. The Commissioner's role is to:

- handle complaints from concerned community residents about wind farms, large-scale solar farms, energy storage facilities and new major transmission projects
- promote best practices for industry and government to adopt in regard to the planning and operation of these projects, and
- provide greater transparency on information related to proposed and operating projects.

License agreements

A 'license' agreement (also known as an 'access' agreement) allows the developer rights to access a landholder's property for the purposes of surveys and assessments, typically for a specified duration of time. Activities may include the need to access the land to capture wind or solar resources data as well as undertake environmental surveys and investigations, such as geotechnical and cultural heritage to determine the suitability of the site and feasibility of a project.

A license agreement does not guarantee that a project will proceed and should not bind the landholder beyond allowing access for the term of that agreement.

Matters for the landholder to consider include:

- Term of the agreement, extension clauses and ability for landholder to terminate.
- Binding clauses – clauses that may require the landholder to enter into subsequent agreements and specifying the terms of such an agreement.
- Fees payable to the landholder during the agreement including how and when they are paid.

- Constraints on the landholder in the event of sale or transfer of the land.
- Ability of developer to transfer the agreement to another party with or without landowner consent.
- Access protocols that the developer must comply with before and during access to the property.
- Landholder protection from potential damage, claims and legal action.
- Required insurances to be taken out by the parties to the agreement.
- A dispute resolution mechanism.

Option agreements

An ‘option’ agreement provides the developer with rights to lease some or all of a landholder’s property for the purposes of construction and operation of the project. Such an agreement should be in place for a specified duration of time.

An option agreement does not guarantee that a project will proceed or that the developer will enter into lease, nor does it typically guarantee that the landholder will host the number or capacity of assets that may have been discussed with the landholder. However, option agreements may bind the landholder to the terms of a lease.

- Term of the agreement, renewal/extension clauses and ability for landholder to terminate.
- Any binding clauses (clauses in the agreement that may require the landholder to enter into subsequent agreements and terms of such agreements).
- Fees payable to the landholder during the agreement including how and when they are paid.
- Sale or transfer of the land by the landholder and ability of developer to transfer the agreement to another party with or without landowner consent.
- Mechanisms to apply if the project’s scope materially changes, particularly if the changes result in negative impacts for the landholder, such as a reduced number of turbines or arrays.
- Milestones that must be achieved by the developer during the term of the agreement, including considerations if the project’s approval or financing is materially delayed.
- A dispute resolution mechanism.

Lease agreements

The lease agreement (or ‘host’ agreement) is a complex commercial lease that commits the landholder for a very long time and places significant obligations and responsibilities on the landholder.

A wind or solar farm usually consists of one or more ‘host’ landholders willing to have project infrastructure (e.g. wind turbines or solar panels) located on their land. A lease agreement is a long-term agreement that is negotiated between a project developer and the landholder. This agreement is essentially a commercial lease and should set out the terms to enable the developer to install, operate and maintain the project infrastructure.

It is important that any lease agreement presented to a landowner is fair, reasonable and written in plain English.

Landholders may also enter into agreements for land access, private transmission line easements, substations, office buildings and other items associated with a project.

Matters for the landholder to consider include:

- Fees payable to the landholder during the development stage (pre-permit approval), financial close stage (post-permit approval), construction, operational and decommissioning stages.
- Method of calculating the fee amounts and fee increases over time.

- Timing of payment of fees to the landholder by the project.
- Rights of the landholder in the event of non-payment of the annual fees by the operator.
- Variations to fees in the event of changes to turbine or solar array layout, turbine specifications, turbine capacity and number of turbines or solar arrays or other infrastructure to be hosted.
- Whether there is a payment amount in the event that wind turbines, solar arrays or other infrastructure will no longer be hosted.
- Easements that may be required, such as for a connecting powerline.
- Landowner's responsibilities in regard to residential tenants and/or property lessees.
- Sale or transfer of the land by the landholder or transfer of ownership by the project.
- Restrictions on further development on the property.
- Provisions in the event of subdivision of the property.
- Term of the agreement, options for renewal of the agreement and provisions for termination.
- Required insurances and responsibility for taking out insurances and payments.
- Funding security provisions to protect the landholder in the event of 'tenant default'.
- Dispute resolution procedure, including key contacts at the developer for the raising and escalation of issues.

Lease agreements – pre-construction

There can be quite a long period between a developer lodging a permit application for a project and commencement of construction.

Typically, a developer must obtain the necessary permit approvals and then go on to arrange and confirm project finance, known as 'financial close'.

Even after financial close there may still be further delays due to changes in equipment selection and design, resulting in the need for permit modifications and further approvals.

During this time, the developer needs to have 'occupancy' of the land required for the project – which is typically done via a lease agreement with the landholder.

Landholders should consider what fees should be payable to them during this time, which may last for many years. Landholders should also consider termination provisions in the event that the landholder wishes to exit the Lease due to ongoing delays.

Lease agreements – construction activities

Construction activities can be particularly disruptive to the landholder for a period that may last a few years, so it is important that the landholder has a clear understanding of the extent of any potential impacts to the property during this phase and has discussed how these impacts can be managed or mitigated.

Key matters for the landholder to discuss or negotiate in relation to the construction phase of project include:

- Fees payable to the landholder during the construction period.
- Proposed internal road layout for the project – consider impact on farming operations.
- Location of other infrastructure (cabling, construction offices, substations, transmission lines etc.).
- Gate policy and other on-site procedures, such as biosecurity compliance requirements for contractors entering the property.
- Use of additional land during construction and major maintenance activities.
- Responsibilities for maintenance of shared use infrastructure.

- Removal of construction waste, including who is responsible and timeliness of removal.
- Access agreements required for accessing easements via a landholder's property.
- Removal of ancillary infrastructure and rehabilitation of disturbed land after the completion of construction works, such as replacement of soils over underground trenching for cabling.
- Work place safety responsibilities during construction, including required insurances.
- Compliance with permit conditions related to construction.
- Provisions and process for handling disputes such as damage to landholder's property/equipment by contractors.

Lease agreements – operational activities

Both wind and solar farms typically have a project life span of approximately 25 years. During the operational phase of a project, it is expected that there will be some ongoing maintenance activities which will require periodic access to the property.

It is also important to consider the administration of the agreement over the course of the project. The landowner should set aside adequate time on a periodic basis to review the terms of the agreement, ensure adherence by both parties and resolve any conflicts that may arise.

In considering a proposed lease agreement, key matters for the landholder to review/negotiate in relation to the operational aspects of the project include:

- Fees payable to the landholder during the operational phase of the project, including timing of fee payments and escalation of fees.
- Additional fees payable for use of extra land during operations for major maintenance activities
- Ongoing access requirements for operational and maintenance activities.
- Responsibility for occupational health and safety plans and communications.
- Responsibility for developing and maintaining the emergency plan
- Compliance with permit conditions related to operations (e.g. noise emissions).
- Responsibility for fire and emergency plans and communications.
- Required insurances to be taken out by the project operator in respect of the landholder.
- Required insurances to be taken out by the landholder in respect of the project.
- Additional insurances that may be required to be taken out by (or for) neighbours to the project, such as increased public risk & liability insurance.
- Responsibility for the costs and payment of:
    - the various insurances
    - additional council rates levied on the landowner as a result of the project
    - additional land taxes levied on the landowner as a result of the project
    - additional emergency services or other levies as a result of the project
    - additional duties payable upon sale or transfer of the land.
- Payment of outgoings – are they paid directly by the project or is the landholder required to pay and then seek reimbursement.
- Provisions for landholder to sub-let some or all of the property.
- Development restrictions that may be placed on the land by the project.

- Constraints on sale or transfer of the property.
- Term of the lease agreement, options for renewal and termination provisions by either party
- Key contacts at the developer for the raising and escalation of issues and the dispute resolution process for handling breaches of the agreement

Lease agreements – decommissioning

At the end of the operating life of a project, there is a clear expectation that the wind or solar farm will be decommissioned and all turbines, solar arrays and other infrastructure will be removed from the property, with the property returned to its original condition. However, it is important for the landholder to have a clear understanding of how the decommissioning phase will be managed by the project operator.

In relation to the decommissioning of a proposed project, key matters for the landholder to discuss or negotiate include:

- Scope of the decommissioning activities required.
- Decommissioning plan and provision of the plan to the landholder.
- Decommissioning responsibilities of the parties, which may be defined in the plan and/or the permit.
- Detailed, verified estimates of the likely decommissioning costs.
- Clarify who is responsible for decommissioning the site and pays for the decommissioning costs.
- Arrangements to ensure decommissioning funding is set aside and secured, such as:
    - bank guarantee
    - bond, or
    - trust fund.
- Ability to audit funding security arrangements to ensure funding is in place and contributions meet the agreed requirements
- Provisions for dealing with default by the project.

Seeking independent advice

Our Office strongly encourages all landholders considering entering into commercial agreements with developers to obtain independent legal, financial and insurance advice prior to entering into any agreement.

An agreement can always be negotiated before a landowner signs, however it is much more difficult to negotiate terms of the agreement thereafter.

Further information

The Commissioner's 2019 Annual Report includes a Section on the Commissioner's Observations and Recommendations, including Section 1: Host Landowner Negotiations (pages 24-31). This is available at:

https://www.aeic.gov.au/publications/2019-annual-report

The NSW Farmers Association has also released a Renewable Energy Landowner Guide which is designed as a resources who may be considering hosting a wind or solar development on their property. This guide is available at:

https://www.nswfarmers.org.au/NSWFA/Content/IndustryPolicy/Resource/Renewable_Energy_Landholder_Guide.aspx

More information and resources are available on our website www.aeic.gov.au.

If you have any questions, please contact us via email at aeic@aeic.gov.au or at our toll free number 1800 656 395.

From:	noreply@feedback.planningportal nsw.gov au
To:	DPE Energy and Resources Policy Mailbox
Subject:	Webform submission from: Revised Large-Scale Solar Energy Guidelines
Date:	Friday, 25 February 2022 4:59:16 PM
Attachments:	re-alliance-submission-to-dpie-revised-large-scale-solar-energy-guidelines.pdf

Submitted on Fri, 25/02/2022 - 16:57

Submitted by: Anonymous

Submitted values are:

Submission Type
I am submitting on behalf of my organisation

Name

First name
Lu

Last name
Allan

I would like my submission to remain confidential
No

Info

Email
[redacted]

Suburb/Town & Postcode
4870

Please provide your view on the project
I am just providing comments

Submission file
re-alliance-submission-to-dpie-revised-large-scale-solar-energy-guidelines.pdf

Submission
We would like to thank the Department for the opportunity to input into he revised Solar Guidelines.

Our goal in providing feedback here is to encourage best prac ice from the solar industry when it comes to key issues of concern for our communi ies currently experiencing high demand from solar developers for their land.

Our submission asks DPE to support the industry to consider local impacts in tandem with other local projects, and wi h the energy transforma ion as a whole.

We maintain hat cleared land, which often happens to be agricultural land, is the best place for solar farms. However, he concern from farmers that the cumulative impact of solar farms will impact the ability of the family farmer to buy land must be taken seriously and addressed. Community attitudes around the siting of solar projects need to be given more prominence than is currently the case. While it may be beyond the scope of these Guidelines, we would like to see DPE lead collaborative community mapping for each REZ to ensure the op imal siting of renewable projects.

Co-loca ion of solar and agriculture should be prioritised as best-practice.. Co-locating solar with cropping, while common prac ice in other countries, has not been sufficien ly explored in Australia.

Our commitment is to an energy transforma ion that sees genuine long-term benefits for regional Australia, and we would welcome he opportunity to discuss any of our recommendations with the department.

Please see full submission attached.

I agree to the above statement
Yes

Submission to DPE Revised Large-Scale Solar Energy Guidelines

25th February 2021

Contact: Kate Healey | *Transmission Advocate* | kate@re-alliance.org.au | 0456 674 551

About RE-Alliance
RE-Alliance works to deliver a renewable energy transformation in Australia filled with sustainable, long-term benefits for regional communities. We do this by listening to the needs of communities most impacted by the transition, facilitating collaboration across the renewables industry to deliver social outcomes and advocating for meaningful benefits for regions at a policy level.

Contents

Introduction:

We would like to thank the Department for the opportunity to input into the revised Solar Guidelines.

Our goal in providing feedback here is to encourage best practice from the solar industry when it comes to key issues of concern for our communities currently experiencing high demand from solar developers for their land.

Our submission asks DPE to support the industry to consider local impacts in tandem with other local projects, and with the energy transformation as a whole.

We maintain that cleared land, which often happens to be agricultural land, is the best place for solar farms. However, the concern from farmers that the cumulative impact of solar farms will impact the ability of the family farmer to buy land must be taken seriously and addressed. Community attitudes around the siting of solar projects need to be given more prominence than is currently the case. While it may be beyond the scope of these Guidelines, we would like to see DPE lead collaborative community mapping for each REZ to ensure the optimal siting of renewable projects.

Co-location of solar and agriculture should be prioritised as best-practice. Co-locating solar with cropping, while common practice in other countries, has not been sufficiently explored in Australia.

Our commitment is to an energy transformation that sees genuine long-term benefits for regional Australia, and we would welcome the opportunity to discuss any of our recommendations with the department.

Summary of Recommendations

Topic	Recommendation
Compliance	• DPE inserts a section in the Guidelines with the purpose of highlighting to landholders, project neighbours, and the broader community, the steps that can be taken where a developer is breaching their planning permit or causing significant problems.
Agricultural Land	• DPE change the Guidelines to encourage agrivoltaics as a preferred option to a blanket avoidance of high-value agricultural land • The NSW Government consider providing grant funding to solar projects trialing agrivoltaic practices, especially with regard to co-location of solar and cropping, which are as yet uncommon or untried in Australia • DPE provide clarification on how the Large-Scale Solar Energy Guidelines interact with the concurrent consultation happening for State Significant Agricultural Lands given both agriculture and energy are state priorities • DPE works with the Department of Primary Industries to link up SSAL and REZ processes and to provide clarity to the community in the Guidelines on how these tools will be used. • existing agricultural mapping tools are limited; the Guidelines should indicate to developers that local community understanding of what is “high-value agricultural land” may differ from the results provided by some mapping tools. • as some land classified as BSAL or LSC Class 1 - 4 may not be currently used for high value agriculture such as horticulture and cropping, this

	should be considered when determining whether a developer is required to undertake a Level 3 assessment. ● developers should consider harvest season and other periods where community engagement might be impacted when planning their engagement timelines
Neighbour impacts	● consultation with neighbours and those impacted by a solar farm, should be required in all levels of assessment. Currently it appears only in Level 1. ● insurance changes for neighbours should be assessed as part of the Agricultural Impact Assessment, so that mitigation measures can be put in place if an increased premium is predicted.
Biodiversity	● the Guidelines guard against excessive land clearing. ● the Guidelines preclude solar developments from areas of high biodiversity and native vegetation coverage. ● the Guidelines adopt all four steps of the sequential mitigation hierarchy
State Planning	● as part of the REZ development process, DPE should conduct mapping to reduce and mitigate land use issues associated with renewable energy development. This mapping should determine the best areas of NSW for the development of renewables. Consultation should occur with First Nations representatives, farmers, and environmental groups.
Community Benefits	● Community Enhancement Funds (CEFs) should be separate from VPAs. ● The Guidelines ensure community representation on committees for decision making on how CEFs are spent, including representatives from highly impacted areas. ● while VPAs should be separate from CEFs, there should also be community representatives included early in VPA negotiations between developers and Councils. ● the Guidelines include other types of community benefits, beyond community enhancement funds for consideration by proponents
Decommissioning	● project consent conditions should clarify the party who is responsible for decommissioning and rehabilitation. ● guidance should also be provided to landholders in the Guidelines on ways to ensure any funds put aside for decommissioning and rehabilitation are secured to protect the landholder from default.
First Nations Engagement and Benefit-Sharing	● First Nations engagement and benefit-sharing should have its own section in the Guidelines that extend beyond cultural heritage and outline the principles of free, prior and informed consent for First Nations groups. ● principles from DPE First Nations engagement in REZs should be brought into the NSW Solar Guidelines.

Cumulative impacts	● DPE and project proponents consider ways to avoid consultation burden which are already being felt in REZs and other areas where multiple renewable energy projects are being proposed and built. One possible option is for shared Social Impact Assessments with other projects to avoid consultation fatigue. ● within REZs, NSW DPE coordinates engagement including community mapping to identify and avoid or manage key sites of agricultural, environmental or First Nations cultural value.
Negotiated Agreements	● proponents cover costs for project neighbours seeking independent advice on impacts to their operations & insurance ● NSW Solar Guidelines discourage the use of non-disclosure agreements that prevent hosts and/or neighbours from talking about solar developments

Compliance (Section 2.5)

RE-Alliance has heard from local community members living near renewable energy projects about the need for stronger compliance enforcement and easier processes for the community to contact and receive genuine responses from the department's compliance team.

There is a lack of clarity for the community around responsibility for compliance and enforcement between project proponents, local Councils and the Department. We understand that a local resident in the Central-West Orana REZ is providing a submission to the department in response to these Guidelines that details in some depth the issues with compliance that community members are experiencing.

Recommendation:

- DPE inserts a section in the Guidelines with the purpose of highlighting to landholders, project neighbours, the steps that can be taken where a developer is breaching their planning permit or causing significant problems.

Visual Amenity (Section 4 & 5.1)

Whilst the intent of the 'visibility and topography' section in Table 1 on page 27 is clearly to reduce visual impacts of large scale solar developments on residential or urbanised areas it would be possible to construe this as solar developments are not welcome on hills or valleys unless existing vegetation, structures and/or landforms that would provide natural screening of any development. This would significantly reduce the amount of land available to be developed and preference flat land for solar developments;

RE-Alliance supports the key principles outlined on page 30 of the Draft Guideline. We consider that the visual assessment approach consisting of a preliminary visual assessment, a further more detailed visual assessment which determines the visual impact followed by a final visual performance objectives and mitigation is appropriate. These steps are explained in further detail in Appendix A.

We consider that early engagement with affected landholders, the local community and Council is vital to the success of any large-scale solar development. Applying these steps will inform local residents and key stakeholders about the project and give them an opportunity to provide early input into the planning process. It may be that early changes in design can ameliorate problems that would otherwise emerge later in the process, saving the proponent time and money and addressing landholder or local community concerns.

We agree proponents should avoid and mitigate high impact areas, and agree with the mitigation measures outlined on pages 14-15 of Appendix A. Considerations of vegetation screening outlined are important.

Agricultural Land (Section 4 & 5.3)

Regional communities have a unique connection to their surrounding landscapes and this can't be understated when planning for major land use changes within REZs. A significant social risk impeding the success of the CWO REZ has been the perception that prime agricultural land is being locked up for large-scale solar developments and that the loss of surrounding farming operations is a threat to those that continue in the region.

A report from ABARES last year found that the changing climate is putting pressure on the production of food and fibre in Australia. Diminished rainfall in the last 20 years, has resulted in farm profits reducing, on average, by 23 per cent, or $29,200, as the risk doubled of farmers receiving very low returns due to climate variability.[1]

It is therefore critical that the right balance is struck between ensuring a swift transition to renewables, while not impacting negatively on farming land and ensuring regional communities are brought along the journey.

RE Alliance broadly supports the Guidelines' goals of safeguarding high value agricultural lands and facilitating the continuation of farming between solar arrays. We would like to put forward the following points for consideration:

Compatibility with agricultural land

Regarding Principle 1. "Siting of solar energy infrastructure should avoid important agricultural land" (Section 5.2).

Completely avoiding important agricultural land limits farmers' opportunities to earn a secondary income. A guaranteed, secondary income may be critical to the viability of the future of some farms, and also greatly increases the economic resilience of smaller regional towns during years of drought. This is a choice farmers should continue to have.

Rather than completely avoiding high-value agricultural land, ensuring the dual use of land or co-location of agriculture and energy production using photovoltaic practices should be the first priority.

While co-location of solar with grazing and cropping is commonplace in countries like Spain and Japan; there has not been adequate research and piloting of agrivoltaics in Australia, especially with regard to colocation of solar and cropping. Government funding to support pilot agrivoltaic programs would greatly support the industry in developing knowledge in deploying solar in a way that is compatible with agricultural land and more acceptable to agricultural communities.

---

[1] ABARES says changing climate is costing every farm, on average, $30,000 every year available at: https://www.abc.net.au/news/rural/2021-07-29/abares-climate-change-costs-30k-per-farm/100331680

Recommendation:

- DPE change the Guidelines to encourage agrivoltaics as a preferred option to a blanket avoidance of high-value agricultural land
- The NSW Government consider providing grant funding to solar projects trialing agrivoltaic practices, especially with regard to co-location of solar and cropping, which are as yet uncommon or untried in Australia
- DPE provide clarification on how the Large-Scale Solar Energy Guidelines interact with the concurrent consultation happening for State Significant Agricultural Lands given both agriculture and energy are state priorities

Agricultural Impact Assessments

RE-Alliance strongly supports the use of varying levels of assessment to ensure the impacts of solar developments on farming land and local economies is well understood. We however would make the following suggestions;

The State Significant Agricultural Land (SSAL) mapping tool, recently out for consultation from the Department of Primary Industries, has not finalised how the SSAL would be utilised, especially regarding interactions with REZs. Better collaboration across Government Departments is required to link up these processes and to provide clarity to the community on how these tools will be used and prioritised.

While the Draft Large Scale Solar Guidelines mention Biophysical Strategic Agricultural Land (BSAL), and the Land and Soil Capability Assessment Scheme, these tools become meaningless unless broadly accepted by the local community as an accurate representation of high value agricultural land.

Consultation on development of these mapping tools is often not extensive or representative, with a limited ability to reach those on the ground. Mapping of strategic agricultural land should be ground truthed and agreed to by regional communities if it is to be accepted and play a key role in decision making around solar developments.

There is a need for greater communication and awareness raising of agricultural mapping tools to ensure a continued opportunity for input and higher acceptance levels.

Given the shortcomings of the online mapping tools mentioned above, local consultation is critical and of equal importance to understanding a more nuanced perspective of the farming landscapes. The Australian Farm Institute's 'Managing Farm Related Land Use Conflict in NSW' report indicated that communities often feel a lack of insight and participation in the development process as Local Government have less power in the SSD approvals process[2].

Developers will need to consult more widely so that the community, who may have an interest in the land, have an opportunity to understand the BSAL ratings and provide input into the siting of solar farms.

---

[2] Australian Farm Institute (2020) Managing Farm Related Land Use Conflict in NSW p. 13 available at: https://www.farminstitute.org.au/wp-content/uploads/2020/12/AFI_REPORT_LanduseconflictinNSW_July2020_V2.pdf

Studies such as''Managing Farm Related Land Use Conflict in NSW'' [3]indicated that the most severe impacts from land use conflicts are non-economic, and instead are related to mental health, industry decline, erosion of trust and social and physical amenity. This further strengthens the call for developers to consult widely in the local area about land chosen for solar development. Developments that are not planned and delivered well create division in small communities.

Additionally, some land that may be classified as BSAL or LSC Class 1 - 4 may not currently be used for high value agriculture such as horticulture and cropping. Therefore, this should be considered when requiring the developer to undertake a Level 3 assessment, particularly if they intend to continue farming on the project site.

Recommendations:

- DPE works with the Department of Primary Industries to link up SSAL and REZ processes and to provide clarity to the community in the Guidelines on how these tools will be used.
- Existing agricultural mapping tools are limited; the Guidelines should indicate to developers that local community understanding of what is "high-value agricultural land" may differ from the results provided by some mapping tools.
- As some land classified as BSAL or LSC Class 1 - 4 may not be currently used for high value agriculture such as horticulture and cropping, this should be considered when determining whether a developer is required to undertake a Level 3 assessment.

Engagement in Farming Communities

As stated in the Australian Farm Institute's 'Managing Farm Related Land Use Conflict in NSW', the inflexibility of the SSD submission process can be prejudicial to farmers. Developers should consider harvest season and other periods where community engagement might be impacted when planning their engagement timelines. As a note to the department outside of these Guidelines, consideration should be given to extending the 28 day period for public comment on projects, particularly if coinciding with a busy time for farmers, e.g. harvest, otherwise farmers will not have time to respond and valuable input will be lost as a consequence.

Recommendations:

- Developers should consider harvest season and other periods where community engagement might be impacted when planning their engagement timelines.

Neighbour impacts

RE-Alliance applauds the consideration of impacts on neighbours in Agricultural Impact Assessments. However we consider that the impacts on adjacent agricultural land and neighbours should be given a higher priority given the risk to the social licence these impacts can pose. Consultation with neighbours and those impacted by a solar farm, should be required in all levels of assessment. Currently it appears only Level 1 strongly encourages this.

RE Alliance have liaised with a neighbouring landholder to a solar farm in the CWO REZ, who's property has suffered from severe erosion caused by the construction of a new road within the project site. Initial information from the hydrology report was inaccurate, causing issues with easements and access to bores with negotiations becoming drawn out and protracted. In small communities, news of situations like this spread quickly and easily, impacting the opportunities for future solar development in the region. Discussion with the developer and landholder involved suggest that earlier and more

---

[3]*Ibid.*

comprehensive hydrology studies and agreement on water flows could have avoided much of the issues being faced today.

Impacts of solar farms on neighbour's insurance costs are increasingly becoming an issue, both due to the lack of clarity of what the impact could be, and the lack of clarity around who is liable for increased costs.[4] It is therefore crucial that insurance changes for neighbours are assessed as part of the Agricultural Impact Assessment so that mitigation measures can be put in place if an increased premium is predicted.

Recommendations:

- impacts on adjacent agricultural land and neighbours needs to be given a higher priority in the Guidelines, given the risk to the social licence they pose. Consultation with neighbours and those impacted by a solar farm, should be required in all levels of assessment. Currently it appears only in Level 1.
- insurance changes for neighbours should be assessed as part of the Agricultural Impact Assessment, so that mitigation measures can be put in place if an increased premium is predicted.

Biodiversity (Section 4)

While most land-use concerns associated with solar farms are associated with agricultural land, there is also potential in NSW for issues at sites which are suitable for solar development and areas of high biodiversity value and ecological significance.

Mitigation Hierarchy

RE-Alliance supports the use of the mitigation hierarchy described below, a framework to support best-practice environmental impact mitigation. We note that avoidance, minimisation and offsets are mentioned in the Guidelines, however there is not a sense of prioritisation, or step 3: restoration/rehabilitation.

Sequential steps of the mitigation hierarchy[5]

1. Avoidance: the first step of the mitigation hierarchy comprises measures taken to avoid creating impacts from the outset, such as careful spatial placement of infrastructure, or timing construction sensitively to avoid or disturbance. Examples include the placement of roads outside of rare habitats or key species' breeding grounds, or timing of seismic operations when aggregations of whales are not present. Avoidance is often the easiest, cheapest and most effective way of reducing potential negative impacts, but it requires biodiversity to be considered in the early stages of a project.

2. Minimisation: these are measures taken to reduce the duration, intensity and/or extent of impacts that cannot be completely avoided. Effective minimisation can eliminate some negative impacts, such as measures to reduce noise and pollution, designing powerlines to reduce the likelihood of bird electrocutions, or building wildlife crossings on roads.

[4] *Ibid.* p. 8

[5] The Biodiversity Consultancy webpage available at: https://www.thebiodiversityconsultancy.com/our-work/our-expertise/strategy/mitigation-hierarchy/

3. Rehabilitation/restoration: The aim of this step is to improve degraded or removed ecosystems following exposure to impacts that cannot be completely avoided or minimised. Restoration tries to return an area to the original ecosystem that was present before impacts, whereas rehabilitation only aims to restore basic ecological functions and/or ecosystem services – such as through planting trees to stabilise bare soil. Rehabilitation and restoration are frequently needed towards the end of a project's life cycle but may be possible in some areas during operation.

   Collectively, avoidance, minimisation and rehabilitation/restoration serve to reduce, as far as possible, the residual impacts that a project has on biodiversity. Typically, however, even after their effective application, additional steps will be required to achieve no overall negative impact or a net gain for biodiversity.

4. Offset: offsetting aims to compensate for any residual, adverse impacts after full implementation of the previous three steps of the mitigation hierarchy. Biodiversity offsets are of two main types: 'restoration offsets' which aim to rehabilitate or restore degraded habitat, and 'averted loss offsets' which aim to reduce or stop biodiversity loss in areas where this is predicted. Offsets are often complex and expensive, so attention to earlier steps in the mitigation hierarchy is usually preferable.

The problems associated with the biodiversity offset method are well recognised and have been canvassed extensively, for example through the public submissions to the NSW Parliament's Inquiry into the Integrity of the NSW Biodiversity Offsets Scheme. RE-Alliance supports the recommendations made by the Environment Defenders Office in their submission to the Inquiry.[6]

Recommendations:
- The Guidelines should guard against excessive land clearing.
- The Guidelines preclude solar developments from areas of high biodiversity and native vegetation coverage.
- The Guidelines adopt all four steps of the sequential mitigation hierarchy as a framework for developers to use

State Planning

RE-Alliance supports the following recommendation made by the Environment Defenders Office Qld in their submission to the draft Queensland solar farm Guidelines and we suggest it could also be applied in NSW:

> *"We recommend that the Queensland Government transparently maps the best areas of Queensland for the development of renewables, having regard to the ideal siting for solar projects next to grids etcetera, but also having regard to our good quality ag land and areas of environmental value. This mapping should be implemented as statutory mapping in our planning framework. These areas could be protected as 'Key Resource Areas' (KRA) under our State Planning Policy and regional plans, much like KRAs are provided for fossil fuel resource activities. This will ensure that renewable energy projects can access the best sites for their operations, while avoiding inappropriate zones where conflicts with other important land uses may arise. It will also ensure consistency in dealing with*

[6] Environment Defenders Office submission to the Inquiry into the Integrity of the NSW Biodiversity Offsets Scheme, submission no. 92 available at: https://www.parliament.nsw.gov.au/lcdocs/submissions/76400/0092%20Enviromental%20Defenders%20Office.pdf

energy resources our state relies on, particularly given that we will need to rely much more heavily in the future on renewables".

Recommendation:

- As part of the REZ development process, DPE should conduct mapping to reduce and mitigate land use conflicts associated with renewable energy development. This mapping should determine the best areas of NSW for the development of renewables. Consultation should occur with First Nations representatives, farmers, and environmental groups.

Infrastructure contributions, benefit sharing & agreements (Section 5.4)

Contributions

RE-Alliance recently submitted a response to DPE's Infrastructure Contributions: Proposed Environmental Planning and Assessment Amendment (Infrastructure Contributions) Regulation 2021.

Our submission outlined the importance of building social licence in communities set to host renewable energy projects, particularly Renewable Energy Zones, and how this related to the proposed amendment.

More specifically, our submission suggested that greater clarity is required around the interplay between voluntary planning agreements (VPAs), local contributions and community enhancement funds (CEFs) that are often established for wind and solar developments. The full submission can be found here[7]

Benefit sharing

RE-Alliance strongly supports benefit sharing initiatives for renewable energy projects. We support the prioritisation of locally impacted communities in the sharing of benefits from renewable energy projects.

Project proponents should consider at least three different levels of benefits:

- Neighbour benefits for directly impacted neighbouring properties
- Local benefits for the village, hamlet or town most impacted by the project
- Regional benefits for the broader region hosting the project

All benefit sharing programs should be developed in consultation with local communities to ensure actual benefit to the community, building trust in the project.

As the market for new development becomes increasingly crowded and developers jockey for a position in a REZ, there needs to be a clear sense within industry, matched by expectations from REZ communities, of what constitutes best practice in terms of community engagement and benefit sharing practice.

Recommendations:

- Project proponents consider at least three different levels of benefits:
    - Neighbour benefits for directly impacted neighbouring properties
    - Local benefits for the village, hamlet or town most impacted by the project

[7] RE-Alliance submission to DPE available at: https://assets.nationbuilder.com/vicwind/pages/2698/attachments/original/1645749324/REA_submission_on_Infrastructure_contributions.pdf?1645749324

    - Regional benefits for the broader region hosting the project
- We recommend that community representatives be engaged early to co-design benefit sharing programs alongside project proponents. Ideas and examples of benefits can be found in RE-Alliance's Community Benefits Handbook
- Community benefit programs are designed in collaboration with the community and begun prior to project construction

Voluntary Planning Agreements and Community Enhancement Funds

We agree that VPAs "are not the preferred mechanism to administer [Community Enhancement] funds"[8]. For examples and further discussion on the VPA issue see RE-Alliance's Community Benefits Handbook

Recommendations:

- Community Enhancement Funds (CEFs) should be separate from VPAs.
- mandatory community representation on committees for decision making on how CEFs are spent, including representatives from highly impacted areas.
- While VPAs should be separate from CEFs, there should also be community representatives included early in VPA negotiations between developers and Councils.

Benefits beyond Community Enhancement Funds

We note that the majority of Section 5.4 of the Draft Guidelines focuses on CEFs and VPAs. There are a whole range of potential benefits beyond CEFs and VPAs that should be included in the Guidelines for proponents to consider. These include:

- local decision-making,
- in-kind contributions,
- regional enhancement funds,
- empowerment of First Nations communities,
- neighbour benefits schemes,
- community co-investment and co-ownership,
- tourism and education programs,
- local jobs and procurement.

Ideas, including Australian case studies of community benefits in the renewables industry, can be found in our Community Benefits Handbook

Recommendation:

- The Guidelines include the above types of community benefits for consideration by proponents along with community enhancement funds.

Decommissioning and rehabilitation (Section 5.5)

RE-Alliance notes the following comments made by Mr Andrew Dyer, the Australian Energy Infrastructure Commissioner (AEIC), in his 2020 Annual Report to the Australian Parliament.

> *"From a landowner's perspective, it is imperative that any commercial agreement to host assets and the related infrastructure clearly sets out the responsibilities for*

---

[8] Draft Large-Scale Solar Energy Guideline page 37. available at: https://shared-drupal-s3fs.s3.ap-southeast-2.amazonaws.com/master-test/fapub_pdf/Exhibition+Draft+Revised+Large-scale+Solar+Energy+Guidelines+(1).pdf

decommissioning and restoring the site and also provides the mechanism for security of the funding to pay for decommissioning. A landowner may therefore also wish to seek ongoing evidence that the project owner has the capacity to fund the decommissioning activity and that such funds are properly set aside securely for that purpose. Examples that could be considered include bank guarantees, a sinking fund, a trust fund or a deposit held by the landowner…

Some proponents are offering to deposit decommission funding into a trust fund, but typically not commencing until year 20 of the project life. There are a number of risks with the timing of such an approach. It would be much more acceptable, and at less risk to the landowner, for the developer to commence funding the decommissioning trust fund from commencement of operations….

At a minimum, there needs to be clarity surrounding who is responsible for decommissioning, who pays and how those funds are secured to protect the landholder from default".[9]

RE-Alliance supports these points. We note the Department's comment within the Draft Guideline that "it is the NSW Government's policy that financial assurances should be dealt with in commercial arrangements outside of the planning system".[10]

RE-Alliance considers that this section could be strengthened or at least some further information be added along the lines of the AEIC's comments above, to educate prospective solar farm hosts about potential financial risks that may arise from decommissioning and rehabilitation issues and costs.

Recommendations:

- Project consent conditions should clarify the party who is responsible for decommissioning and rehabilitation.
- Information should also be provided to landholders via the Guidelines on ways to ensure any funds put aside for decommissioning and rehabilitation are secured to protect the landholder from default.

First Nations Engagement and benefit-sharing(Section 5.7)

RE-Alliance notes the mention of Aboriginal Cultural Heritage[11] protocols included in the draft solar Guidelines. We recommend that the Guidelines be updated to include a new section on First Nations engagement and benefits that extend beyond Aboriginal Cultural Heritage.

RE-Alliance has been working with communities, governments and industry across the Eastern seaboard of Australia to improve the social licence of the renewable energy industry since 2013. During this time we have witnessed increasing interest from industry proponents in providing specific benefits

---

[9]Office of the National Wind Farm Commissioner Annual Report to the Parliament of Australia Year ending 31 December 2020 p. 27 available at: https://www.aeic.gov.au/sites/default/files/national-wind-farm-commissioner-2020-annual-report.pdf?v=1635399538

[10]Draft Large-Scale Solar Energy Guideline page 39 available at: https://shared-drupal-s3fs.s3.ap-southeast-2.amazonaws.com/master-test/fapub_pdf/Exhibition+Draft+Revised+Large-scale+Solar+Energy+Guidelines+(1).pdf

[11] *Ibid.* p. 41.

to First Nations communities, however knowledge and experience within the industry in how to respectfully and successfully implement these types of programs has been lacking.

To support innovation in this area, we encourage the NSW government to provide grants to developers, in partnerships with local First Nations groups, who are trialing First Nations community benefits programs that have not been seen in the industry previously.

We are thrilled to see that the First Nations REZ Guidelines have been written and are supported by the Department, and we recommend that the Guidelines be adopted for all renewable energy projects in NSW, not just those in REZs.

Recommendations

- First Nations engagement and benefits should have its own section in the Guidelines that extend beyond cultural heritage and outline the principles of free, prior and informed consent for First Nations groups.
- Principles from DPE First Nations engagement in REZs should be brought into the NSW Solar Guidelines.

Cumulative Impacts (Section 5.7)

While the development of Renewable Energy Zones is drawing renewable energy projects closer together, there are already regions in the state where solar farms are being developed in close proximity to other solar and wind projects. We support the Guidelines' requirement that projects consider how their impacts will interact with those of other projects in the region.

One issue we have identified in our work in the Central West Orana Renewable Energy Zone, but which is applicable to other areas of the state with numerous solar farm proposals, is 'consultation fatigue'.

The Central West Orana Renewable Energy Zone will see a high concentration of solar, wind and transmission projects developed in a relatively small geographical area. Currently communities around Dunedoo and Coolah are being approached by numerous consultants and developers, all seeking input, feedback and time as part of their planning approvals processes.

Community volunteers are finding themselves stretched and overwhelmed by the sheer quantity of time required to give due consideration to significant changes happening around their hometowns. This burden has begun to emerge as a critical issue and risk for small communities who lack the resources and time to adequately respond with cohesive community responses for developers.

It is crucial that proponents undertake their own research about what other projects are proposed (even in early stages) in close proximity to their own development, particularly in a REZ context.

Within REZs, there is an important role for governments to coordinate this consultation and engagement work, including community mapping, identifying the preferred locations for solar development; avoiding sites of high cultural, environmental or agricultural value. Communities need to be valued for the time they are required to put towards contributing to various consultations, Information Days, surveys and CCCs.

Responses to engagement fatigue should similarly be tailored to be specific to the needs of each community. For example, RE-Alliance has pitched the hiring of two Local Community Development Officers for the Central West Orana Renewable Energy Zone to DPE as one partial solution to this issue.

This will avoid overlap of work and engagement fatigue experienced by local communities when numerous developers are interested in the region.

Recommendations:

- DPE and project proponents consider ways to avoid engagement fatigue and consultation burden which are already being felt in REZs and other areas where multiple renewable energy projects are being proposed and built. One possible option is for shared Social Impact Assessments with other projects to avoid consultation fatigue.
- Within REZs, NSW DPE coordinates engagement including community mapping to identify and avoid or manage key sites of agricultural, environmental or First Nations cultural heritage value.

Negotiated Agreements (Appendix C)

We support the proposal that proponents cover costs for landholders seeking independent advice but strongly recommend that impacted neighbour's costs are also covered as they seek advice on impacts to their operations, insurance and lifestyles.

Non-disclosure and confidentiality agreements

The NSW Government's 'Right to Farm' policy[12] recommends discussing major changes in land use with neighbours. RE Alliance is aware of some solar developers who employ legal agreements that prohibit landholders and neighbours from externally discussing the existence of sale, option and other agreements made between the parties.

We acknowledge that confidentiality of commercial terms can be a necessary part of such agreements but It is our experience over years working with communities that the breakdown of trust between neighbours created by non-disclosure agreements is a major driver of localised opposition to renewable development. We have advocated for this in many submissions and at industry forums over the years. We consider this practice to be inappropriate and damaging for the social licence of the industry and threatens our energy transformation.

Below is an example from the Central-West Orana:

> A Non-Disclosure Agreement (NDA) that went beyond commercial-in-confidence details to non-disclosure of the agreement itself was requested by a solar developer in the Central West from a neighbour before remediation of erosion on the neighbour's property caused by construction within the solar farm's project boundary could proceed.
>
> This practice damages trust and only delays urgent works as the neighbour sought expensive legal advice as to whether they needed to sign the Agreement or not.
>
> An NDA was also used in the sale of the land next to this same neighbour. There was negative flow-on impacts due to shared easements and bores with the neighbouring landholders. All of this resulted in a break-down of community, given there was opposition to the land being sold to a solar developer.

[12] https://www.dpi.nsw.gov.au/__data/assets/pdf_file/0006/587184/NSW-Right-to-farm-policy.pdf

Recommendations:

- Proponents cover costs for project neighbours seeking independent advice on impacts to their operations & insurance
- NSW Solar Guidelines discourage the use of non-disclosure agreements that prevent hosts and/or neighbours from talking about solar developments

4 March 2022

Matthew Riley
Director – Energy and Resources Policy
c/ Kaitlyn Lieschke
Department of Planning and Environment

Via email: Kaitlyn.Lieschke@environment.nsw.gov.au

Dear Mr Riley,

PIA NSW Submission to Revised Large-Scale Solar Energy Guidelines

Thank you for the opportunity to provide a submission on the Revised Large-Scale Solar Energy Guidelines (the Guidelines) and for recent opportunities to be briefed on this work.

The Planning Institute of Australia NSW Division (PIA NSW) has many members with deep expertise in the preparation of visual impact assessment (VIA) and we take a strong interest in ensuring a policy framework exists ensuring consistency and quality in this work.

PIA NSW has focused this submission on elements where we can provide specialist knowledge to assist planning processes. For detailed methodology and technical feedback, we commend the work of the interested group in the Australian Institute of Landscape Architects (AILA) NSW Division, with whom your team and I recently met.

PIA NSW welcomes the preparation of this guideline as an important step in ensuring higher quality VIAs are prepared and that assessing officers have the skills and understanding to consider these proposals. This is particularly important as land for large-scale solar energy becomes more scarce and challenging sites are considered for this development type.

PIA NSW's key feedback and suggestions for refinement are summarised in the table in Attachment 1. If you would like to discuss any element of our submission further, please do not hesitate to contact me on 0431 019 989 or audrey.marsh@planning.org.au.

Yours sincerely

Audrey Marsh MPIA
Advocacy and Campaigns Manager

Planning Institute of Australia
Australia's Trusted Voice on Planning
NEW SOUTH WALES PO Box 3825 MARSFIELD NSW 2122 | ABN: 34 151 601 937
Phone: 02 4044 5748 | Email: nsw@planning.org.au | @pia_planning Planning Institute of Australia planning.org.au/nsw

Attachment 1: Detailed Feedback

KEY ISSUE	FEEDBACK AND RECOMMENDATION
Identifying important agricultural land	The identification of important agricultural land is currently undertaken using a variety of disparate sources, including those identified on pg. 27 and Section 5.2. The Agricultural Commissioner is currently considering the preparation of a State Significant Agricultural Land map. Additionally, many local governments have prepared detailed rural land use mapping and studies that also identify significant agricultural land in those communities.
	Recommendation Expand the list of source material for identifying important agricultural land to include the State Significant Agricultural Land map, local strategies, local mapping and 'any other relevant material'.
Relationship to strategic planning	PIA NSW welcomes the inclusion of Local Strategic Planning Statements and Housing Strategies as a key factor in site identification. These local strategies provide not just a vision for growth, but also identify those areas where values, character and existing land uses should be preserved and enhanced.
	Recommendation Rephrase the following paragraph in Table 1 (pg. 27): The applicant should consult with the relevant council and identify the community vision for any considered site and surrounding area, as outlined in strategic planning documents including Local Strategic Planning Statements and Housing Strategies.
Agricultural impact assessment	PIA NSW continues to advocate for an approach to agricultural impact assessment that goes beyond soil classification (see for instance our submission to the Options Papers for Agricultural Land Use Planning Strategy). Our position is that productive land should be identified via attributes like soil quality, fragmentation, topographic constraints, surrounding land use, land use conflict, natural hazards, immediate and long-term economic productivity potential, social and cultural importance, and environmental contribution. While we acknowledge that this policy approach is still in development, the methodology in Appendix B should explore a wider range of considerations.
	Recommendation Include in Appendix B a wider range of considerations beyond soil classification, including consideration of Regional Plans, Local Strategic Planning Strategies and other local government strategies.
Visual impact assessment and scenic quality	While it is understood that a development specific approach to visual impact assessment and scenic quality is important, there would be significant benefit from a state-wide approach to both.

	Recommendation Adopt a standard visual impact assessment methodology, based on widely used methodologies, for all relevant development in NSW. Prepare state-wide mapping of valued scenic landscapes, focussing on Renewable Energy Zones as a priority.
Landscape character	Landscape character is seen as a particularly important consideration, however insufficient detail is provided in the guidelines on this element. Proponents and assessing officers would benefit from additional information on how to identify and assess landscape character.
	Recommendation Provide additional detail on the assessment of landscape character and what factors are important in determining this.
Views from the public domain	There is a strong focus on assessing private viewpoints but little given to how to assess viewpoints from the public domain such as roads.
	Recommendation Include more emphasis and guidance on the assessment of public domain viewpoints.
Consultation process	VIA practitioners continue to report difficulty in undertaking consultation, with barriers including people denying access to property. While it is acknowledged that the Department has a Community Participation Plan, this is likely too general to be of assistance in this work.
	Recommendation Additional detail should be provided on the purpose, process and alternative mechanisms for consultation at all stages and scales.
Planner resources	While there are many highly skilled professionals undertaking this work, resources and skills will vary in the assessment process. This guideline should be supported with skills and training assistance for DPE assessing officers, especially to assist in interpreting material provided by proponents and assessing alternative solutions.
	Recommendation Prepare an implementation plan which includes skills and training components for DPE assessing officers.

[redacted]

From: Alison Thompson [redacted]
Sent: Monday, 16 May 2022 1:29 PM
To: DPE Energy and Resources Policy Mailbox; Matt Riley - Planning
Cc: damian.thomas; Susy Cenedese
Subject: FW: Draft LGNSW Submission - Draft Large-Scale Solar Energy Guideline
Attachments: LGNSW Large Scale Solar Energy Guideline Submission.pdf

Follow Up Flag: Follow up
Flag Status: Flagged

Good Afternoon,

At the LGNSW April Board meeting held on 22 April 2022, the Board resolved to revise the submission on the Draft Large Scale Solar Energy Guideline that LGNSW had previously lodged on 11 March 2022.

The revisions are focused under the area of Decommissioning and Rehabilitation.

Please find attached the revised and now endorsed submission for your records, if you require any more information please do not hesitate to contact me.

Kind Regards

Alison Thompson
Senior Policy Officer, Waste
T: 02 9242 4095
[redacted]
Please note I work part-time and only work Monday - Friday until 3.00pm
lgnsw.org.au

From: Alison Thompson
Sent: Friday, 11 March 2022 12:36 PM
To: energy.resourcespolicy@dpie.nsw.gov.au; [redacted]
Subject: Draft LGNSW Submission - Draft Large-Scale Solar Energy Guideline

Good Afternoon,

Please find attached a submission covering the Draft Large-Scale Solar Energy Guideline on behalf of Local Government NSW (LGNSW).

Please note that this is a draft submission until it is endorsed by the LGNSW Board. We will advise at that time if there are any substantive changes to this submission.

LGNSW would also like to acknowledge the flexibility of the Department of Planning and Environment in accepting this late submission, as per the email advice of 23 February. We have appreciated the additional time to ensure that this submission could be finalised.

Kind Regards,

Alison Thompson
Senior Policy Officer, Waste
T: 02 9242 4095
[redacted]
Please note I work part-time and only work Monday - Friday until 3.00pm
lgnsw.org.au

LOCAL GOVERNMENT NSW

APR 2022

SUBMISSION

DRAFT LARGE-SCALE SOLAR ENERGY GUIDELINE

LOCAL GOVERNMENT NSW
GPO BOX 7003 SYDNEY NSW, 2001
L8, 28 MARGARET ST SYDNEY NSW 2000
T 02 9242 4000 F 02 9242 4111

Local Government NSW (LGNSW) is the peak body for local government in NSW, representing NSW general purpose councils and related entities. LGNSW facilitates the development of an effective community-based system of local government in the State.

OVERVIEW OF THE LOCAL GOVERNMENT SECTOR

Local government in NSW employs more than **55,000 people**

Local government in NSW looks after more than **$136 billion of community assets**

Local government in NSW spends more than **$1.9 billion each year on caring for the environment, including recycling and waste management, stormwater management and preserving and protecting native flora and fauna**

NSW has 450 council-run libraries that attract more than **34.8 million visits each year**

Local government in NSW is responsible for about **90% of the state's roads and bridges**

NSW councils manage an estimated **3.5 million tonnes of waste each year**

NSW councils own and manage more than **600 museums, galleries, theatres and art centres**

TABLE OF CONTENTS

LOCAL GOVERNMENT NSW

OPENING

Local Government NSW (LGNSW) is the peak body for local government in NSW, representing NSW general purpose councils and associated entities. LGNSW facilitates the development of an effective community-based system of local government in the State.

LGNSW welcomes the opportunity to make a submission on the Draft Large-Scale Solar Energy Guideline as this is a matter of significance to several NSW councils and other stakeholders within the local government sector. Councils support an efficient, fair, and locally-led planning system that prioritises quality of life and meets the needs and expectations of local communities. Decisions of successive state governments have gradually diminished councils and communities' authority to determine what and how development occurs in their local areas. Restoring community-led planning powers to local government is a long-standing advocacy priority for LGNSW.

LGNSW has consulted with councils to help inform the content of this submission.
This submission was endorsed by the LGNSW Board in April 2022.

BACKGROUND

LGNSW acknowledges the NSW Government's support for the development of a sustainable solar industry in NSW and concurs that the growth of the renewable energy industry will reduce reliance on fossil fuels, thereby contributing to a reduction in air pollution and greenhouse gas emissions and that renewable energy will increasingly contribute to a reliable and affordable energy supply for the people of NSW.

LGNSW concurs that the State Government's Net Zero Plan Stage 1: 2020-2030 is the foundation for NSW's action on climate change and goal to reach net zero emissions by 2050 with aims to strengthen the prosperity and quality of life of the people of New South Wales, while helping to achieve the State's objective to deliver a 50% cut in emissions by 2030 compared to 2005 levels. The plan will support a range of initiatives targeting energy, electric vehicles, hydrogen, primary industries, technology, built environment, carbon financing and organic waste.

Local government has a significant role in reducing carbon emissions and adapting to the impacts of climate change. Councils are responsible for $160 billion worth of assets. Reducing emissions can lower operating costs associated with these assets. The effects of climate change also have the potential to damage council assets, cause serious disruptions to the delivery of council services, generate unbudgeted financial impacts, and affect the wellbeing of the community.

For NSW councils to achieve emissions targets LGNSW supports a renewable energy target of 40% by 2025 which would support investment and market confidence in renewable energy projects. In addition to this ambitious but achievable target we believe that a robust regulatory framework underpinned by support from all levels of government can enable NSW to meet emissions targets whilst balancing the priorities and objectives of al key stakeholders.

LGNSW notes that despite the renewable energy sector contributing substantial opportunity to meet emissions targets this must be achieved whilst balancing the generation of emissions in other areas. Waste emissions accounted for 4.8 Mt CO_2-e in 2018–19, making up 3.5% of NSW emissions and 14% below 2005 levels. Three-quarters of waste emissions were due to solid waste disposal with much of the remainder from domestic and industrial wastewater.

The decrease in emissions was due in part to the use of landfill gas (methane) capture technology, which allow the gas to be used for power generation, transferred off-site or flared on-site (where the methane is combusted to carbon dioxide, a much less potent greenhouse gas). The fall in emissions was also due to reduced waste generation per capita and increased recycling rates and diversion of waste away from landfills.

The Waste and Sustainable Materials Strategy: 2041 (WaSM) is the new cornerstone for strategic waste planning over the next twenty years and the WaSM program priorities currently under development will significantly assist councils and communities with maximising resource recovery, reducing landfilling rates and helping to meet emissions targets. Therefore, it is imperative that gains made through the renewable energy sector are not lost through poor waste management and LGNSW would call upon the Department of Planning and Environment to ensure that good waste outcomes are central to the Large-Scale Solar Energy Guideline which is currently under review.

LGNSW notes that The Large-Scale Solar Energy Guideline (the Guideline) provides the community, industry, applicants, and regulators with guidance on the planning framework for the assessment and determination of large-scale solar energy projects under the *Environmental Planning and Assessment Act 1979* (EP&A Act).

LGNSW ADVOCACY PRIORITY

LGNSW advocates for:

- Local government to be treated as a partner (not just another stakeholder) in metropolitan, regional and district planning processes – the role and voice of local government is vital in delivering productivity, liveability, and sustainability.
- The State and Federal Government to develop a strategic approach to state significant developments such as newly emerging solar farms to ensure their impact on farmland and neighbouring communities is properly considered and local councils receive development contributions to fund the local infrastructure required to support them.

RESPONSE

Through consultation with regional NSW councils, Regional Organisations of Councils (ROC[1]s) and other local government stakeholders, regional and rural councils have a keen interest in the Large-Scale Solar Energy Guideline.

Councils have experience with both the opportunities and challenges arising from large-– scale solar energy projects as well as other State Significant Development. Whilst councils may concur with the benefits of investment, they also have identified concerns around how the Guideline addresses agricultural land use conflict, infrastructure contributions, benefit sharing and agreements, decommissioning and rehabilitation and waste management.

There is substantial opportunity to address many of these concerns though the Guideline, by using clearer language to ensure the responsibilities of applicants as set out in the Guideline are clear. In addition, mandating or strengthening many of the Guideline's recommendations would ensure that applications meet regulatory standards as well as the expectations of councils and communities in achieving social, economic, and environmental priorities.

The local government sector supports renewable energy, not only to achieve emissions targets but to ensure affordable clean energy for NSW, to provide employment and to facilitate investment in regional and rural communities. However, the sector would still welcome a strengthening of the Draft Large-Scale Solar Energy Guideline to ensure that future renewable energy projects do not disadvantage rural and regional communities and that the principles across the five key priority areas contained within the Guidelines remain central to the development assessment process.

RENEWABLE ENERGY ZONES

The Guideline states that the NSW Government's Electricity Infrastructure Roadmap introduces the proposed location of five Renewable Energy Zones (REZ) across the Central-West Orana, New England, South-West, Hunter-Central Coast, and Illawarra regions of NSW. The NSW Government will encourage future development in these areas as they are; close to existing transmission and distribution infrastructure and likely to have less environmental, heritage and land-use constraints. Despite this 70% of existing solar development is located outside these areas, potentially leading to future legacy issues for councils and communities.

As such LGNSW would recommend that the Department of Planning and Environment (DPE) undertake an audit of existing large-scale solar farm developments located both inside and outside the proposed REZ areas to determine any legacy issues which could impact communities. Information obtained through such an audit could assist with addressing issues in the short to medium term which in turn could positively influence future projects.

Local Government recognises the multiple benefits that can come from investment in renewable energy and acknowledges that large solar farms can have substantial benefits for the immediate community as well as the wider energy supply network. However, councils are often called upon to resolve issues which may not have been appropriately addressed through the development application process. LGNSW suggests that more detail could be provided, through the Guideline about the local benefits which would be delivered to the communities that will host the large-scale solar projects. In addition, there must be a commitment made by DPE to ensure that benefits are not completely “exported” from the host region through negotiation or other means.

Recommendation 1: LGNSW recommends that the Department of Planning and Environment undertake an audit of existing large-scale solar farm developments located both inside and outside the proposed REZ to determine any legacy issues which could inform future consents.

COMMUNITY AND STAKEHOLDER ENGAGEMENT

The Guideline sets out that applicants are expected to engage with stakeholders throughout the environmental impact assessment process. However in terms of any mandated process there is very little detail contained in the Guideline. There are concerns that unless stakeholder engagement is mandated~~,~~ and the process specified in detail that applicants will only engage at the most basic level to ensure compliance. This is likely to lead to poor outcomes for communities.

We concur that community engagement should be commenced as early as possible to be effective and ensure that stakeholder views are considered as part of the planning for future developments. There is an expectation that authentic engagement with stakeholders is undertaken in a process that is well planned and timely.

Both applicants and the DPE should be mindful of the cumulative impacts of multiple solar farm projects within REZ regions, and applicants should engage and collaborate with existing and proposed projects so that the cumulative effects of large-scale solar energy projects can be understood and taken into consideration when planning for new projects.

Community and stakeholder engagement should be planned to consult with a wide group of stakeholders, including (but not limited to).

- Traditional owners including local Elders and Aboriginal Land Councils to determine any impact on Indigenous land and to understand any risk to Indigenous cultural history.
- Property owners and adjoining property owners to ensure that agricultural land is not subject to further fragmentation and that the views of any impact on adjoining stakeholders is considered.
- Business and community groups to ensure that social and economic impacts of any development are recognised and addressed at the application stage. In addition, consultation with business could identify opportunities for local employment opportunities.
- Stakeholders located in adjoining Local Government Areas routinely need to be included in consultation to ensure that impacts that are outside the host LGA are recognised and addressed. Waste disposal is a key issue associated with large-scale solar farms that easily covers multiple government boundaries and waste can be transported large distances to landfills which are not located within the host area.

When undertaking consultation factors such as seasonal agricultural workloads, engagement fatigue, socio-economic and cultural circumstances, access to communication technology such as mobile phone and internet reception should always be factored into planning for community and stakeholder engagement. This will help to garner high-participation rates and that communities are given every opportunity to contribute feedback on development applications that will affect their community. Consultation should be integrated at every point within the development application process to ensure that stakeholders have ample opportunity to express views which would lead to improved outcomes for all parties.

Recommendation 2: LGNSW recommends that the Guideline clearly articulate the expectation that meaningful community and stakeholder consultation will be undertaken by the project owner throughout the application process.

AGRICULTURAL LANDUSE CONFLICT

LGNSW concurs that the co-location of solar energy projects with existing agricultural land uses is often possible. As such the Guideline must ensure that renewable energy and agricultural activity can be undertaken concurrently in such a way to ensure that regional and rural communities' benefit from both enterprises. Councils are also mindful that any new policy or strategy to protect agricultural land should be an enabler for development and investment in agriculture, not a barrier. It will be important to avoid unintended consequences that could be detrimental to local and regional economic development.

Minimising land use conflict is a priority for councils as the impacts can be far-reaching and result in unintended environmental, social, and economic impacts. Issues should be resolved through the development application process~~,~~ wherever possible, to save time and resources in managing conflicts at a later stage. Limiting land use conflict~~,~~ broadly requires several measures working together. These can include (but are not limited to).

- Having clear planning frameworks in place,
- Managing community expectations when living and working in agricultural areas,
- Incorporating buffers into non-agricultural land approvals and where buffers cannot be incorporated, provide guidance on alternatives,
- Community consultation with stakeholders to understand issues,
- Mediation assistance where issues cannot be resolved easily.

A priority when assessing site suitability for large-scale solar projects must be to provide greater protection to irrigation lands and other high yielding agricultural lands where local communities consider solar farms incongruous with their long-term economic wellbeing. This priority can be delivered by respecting Local Environmental Plans and ensuring that early engagement with affected councils and local communities is undertaken.

LGNSW acknowledges the land mapping mechanisms referenced within the Guideline including the Land and Soil Capability Assessment Scheme (LSC Mapping) as a method for assessing agricultural land capability. We concur that rigorous assessment of land capability should be undertaken and that the level of assessment should be proportionate to the quality of the land.

There is, however, concern from councils that the Level 1 Basic Assessment that is required for land located adjacent to rural zoned land and the Level 2 Reduced Assessment required for rural zoned land mapped as LSC Class 4 do not go far enough in detailing the need for consultation with stakeholders to determine impacts including cumulative impacts of large-scale solar projects on agricultural land. As LSC Classes 4 – 8 are most likely to represent sites suitable for the co-location of agricultural activity and large-scale solar projects it is imperative that consultation be undertaken to ensure that incompatible issues are identified and addressed as early as possible.

To increase the protection of agricultural land and to ensure that all impacts are identified, further detail within the Guideline covering the Basic, Reduced and Detailed Assessment could include.

- Provision of templated reporting requirements across each of the three assessment levels to ensure details are recorded in a consistent way an easily interpretable.
- Detailing key stakeholder groups (including traditional owners) which need to be consulted as part of any assessment.
- Making recommendations as to how consultation should be undertaken to ensure it is meaningful and enables feedback to be incorporated into planning.
- The definition of adjacent land being expanded to include land which may be in the vicinity of the site but not directly adjacent, to avoid cumulative impacts of projects.
- Aspects of visual amenity should be included in the design and mitigation measures; this is appropriate to all levels of assessment.
- Potential climate change impacts on agricultural land with lower productivity should be considered as increased rainfall, changing inputs and technology could improve productivity over time and contribute to improved local food security.

LGNSW recommends the Guideline be reviewed to ensure that every precaution to protect agricultural land of varying capability be protected. Even greater protection needs to be afforded to Land verified as LSC Class 1,2 or 3. The Guideline indicates that siting of solar projects on these classes of land should be avoided however councils recommend that it be strengthened to prevent projects from being sited on prime agricultural land. Community sentiment across several regional communities supports productive agricultural land be conserved and protected for future generations to ensure sustainability and viability of the agricultural sector which makes a substantial contribution to the small regional and remote communities.

Recommendation 3: LGNSW recommends the Guideline be reviewed to ensure that every precaution to protect important agricultural land of all capability be undertaken through, rigorous soil class assessment and meaningful consultation with stakeholders.

INFRASTRUCTURE CONTRIBUTIONS, BENEFIT SHARING AND AGREEMENTS

The NSW Government recently exhibited reforms to the contributions system that introduce Section 7.12 levy rates for State Significant Development including, but not limited to, large-scale solar projects. The Guideline suggests that Section 7.12 levies along with Voluntary Planning Agreements (VPA's) are the two primary mechanisms by which councils can collect contributions towards infrastructure arising from State Significant Developments including large-scale solar projects. LGNSW is aware that many throughout the local government sector have previously identified concerns to the Department with this methodology and its application to this type of development. The significant concerns that councils reported to LGNSW were previously detailed though the Draft submission to NSW Department of Planning, Industry and Environment on [Infrastructure Contributions Reforms.]

The position of LGNSW as outlined in the Infrastructure Contributions Reforms submission is that the Act should be amended to guarantee the payment of local infrastructure contributions for all State Significant Developments (SSD) where there is a local contributions plan in place. Several regional councils have expressed concerns that the proposed changes to Section 7.12 levies will create a significant gap in contributions, as this charge is a departure from their current contributions policy, for example where they apply a 1% levy under s 7.12.

In regional areas, Councils and their communities are concerned that they are being overlooked for important supporting infrastructure because the approval bodies for these developments do not always require payment of contributions for local infrastructure as a condition of approval for SSD. This means that conditions requiring local infrastructure contributions for SSD are not being applied consistently, as they are for locally approved development. Councils and communities are not seeking a windfall through the application of contributions, in contrast they are seeking fair contributions in recognition of the impacts of large-scale solar projects and the contributions that communities within the REZ will make to renewable energy and emissions reductions.

The Guidelines refer to the cap on developer contributions levied on large-scale solar projects at $450,000 per project (under s7.12 of the EP&A Act). This limits the ability of Councils to capture infrastructure contributions for communities. The Guidelines also discourage councils from negotiating VPAs for benefit sharing arrangements and suggest if community benefit funds are set up then they should be overseen by developers. This is unacceptable and there should be an expectation that all solar project proponents will negotiate in good faith benefit sharing arrangements with local councils.

Councils are concerned that the levy will be charged for solar and wind farms based on $2,000 per megawatt capped at $450,000. We understand this to mean that every solar farm regardless of the size will pay the same. We believe however that the proposed approach will leave communities worse off, is inequitable for proponents and may also encourage project applicants to seek ways to avoid additional costs potentially though consolidating projects.

The following example as provided to LGNSW from a local government stakeholder highlights the key issues raised by several councils and ROCs across the sector with respect to the way the infrastructure contributions and benefit sharing will be applied in the case of large-scale solar projects as detailed in the Guideline.

Greater Hume Shire recently entered a VPA with a solar farm proponent. The farm will generate 1,000 megawatts of electricity and the total value of the project is $636.56 million. The VPA provides for the company to pay the Council $150,000 per year for the life of the development (30 years). In addition, the company is establishing a community fund valued at $5 million which it will directly manage. The VPA recognises the time it takes for this type of development to reach fruition and is providing direct benefits for the community. The alternative charging approach will negate these agreements and the impact on councils and the communities they represent will be significant.

A further example at the other end of the spectrum is another development in Greater Hume Shire for a 5- megawatt solar farm development valued at $7.6 million. Council is the Consent Authority and will apply a 7.12 levy of 1% to the development resulting in a contribution of $76,000. Under the new proposed arrangements Council will be forced to impose a flat fee of $2,000 a megawatt resulting in a total contribution of $10,000. The $10,000 is the same contribution as a person building a house in Greater Hume Shire will be required to pay under the Set Local Levy Condition. The proposal to cap contributions at $450,000 means the total contribution the company building the $636.6 million dollar development will be the same as a development half its size.

There are concerns that this approach could have the perverse result of undermining the Government's REZ initiative. Solar and wind farm developers could decide to minimise their infrastructure contributions by choosing to consolidate developments rather than spreading them across the State. Why build 5 solar farms generating 225 megawatts and pay $2,250,000 in levies when a developer could build one farm generating 1000 megawatts and pay just $450,000. There is clear support for a scaled approach to solar and wind farms to ensure there is some level of equity.

Recommendation 4: LGNSW recommends that levies for large-scale solar projects are scaled appropriately, and the cap removed so that communities receive the financial contribution that is proportionate to the size and impacts of the development.

DECOMMISSIONING AND REHABILITATION

Large-scale solar projects are long term projects, as such detailed consideration should be afforded to every aspect of the project. This should include all waste the project will generate over its lifespan to ensure that legacy issues do not impact community amenity or jeopardise the sustainability of future council waste facilities.

The lifespan of large-scale projects extends from commissioning, through to the rehabilitation and replacement of solar panels during the project then the eventual decommissioning and rehabilitation. There are concerns that issues will arise if all these phases are not adequately recognised and addressed during the application process and subsequent consent conditions.

Solar projects do not have finite timescales which can add to the complexity of decommissioning and rehabilitation. The Guideline suggests that decommissioning and rehabilitation is straightforward, however the experience of councils does not reflect this. LGNSW has received advice from councils that decommissioning, and rehabilitation is not always straightforward and more stringent controls are required to protect councils, communities, and landholders. The length of project timeframes, the volume of project applications and the political and economic influence of a small pool of developers can all affect decommissioning and rehabilitation outcomes, especially when this is balanced against the availability of council resources to ensure compliance with development consents.

In addition, project owners are not always located within Australia, and this can impact the influence of regulatory controls where applicants are not likely to be impacted by the penalties for non-compliance with decommissioning requirements. Given the lengthy timeframe for large-scale solar projects, it is not uncommon for the land and project infrastructure to be on-sold to the point where controls become difficult to regulate with the new project owner and council is then required to utilise its limited resources to negotiate a reasonable outcome.

All possible eventualities, including phased decommissioning and rehabilitation should be considered early on and clear pathways for appropriate decommissioning and rehabilitation at any stage, should be identified and documented as part of the consent conditions. The Guideline should specify clear expectations around the need to include detailed and costed rehabilitation plans. These plans should be accompanied by annual financial contributions to a fund managed by the NSW State Government to ensure that decommissioning and rehabilitation is funded by the project owner or host landowner with funds set aside for this work from the outset. The financial contributions should form part of the consent conditions and include an annual increase of at least the ABS Producer Price Index for Heavy and Civil Construction. This fund would act as a quasi-bond to ensure that councils and communities are not liable for future project costs. Such a process would afford much greater protection to councils, ensuring that they are not left with managing the financial burden of rehabilitation if obligations are not met by other parties.

LGNSW supports Principle 1 in Section 5.5.2 contained in the Guideline that states, “Land must be rehabilitated and restored to pre-existing use, including the pre-existing land and soil capability class if previously used for agricultural purposes.” It is essential that land capability is monitored throughout the lifespan of the project, through regular soil monitoring and that any negative impacts on soil class should be addressed as early as possible to ensure the development is not degrading soils to such an extent that the land is no longer fit for its previous purpose. Whilst it is noted that large-scale solar farms are more likely to be permitted on land with lower agricultural productivity this should not deter regulators from ensuring that agricultural land of any capacity is restored to its original capability. The requirement to monitor and test should be included in the consent conditions along with an obligation to repair any damage that is detected at the time of detection.

Councils have indicated strong concern with Principle 4 in Section 5.5.2 contained in the Guideline that suggests that the solar project owner or operator should be responsible for decommissioning and rehabilitation unless there is an agreement with the “host landowner” that clearly outlines alternate responsibilities. There are two primary concerns with this principle, the first is the term “should”, this terminology needs to be strengthened to represent the need for the decommissioning process to be detailed during the assessment process and for absolute responsibility to be identified and clearly communicated to councils and other stakeholders. This is a necessary measure to ensure that councils are not responsible for the decommissioning of this infrastructure in the future or that property owners, adjoining land holders or communities are not left with a “white elephant” located on agricultural land due to a failure of the project owner to decommission infrastructure in a timely and appropriate way.

Recommendation 5: LGNSW recommends the Guideline be revised to ensure that detailed decommissioning and rehabilitation plans for all large-scale solar projects are included with any applications.

Recommendation 6: LGNSW that applicants should be required to make annual financial contributions to an established State managed fund to cover the costs of decommissioning and rehabilitation throughout the life of the project.

WASTE MANAGEMENT

The management of waste resulting from large-scale solar projects is a significant issue that has been raised with LGNSW by the local government sector. The key issues are:

1. Addressing the opportunity to minimise waste and,
2. Where waste cannot be minimised, to ensure that controls are in place to manage waste appropriately throughout the lifecycle of the project.

In the case of large-scale solar projects waste is typically generated from failed, replaced, or decommissioned infrastructure, as well as from the packaging of project infrastructure which represents the predominate waste stream at the commencement of projects. The bulk of solar project packaging waste has historically been made up of pallets, plastic shrink-wrap, and cardboard. Apart from cardboard which can be easily recycled, the other elements of solar packaging waste represent an emerging waste issue for many host communities and whilst these may be recyclable the lack of accessible recycling opportunities is an issue which will affect recycling rates.

The Guideline acknowledges that large quantities of waste are likely to be generated through the construction and decommissioning phases of large-scale solar projects but suggests that waste generated throughout the operation of solar projects will be negligible. LGNSW does not concur with this statement as feedback from councils has indicated that in addition to an increasing volume of PV panel waste resulting from new projects there is also evidence of solar panel failure, which may currently be in the order of 1% of all panels. The volume of damaged and failed panels could potentially further increase because of future climate driven extreme weather events.

To strengthen the Guideline and achieve good waste management outcomes, there is an opportunity to mandate a detailed Waste Management Plan for all large-scale solar projects. This would ensure that councils and other consent authorities have a full understanding of the total quantity of waste which will be generated from the project as well as detailed information relating to the proposed mitigation measures designed to minimise waste and management options for the remaining residual waste. As noted in the Guideline the volume of waste which will be generated through future large-scale solar projects is set to increase substantially and therefore there is a pressing need to identify and implement all opportunities to minimise waste, in addition to addressing disposal options. Waste Management Plans have been successfully used in residential and commercial development applications across NSW, allowing councils and other consent authorities to fully understand the waste implications of the proposed project.

Mechanisms such as product stewardship schemes and product design represent opportunities to minimise waste and improve the sustainability of future renewable energy projects. LGNSW is supportive of product stewardship schemes as a mechanism to ensure that producers are responsible for both the costs and logistics of product disposal at the end of the products life. In relation to large-scale solar projects LGNSW advocates for a mandatory product stewardship scheme which could be designed to cover both panels and accompanying infrastructure with a separate mechanism covering the substantial packaging required to transport project infrastructure to approved sites.

LGNSW acknowledges that a product stewardship scheme is currently outside the scope of the Guideline however the National Waste Policy outlines the role that all levels of government must play in supporting resource recovery and reducing the generation of waste. LGNSW supports the implementation of a mandatory scheme supported by all tiers of government and industry where producers are responsible for all scheme costs including compliance.

The experience of councils is that the volume of pallets and plastic wrapping which accompanies large-scale solar projects is substantial and a reverse logistics program like those that already exist, including the CHEP scheme, would be a relatively straightforward option to minimise pallet waste. The pallets used to transport solar panels are often poor-quality meaning that they cannot be reused, and recycling options can be limited in rural and regional communities. There is opportunity to redress this through regulatory measures which would ensure that project applicants seek out improved packaging options. Similarly ensuring that the large volume of plastic shrink-wrap designed to protect panels in transit is returned to appropriate recycling facilities would significantly reduce pressure on rural and regional landfills and ensure the reuse of these products.

Product design is a key factor influencing future circular economy outcomes and should represent a priority area for consideration. Designing out waste is one of the seven key principles contained within the NSW Government's Circular Economy Policy Statement. The policy suggests that not only can improved product design enable increased recycling and reprocessing through a product stewardship scheme or similar but that innovating product design for longevity, re-use, remanufacture and resource recovery will make it easier for customers to share, repair or upgrade goods. It also notes that increasing service offerings as well as increased remanufacture and repair activities will minimise the number of resources used and avoid the generation of waste. Whilst again this is outside the scope of the Guideline, there is potentially an opportunity through the requirement of a waste management plan to apply consent conditions ensuring that every opportunity to minimise waste is explored and implemented wherever practical.

Principle 2 in Section 5.6.2 suggests that impacts on local waste management facilities must be minimised as far as practicable during construction, operation, and decommissioning. However, the current experience of councils is that this has not always been the priority of project applicants, leading to poor waste management outcomes. Given this experience, the Guideline represents an opportunity to rectify this for future projects.

In terms of total waste volumes of PV panels, the Guideline indicates that by 2025 this figure could increase to 5000 tonnes of PV waste per year and 10,000 tonnes per year in 2035. Without substantial investment in product stewardship schemes and improved product design, coupled with recycling and reprocessing options, solar PV panels are destined for landfill. Landfilling waste is the least preferred option on the waste hierarchy and there are multiple issues which councils have identified in relation to landfilling PV panels, including:

- Increasing evidence of PV panels generating fires in landfill in a way similar to tyres and other hazardous wastes.
- Increasing pressure on councils to expand existing landfills to cope with increasing volumes of commercial and industrial waste.
- Pressure on remote unmanned landfills where waste is disposed of inappropriately.
- Issues arising between councils where waste can only be lawfully disposed of in adjoining council waste management facilities due to licence conditions.
- Issues arising from contaminated leachate where panels are stockpiled at waste facilities.
- Sudden impacts on landfills from a surge in PV panel waste because of a disaster (fire, flood, or other extreme weather events).

There are limited recycling opportunities for solar panels currently and as such, identifying opportunities at all levels of the waste hierarchy to minimise and reprocess waste must be considered to ensure that councils and communities are not left to manage the waste generated by large-scale solar projects within their communities.

Recommendation 7: LGNSW recommends that a Waste Management Plan be required for every large-scale solar project development application identifying which mitigation measures will be undertaken and identifying total projected waste volumes over the lifespan of the project.

CONCLUSION

Our submission includes several recommendations to strengthen the principles contained within the Draft Large-Scale Solar Energy Guideline to ensure that renewable energy projects and agricultural enterprises can co-exist.

There is substantial opportunity through the Guideline to strengthen the conditions of consent to provide greater certainty to councils and communities located within the REZ zones. Communities located within REZ zones are making a substantial contribution to the development of renewable energy and in NSW through hosting large-scale solar projects and this should be recognised and acknowledged.

Local benefit should be positioned at the centre of future projects and project impacts should be clearly determined through consultation with the wide range of stakeholders affected. Meaningful consultation is essential to deliver effective and sustainable large-scale solar projects which are located on suitable sites. It is also essential to ensure that material and significant benefits for the communities that host large-scale solar projects are realised.

The position of LGNSW as outlined in the Infrastructure Contributions Reforms submission and reiterated within this submission is that the payment of local infrastructure contributions for all SSD including large-scale solar projects should be scaled to ensure that contributions are commensurate with the size and impact of the development, ensuring that host communities receive a shared benefit.

Full responsibility for large-scale solar projects needs to be vested with the project owner and/or host landholder and all aspects of the project including decommissioning and rehabilitation should be regulated from the outset, through the application phase to ensure that councils and communities are not left with a burden of legacy remediation.

LGNSW also acknowledges the Department of Planning and Environment's advice received via email on 23 February 2022 advising that late submissions would be considered upon request, and subsequent approval to submit this submission by 11 March. The Department's flexibility in this regard is greatly appreciated.

LOCAL GOVERNMENT NSW

In summary our recommendations are:

01 LGNSW recommends that the Department of Planning and Environment undertake an audit of existing large-scale solar farm developments located both inside and outside the proposed REZ to determine any legacy issues which could inform future consents.

02 LGNSW recommends that the Guideline clearly articulate the expectation that meaningful community and stakeholder consultation will be undertaken by the project owner throughout the application process

03 LGNSW recommends the Guideline be reviewed to ensure that every precaution to protect important agricultural land of all capability be undertaken through, rigorous soil class assessment and meaningful consultation with stakeholders.

04 LGNSW recommends that levies for large-scale solar projects are scaled appropriately, and the cap removed so that communities receive the financial contribution that is proportionate to the size and impacts of the development.

05 LGNSW recommends the Guideline be revised to ensure that detailed decommissioning and rehabilitation plans for all large-scale solar projects are included with any application.

06 LGNSW recommends that applicants should be required to make annual financial contributions to an established State managed fund to cover the costs of decommissioning and rehabilitation throughout the life of the project.

07

LGNSW recommends that a Waste Management Plan be required for every large-scale solar project development application identifying which mitigation measures will be undertaken and identifying total projected waste volumes over the lifespan of the project.

For further information in relation to this submission, please contact Alison Thompson, Senior Policy Officer – Waste on 02 9242 4056 or alison.thompson@lgnsw.org.au.

From:	Kaitlyn Lieschke
To:	DPE Energy and Resources Policy Mailbox
Subject:	FW: AILA Submission to Revised Large-Scale Solar
Date:	Friday, 11 March 2022 12:39:37 PM
Attachments:	NSW Submission to Revised Large-Scale Solar 2022.pdf image001.png image002.png image003.png image004.png image005.png

---

From: Tessa Faucheur <tessa.faucheur@aila.org.au>
Sent: Friday, 11 March 2022 11:57 AM
To: Kaitlyn Lieschke <Kaitlyn.Lieschke@environment.nsw.gov.au>
Subject: AILA Submission to Revised Large-Scale Solar

Dear Kaitlyn,

On behalf of AILA and thanks to our working group of experts who contributed to the response, please find attached our submission to revised Large-Scale Solar including AILA's recommendations.

Please do not hesitate to come back to me if you have any questions,

Best regards,
Tessa

Tessa Faucheur
State Chapter Manager - **AILA NSW**
Australian Institute of Landscape Architects
W www.aila.org.au | Memberscape | E tessa.faucheur@aila.org.au
M 0499 245 222 | HO 02 6198 3268

I respectfully acknowledge the Traditional Owners of the land on which I live and work the Gadigal of the Eora Nation, and pay my respect to the First Nations Peoples and their elders, past, present and emerging.

Australian Institute of
Landscape Architects

3 March 2022

Matthew Riley
Director – Energy and Resources Policy
c/ Kaitlyn Lieschke
Department of Planning and Environment

Dear Mr Riley,

AILA NSW Submission to Revised Large-Scale Solar Energy Guidelines

Thank you for the opportunity to provide a submission on the Revised Large-Scale Solar Energy Guidelines (the Guidelines) and for recent opportunities to be briefed and provide direct input on this work.

Our review has been undertaken by a working group of AILA registered Landscape Architects with extensive experience in the preparation of Landscape and Visual Impact Assessment (LVIA), particularly in the context of large-scale energy infrastructure works throughout Australia. The AILA working group has comprehensive knowledge and understanding of current global best practice for undertaking LVIA and of the technologies available and applied.

AILA NSW welcomes the preparation of this guideline as an important step in ensuring higher quality LVIAs are prepared. We support DPE's objective to provide a clear and concise methodology for assessment that results in clearly defined outcomes that assist with the assessment of proposals. We also understand the importance of consistency and clarity in assessment to enhance community confidence in the assessment and approval process.

Generally, the key concern of the working group centred around the specific tools for assessment for all viewpoints that appear to have been developed for the purpose of providing an approach that quantified impact on surrounding residences. AILA supports this methodology for residences however it was consensus of the working group that these tools were not applicable when assessing impacts to landscape character and broader views from the public domain (roads, lookouts, open space etc). AILA is concerned that accepted methodologies for Landscape Character Assessment have been excluded from the guidelines. It is AILA's position that understanding and defining the unique landscape character and values of a proposed site and its surrounds is a critical step to ensure that the design of any proposal is considerate and sensitive to any specific character elements or values that may be sensitive to change.

It is the AILA's concern that the focus on impact on residences and the absence of the broader character analysis has the potential to lead to poor design outcomes for broader landscape character and public domain.

Our working group determined that there are four key recommendations regarding the structure of the Draft Guidelines that AILA suggest that DPE adopt to assist with consistency of assessment, provide clarity in decision making and to ensure improved design outcomes for solar farms and their surrounding communities.

Recommendation One:

It is the AILA's recommendation that a standard methodology for LVIA is adopted across all large-scale renewable energy infrastructure types for the assessment of landscape character and views as experienced from the public domain. AILA recommends that the DPE consider adapting the methodologies and terminology provided in the Transport for NSW Guidelines for Landscape Character and Visual Impact Assessment (2020) and the AILA Guidance Note for Landscape and Visual Impact Assessment (that is currently being reviewed for adoption by AILA nationally). This methodology could be adapted with minimal modification and would align more closely with international and industry guidance.

The application of a methodology that begins with the identification of landscape character, would inform a design process for the proposal based on established design principles, be a basis for the development of appropriate mitigation measures and provide a means to acknowledge the landscape (and environmental) benefits that can be achieved on renewable energy project sites beyond what is simply seen. An understanding of existing and future landscape character will also inform the assessment of cumulative landscape and visual impacts and allow these to be assessed in a more holistic manner.

Recommendation Two:

It is AILA's recommendation that if a standard LVIA methodology is adopted then a supporting technical guideline should be prepared for each development type (solar, wind, transmission etc) that addresses the specific issues of each renewable energy technology/development type (e.g.: glint/glare, mitigation measures, screen planting and setbacks etc.) and provides design principles that lead to better design outcomes and reduced negative impact on existing landscape character.

Recommendation Three:

It is AILA's recommendation that an approach to the assessment of private dwellings be adopted, which aligns more closely with the principles that would be applied if a project was to go to appeal in the NSW Land and Environment Court. This approach would not assign a sensitivity level to private dwellings, but identify the magnitude of change, which part of the dwelling the view is from, and consider the reasonableness of the change (how it aligns with planning intentions) to determine if there is a visual impact.

The tools provided in the draft guidelines for assessing magnitude could be used together with design principles that seek to improve design outcomes. This would both assist in providing some consistency across assessments, as well as ensuring the assessment of visual impact is not solely based on visibility, but also upon the compatibility of development with the view and landscape character of the area. This approach would clearly communicate to developers the expectations for assessment and, to the surrounding community, what the Department considers to be unacceptable or acceptable impacts upon a private dwelling.

Recommendation Four:

AILA recommend that the visual amenity impacts of glare be approached with a similar methodology to a private dwelling visual impact assessment. With the initial glare minute thresholds being used as a screening tool for further visual analysis. Those properties with a moderate or high potential glare risk impact should be further investigated, with detailed visual analysis used to refine the predicted glare risk (based on visibility) and then combined with other view characteristics to identify the magnitude of change and impact based on this combined with factors relating to the viewer. This would reflect the highly conservative and simplistic nature of the glare risk analysis tools available and avoid unnecessarily restricting the efficient operation of solar farms unnecessarily without a proportionate benefit to the community.

As part of the AILA review process a table of comments was prepared referring directly to the content of the guidelines. This is attached for your reference.

AILA appreciates the opportunity to engage with the Department on the preparation of the draft guidelines and the working group would be more than happy to contribute and provide comment in the future as the guidelines are progressed.

Yours sincerely

Tanya Wood.

Tanya Wood
AILA NSW State Chapter President

David Moir

David Moir
NSW Vice President

Comments from AILA Working Group

Visual impact assessment

Topic	#	Comment	Page
Professional Assessment Skills	**1.**	Landscape Architects are well placed to interpret the landscape and visual conditions, having both landscape analysis and design skills. These skills are necessary to both identify and mitigate landscape and visual impact. Professions such geographers and environmental planners may not have the appropriate skills and training to understand and defining landscape character and values. A qualification process may be required to ensure that professionals are suitably qualified.	**p.2 (appendix)**
Consultation	**2.**	AILA recommends that a topic specific community consultation task be excluded from the visual assessment guidelines and that surrounding residences and broader community be engaged on landscape and visual issues as a part of the broader community engagement activities that are supported by specific community engagement guidelines.	**p.5 (appendix)**
Preliminary Assessment	**3.**	AILA recommends that the preliminary assessment include the identification of existing landscape character and the preparation of Zone of Visual Influence (ZVI) mapping to identify areas where there is the potential for impact. The preliminary assessment should also identify individual receptor locations and settlement areas surrounding the site with the potential for views to the proposal.	**p.4 (appendix)**
Detailed Assessment	**4.**	The visual magnitude and sector tools are appropriate for assessing impacts of private residences but not in assessing impacts on the broader landscape character and views from the public domain. It is recommended that these tools are applied to private dwellings only and a separate and more generally accepted methodology of LVIA is applied when assessing the impact of the proposal on the area's landscape character.	**P.9 (appendix)**
Viewer sensitivity	**5.**	Table 2 Viewer sensitivity – nominates a low sensitivity for state highways and tourist roads. Such viewpoints have a high number of users and should be rated as having at least a moderate sensitivity. For example, the United Kingdom's *Guidelines for Landscape and Visual Impact Assessment* (Landscape Institute, 2013 (3rd Ed)) (referred to hereafter as UK Guidelines) states 'Where travel involves recognised scenic routes awareness of views is likely to be particularly high' (p. 114). Similarly, the identification of Highways as Low sensitivity does not align with most local DCPs where these are associated with the entries to town and are important to the character of smaller towns not covered by the *Infrastructure SEPP amendment (Renewable energy and regional cities)* which protects the setting of regional cities.	**P.9 (appendix)**

Topic	#	Comment	Page
Scenic quality class	**6.**	The consideration of scenic quality is an important part of the assessment of visual impact. However, Table 3 Scenic quality ratings, should be expanded or presented as an example so that further, location specific, detail can be added. The scenic quality ratings should reflect established scenic preferences and also incorporate the specific characteristics of the region. Ideally, these would be based on landscape character / scenic quality mapping prepared for the Renewable Energy Zones and that could be uniformly applied to projects.	**p.10/11 (appendix)**
	7.	The scenic quality rankings do not appear to consider representativeness and rarity. These factors can influence the values associated with the landscape and assist with prioritising areas for protection.	**p.10/11 (appendix)**
	8.	The scenic quality ranking of the rural/pastoral landscape is identified as being of 'low' scenic quality, for example, which unlikely to be unsupported by a predominantly rural community. It is recommended that photographs be included for a range of landscapes that fit into each category, based on Australian examples, to assist with consistency.	**p.10/11 (appendix)**
	9.	It is not clear how the 'scenic quality classification' are to be used in the methodology. Further detail would be required on how to apply the scenic quality class in the assessment to ensure consistency.	**p.10/11 (appendix)**
Landscape character effects	**10.**	Consideration of direct impacts on landscape character would add value to this methodology. The consideration of landscape character is part of most widely accepted methodologies (including the *Transport for NSW Landscape and Visual Assessment guidelines* and the UK *Landscape Institute Guidelines*).	**p.10 (appendix)**
Magnitude	**11.**	The method for identifying magnitude (for both public domain and private dwelling impacts) appears to relate only to the visibility of the proposal. AILA recommend that the assessment of magnitude be expanded to also consider the characteristics of the visible elements (shape, line, colour etc.) and their compatibility with the character of the view. This will encourage design changes to reduce visual impact by means other than visual screening. Such improvements (often at the expense of operational efficiency and project value) should be rewarded with a reduction in visual impact where that is the case. It is not clear in the current methodology how changes to the design and layout of a solar farm would lead to the reduction of an impact level.	**p.7 (appendix)**
Design principles	**12.**	The guideline would preferably include a suite of design principles that seek to improve visual outcomes through siting and design considerations. This would support landscape and visual assessment experts in advocating for design and layout improvements and give greater guidance for proponents.	

Topic	#	Comment	Page
Mitigation measures	**13.**	In Table 6. Performance Objectives for Moderate visual impact, a mitigation target of >75% screening of the PV array is set as a requirement. It is not clear how this is to be assessed i.e.: over what timeframe, is this >75% of the overall solar farm, or of the portion of the solar farm that has resulted in the moderate visual impact. AILA do not support prescriptive visibility measures such as this and would encourage DPE to consider alternative measures to reduce impact that might be included alongside more prescriptive measures such as this.	**p.14 (appendix)**
Screening vegetation	**14.**	Consistent timescales for the consideration of screening vegetation and the assessment of residual impacts would increase consistency across assessments.	**p.15 (appendix)**
Visualisations	**15.**	The guidelines indicate that … 'visualisations must be provided in the EIS to demonstrate the visual impact at each viewpoint that has a visual impact rating of low or higher'. AILA suggest that photomontages are a tool to communicate impact levels and are not the assessment tool in themselves. It is considered reasonable that visualisations be provided to illustrate locations of higher visual impact, or to confirm where there is not a high visual impact on a higher sensitivity viewing location. It is suggested that not all locations would require a visualisation and that this requirement be reconsidered to focus on the most useful locations for visualisations only.	**p.12 (appendix)**
	16.	From experience, access to private dwellings is often not granted. It would be useful if this guideline could clearly outline the expectations for visiting private dwellings, and confirm the approach when access is not possible.	**p.12 (appendix)**
	17.	The guideline identifies the need for surveyor verified photomontages in accordance with the NSW Land and Environment Court policy. It is often not practical to have a surveyor on site when taking photographs for all visualisations, particularly in remote or rural areas.	**p.13 (appendix)**
Grid connection infrastructure and Battery Storage	**18.**	Further guidance as to how to incorporate the assessment of transmission lines, batteries and other grid connection infrastructure into the assessment method would be useful.	

5.2 Glint and glare management

Topic	#	Page	Topic
General	19.	AILA recommends that the potential impacts of glare are differentiated between glare affecting the amenity of residential dwellings and glare as a hazard affecting the safe use of transport routes (roads and rail) and aviation infrastructure. We note that the expertise of Landscape Architects is primarily focused on the visual amenity effects of glare. Consultation with relevant transport and aviation safety authorities should be sought to determine acceptable levels relevant to each type of infrastructure.	**p.33**
	20.	AILA suggest that the terminology 'Glare Risk' be adopted when referring to the predicted glare minutes and hours. The minutes identified by the Solar Glare Hazard Analysis Tools (SGHAT) are a risk of glare only. The glare effect for any receiving location would be lower than the minutes identified by the SGHAT as the model does not account for cloud cover and rain, atmospheric conditions and dust that may scatter and reduce the glare effect, as well as screening by landform or filtering by trees.	**p.33**
	21.	AILA recommend that the amenity effects of glare be set within a similar framework to a visual impact assessment, so that if the private dwelling exceeds the daily thresholds of glare minutes suggested in this guideline, further analysis as to the baseline visual conditions, the magnitude of change (e.g. where there is a partial screening of a view to the development for example), be considered. Noting that the glare modelling does not take this into account and cannot be adjusted to reduce the predicted glare risk minutes to reflect commonly encountered situations such as screening by minor variations in landform or filtering of the view by vegetation for example.	**p.33**
	22.	To improve consistency in the methodology of glare assessment, guidance on the values used as the basis of glare modelling would be helpful, for example the standard height to be used at a dwelling.	**p.33**
5.2.1 Introduction, paragraph 3	23.	It would be useful if the main types of solar farm technology are introduced in the introduction to the guidance for glint and glare management i.e.: fixed, tracking and reflecting. Paragraph 3 appears to be based on single axis tracking systems, whereas a fixed system may cause a glare risk at different times of day.	**p.33**
5.2.3 Assessment	24.	AILA suggest that the distance of 4 kilometres should be reduced to either align with the visual impact boundaries (up to 3.25km) or less. This is because the reflecting area of the solar array is a reflection of the sun, and this area reduces in size with distance.	**p.33**
Mitigation measures	25.	The guideline says that glare analysis is not required for those dwellings that would be 'subject to visual mitigation measures'. Further information on how to assess the effectiveness of visual mitigation measures would be useful in this guideline.	**p.33**

Topic	#	Page	Topic
Backtracking	**26.**	Further details on what DPE expect with regards to the consideration of backtracking would improve consistency. Recent updates to one of the SGHAT software include options for backtracking. The options that are 'slope aware' would be suitable for most sites and would provide DPE with consistency across assessments.	**p.34**
Performance objectives for glare at dwellings	**27.**	Considering the conservative nature of the SGHAT outputs AILA recommend that the thresholds for glare minutes per day be increased. It is not currently possible, with the analysis software tools available, to refine the glare minutes to account for variations in landform or filtering of the view by vegetation, making a quantitative measure difficult to apply. Furthermore, considering that that a glare effect usually occurs across a season as the sun moves through the sky progressively, and the reflecting area of the solar farm also moves with it. In the experience of our members, the per year limits would be exceeded in most cases where the per day limit would otherwise be met.	**Table 3 p.34**
Performance objectives for glare at dwellings	**28.**	AILA recommend that the glare thresholds be one factor considered when determining an impact level for glare risk. The baseline conditions (e.g.: what reflecting surfaces are currently seen in the view) as well as the magnitude of change (incorporating partial screening of a view to the development for example) should also be considered.	**p.34**
Performance objectives for glare at dwellings, Glare types	**29.**	The SGHAT identifies up to three different types of glare, two of which can occur on solar farms. These are yellow glare, which has the potential to cause an after image, and green glare, which does not. The green glare is generally less impactful as it can be more easily tolerated by the eye whereas yellow glare may cause the receiver discomfort. While green glare does not damage the eye, it may be necessary to avoid viewing this effect (similar to how looking directly towards the sun is avoided). AILA recommend that DPE consider differentiating between green and yellow glare with the former being an alteration to the character of the view, and the latter being more likely to cause annoyance.	**p.34**
Other mitigating factors	**30.**	There are other mitigating effects of a glare impact that are useful to note when considering a glare impact. These include seasonal factors, the time of day, and if the glare effect is seen in a view directed also to the sun (when lower in the sky). The scale of the reflecting area should be considered in the determination of the magnitude of change, and the resulting impact level.	**p.34**

From:	Julie Briggs
To:	DPE Energy and Resources Policy Mailbox; Matt Riley - Planning
Cc:	Susy Cenedese; Alison Thompson
Subject:	Submission on Draft Large-Scale Solar Energy Guideline
Date:	Monday, 14 March 2022 1:02:18 PM
Attachments:	Riverina JO Response to the Large Scale Solar Energy Guidelines March 2022.pdf

Good afternoon

Please find attached our submission on the Draft Guideline.

Thank you for the extension we received to lodge and my apologies that we did not make the Friday deadline.

Regards

--

Julie Briggs *MBA, LLM, GAICD*
Chief Executive Officer
Riverina Joint Organisation
PO Box 646
Wagga Wagga NSW 2650
Phone: 02 6931 9050
Fax: 02 6931 9040
Email: eo@riverinajo.nsw.gov.au
Website: www.riverinajo.nsw.gov.au

RESPONSE TO THE GUIDLINES

Draft Large-Scale Solar Energy Guideline

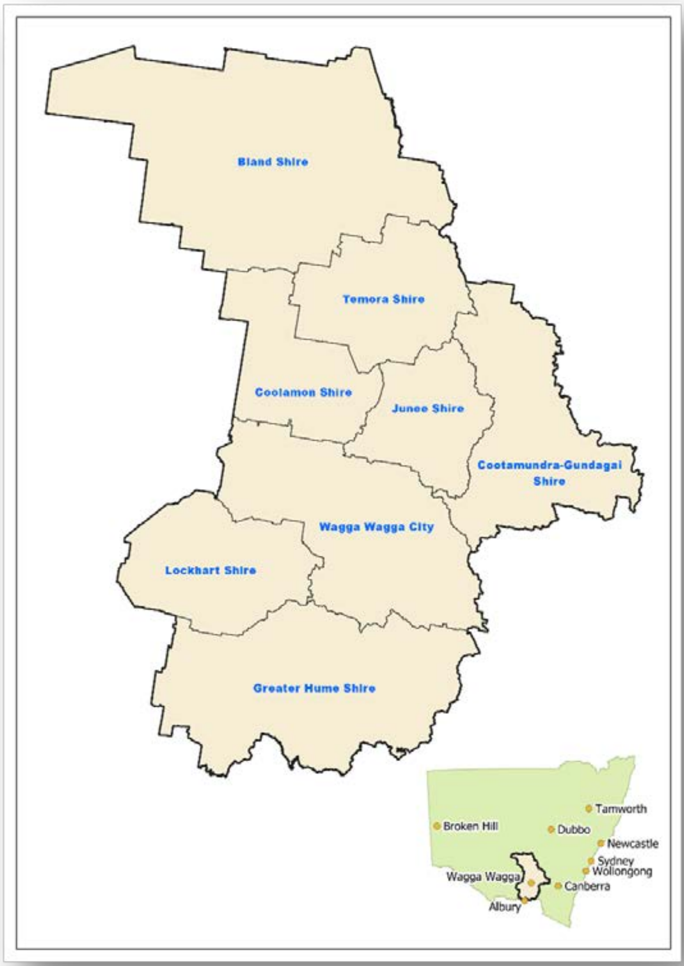
Contact:
Julie Briggs
CEO
Riverina Joint Organisation
PO Box 646, Wagga Wagga NSW 2650
Ph: (02) 69 319050 Email: eo@riverinajo.nsw.gov.au
www.riverinajo.nsw.gov.au

Response
Draft Large-Scale Solar Energy Guideline
Riverina Joint Organisation

Introduction

Our Member Councils welcome the opportunity to provide feedback on the Guidelines for the introduction of the new ARIC regime. In the Riverina JO Region, all eight of our Member Councils, Bland, Coolamon, Cootamundra-Gundagai, Greater Hume, Junee, Lockhart, Temora and Wagga Wagga either have or have planned large-scale solar developments for their LGAs. We anticipate that over the next 5 years over 5 million solar panels will be deployed across the Riverina-Murray as a result of the development of large-scale solar projects.

Riverina Joint Organisation Region



As a consequence of the proliferation of these developments our Member Councils have a strong interest in the Guideline and its ability to inform development decision-making. In making this submission we note that our Region does not fall within a designated Renewable Energy Zone but nevertheless is attracting strong investment because of its proximity to transmission lines.

Our Members continue to be concerned that these developments are not attracting the s7.12 contributions when they are categorised as State Significant Developments. The approach taken by the Independent Planning Commission whereby the requirement to pay the s7.12 contribution is not a condition of consent, leaves councils in the invidious position of having to negotiate a Voluntary Planning Agreement with a developer whose development may not be supported by the council or approved by the State. We strongly believe that this is a waste of resources and time for both the council and the developer.

Our Members also question whether the use of a Guideline is sufficient to meet the challenges and impacts that these multi-million dollar developments are having, and can have, on rural and regional communities. Given the volume and value of the developments that are occurring we believe that it is time for Regulation to be used rather than a voluntary Guideline. The use of Regulation will provide firm guidance to the Planning Commission in relation to determining Consent Conditions that adequately address the risks and the costs of operating a solar farm.

We have consulted with our Member Councils and LGNSW on the Guideline and provide the following feedback:

Agricultural Land Use Conflict

Our Members are concerned about the location of solar farms on prime agricultural land. We therefore agree that the siting of these projects on important agricultural land should be avoided. While the State has created the REZs, until there is transmission infrastructure that is readily accessible in those Zones, developers will continue to utilise land with proximity to the required energy infrastructure.

We note Appendix B to the Guideline outlines the level of assessment required to determine the impact of a development on agricultural land use. We believe this should include an Economic Impact Statement (EIS) to determine the cost-benefit to the community of the development. We are often advised that these developments will create jobs, however our experience to date has been a rush of construction jobs at the outset of the development followed by very few permanent, full-time work once construction is complete. We believe an Economic Impact Statement would enhance the decision-making process in relation to the developments.

We note the release this week of the Farm Renewable Energy Review, we believe the draft Guideline should be altered to accommodate any recommendations that may arise as a result of that Review.

Infrastructure contributions, benefit sharing and agreements

Our Members do not support the reforms to the contributions system that were recently exhibited by the NSW Government, in fact we are strongly opposed to them. The proposed reforms which cap s7.12 contributions for solar farms to $450,000 regardless of the size of the development are inequitable and are likely to undermine the negotiation of Voluntary Planning Agreements (VPA).

Current practice is that the developer either makes the Contribution or negotiates a VPA, the Guideline appears to suggest that the developer will do both. In a commercial world the developer will pay what the developer must pay, which will be $450,000 and will pay no more. It is completely unrealistic to indicate, as the Guideline does, that councils will be able to negotiate VPAs with developers in addition to the payment of the capped s7.12 contribution.

One of our Member Councils, Greater Hume Shire, recently entered a VPA with a solar farm proponent. The farm will generate 1,000 megawatts of electricity and the total value of the project is $636.56 million. The VPA provides for the company to pay the Council $150,000 per year for the life of the development (30 years). In addition, the company is establishing a community fund valued at $5 million which it will directly manage. The VPA recognises the time it takes for this type of development to reach fruition and is providing direct benefits for the community. The proposal for a capped fee will negate these agreements and the impact on councils and the communities they represent will be significant.

A further example at the other end of the spectrum is another development in Greater Hume Shire for a 5- megawatt solar farm development valued at $7.6 million. Council is the Consent Authority and will apply a s7.12 levy of 1% to the development resulting in a contribution of $76,000. Under the new proposed arrangements Council will be forced to impose a flat fee of $2,000 a megawatt resulting in a total contribution of $10,000. The $10,000 is the same contribution as a person building a house in Greater Hume Shire will be required to pay under the Set Local Levy Condition. The proposal to cap contributions at $450,000 means the total contribution the company building the $636.6 million dollar development will be the same as a development half its size.

Our Members believe that the proposed infrastructure contributions' reforms could have the unintended consequence of undermining the Government's REZ initiative. Solar and wind farm developers could decide to minimise their infrastructure contributions by choosing to consolidate developments rather than spreading them across the State. Why build 5 solar farms generating 225 megawatts and pay $2,250,000 in levies when a developer could build one farm generating 1000 megawatts and pay just $450,000. There is clear support for a scaled approach to solar and wind farms to ensure there is some level of equity.

In addition, our councils are concerned that the Guideline proposes "benefit sharing", which is another form of a VPA. This phrase has a marketing ring to it, implying that the developer is somehow sharing the benefits of the development when in fact the developer is only meeting its obligation to pay an infrastructure contribution for its development, money it already owes to the community. The phrase "benefit sharing" should not be included in the Guidelines as it is misleading.

The Guidelines also refer to the establishment of "community enhancement funds" by developers. Notwithstanding what has occurred in Greater Hume, , we do not support this approach to developers meeting their developer levy obligations. Where this type of fund is established in lieu of a direct levy to councils, there is a risk that projects will be undertaken that do not benefit the community as a whole, that are "vanity projects" for the developer or that leave councils with a maintenance legacy that for which there is no budget. We believe the responsibility for executing projects that are funded through VPAs should rest with council and that it is a matter for the council to determine where the funds are expended. Communities already make clear their priorities for services and infrastructure through the Community Strategic Planning process.

Decommissioning and Rehabilitation

Large-scale solar projects are long term projects, and detailed consideration should be afforded to every aspect of the project over its lifespan to ensure that legacy issues do not impact future council operations and community amenity.

Our Members strongly support the Principle that *"Land must be rehabilitated and restored to pre-existing use, including the pre-existing land and soil capability class if previously used for agricultural purposes."* However, we believe that if this is to successfully occur then site operators must be required to undertake regular soil monitoring and testing to ensure that the development is not degrading soils to such an extent that the land is no longer fit for its previous purpose. The requirement to monitor and test should be included in the Consent Conditions along with an obligation to repair any damage that is detected at the time of detection. This is particularly important for our Region as all the developments that are either underway or in the pipeline will be on prime agricultural land.

We are very concerned about abandonment of end-of-life assets particularly as a solar farm may change hands multiple times over its long life. Project owners are not always located within Australia, and this can influence regulatory controls where applicants are not likely to be impacted by the penalties for non-compliance with decommissioning requirements. How will the State enforce consent conditions at end-of-life when the owner is not within an Australian jurisdiction?

The Guideline should require that proponents submit rehabilitation plans and costings with development submissions, the delivery of the rehabilitation plan and funding for the plan must be part of the Consent Conditions. Owners and landholders must be required to contribute annually into a Trust Fund held by the State for the purpose of delivering the rehabilitation plan submitted by the proponent, the contribution should also have an automatic, annual uplift of at least the ABS Producer Price Index for Heavy and Civil Construction.

This approach would afford much greater protection to councils, ensuring that they are not left with managing the financial burden of rehabilitation if obligations are not met by the parties that benefited financially from the development.

Waste Management and Contamination Management

There are three main issues in relation to waste management with regard to large-scale solar developments:

1. the substantial volumes of waste that is generated during the construction phase;
2. the safe disposal of damaged or broken solar panels during the life of the project; and
3. the disposal of solar panels and construction and demolition waste at the end of the project.

Our Member Councils find that all three elements are generally poorly dealt with by development proponents. Solar proponents should be required to lodge a detailed waste management plan for every stage of the life of the development that is prepared in consultation with the councils that will be impacted by the development and the NSW EPA. We strongly recommend that the Planning Commission deal with the three main waste management issues that arise from a solar farm's establishment and operation in the Consent Conditions for the development.

Tonnes and tonnes of waste are generated during the construction phase, from the pallets the panels arrive on, the shrink wrap that surrounds them, to the cardboard and packaging materials that protects them. It is not sufficient for the Guidelines to say that *"waste generation …during construction must be minimised ….and comprised of as much reusable and recyclable materials as possible."* This is an opportunity to introduce Extended Producer Responsibility (EPR), ensuring that solar farm developers understand that they are completely responsible for the disposal of the waste that is generated by their development. A plan to dump the packaging materials and pallets at the local council landfill is simply not acceptable to councils or the communities they represent.

Our Members do not agree with the principle that *"impacts on local waste management facilities must be minimised as far as practicable during construction, operation and decommissioning."* The Principle should read *"there should be no impact on local waste management facilities",* proponents should not assume that dumping their waste at the local landfill is an acceptable fallback position if they unable to find another solution that suits them. The cost of disposing of their waste should be a cost that is built into the development not one that is transferred to the local community and council.

While Guideline acknowledges that large quantities of waste are likely to be generated through the construction and decommissioning phases of large-scale solar projects it suggests that waste generated throughout the operation of solar projects will be negligible. Our Members cannot agree with this sweeping generalisation. When millions of PV panels are deployed, which they will be in the Riverina-Murray region, even if only 1% fail each year there will be 100,000s of panels that must be safely disposed. There is currently no viable recycling alternative that can accept this level of waste.

In addition, it is our understanding that should a hailstorm hit a solar farm, damaged PV panels must be replaced. If extreme weather patterns continue, as they are expected to do, then the likelihood of solar farm operators needing to replace vast numbers of PV panels within a very short space of time is a very real concern.

Pictured: Hail damaged solar panel. Damaged solar panels do not belong in municipal landfills.

In Victoria solar panels are considered ewaste and are banned from landfill

It costs councils millions and millions of dollars and years of planning to have new landfill cells approved. Councils work hard and invest heavily in programs that remove waste from landfill and thereby increase landfill life and improve environmental outcomes for their communities. It is untenable that solar farms should have any expectation that it is acceptable to dump their packaging waste and end-of-life panels in municipal landfills. The sheer volume of the waste will significantly decrease landfill life. It is imperative that the Industry be held to account for the waste it generates and for finding ways that it can be disposed of in an environmentally sustainable way. The Guideline should demand this.

Again, an EPR approach would ensure that solar farm proponents build the cost of waste management and resource recovery into the costs of their development. This approach may encourage proponents to make genuine investments in the development of viable recycling options for PV panels.

Conclusion

Our Region is not a designated REZ, yet as stated above every LGA in our Joint Organisation footprint has, or will have, at least one solar farm, if not multiple developments. This is due to our Region's proximity to transmission lines and until the South-Western REZ has similar access to energy infrastructure we anticipate that the developments will keep coming.

Consequently, our Members strongly recommend that given the volume and value of the developments that are occurring that Regulation to be used rather than a voluntary Guideline. Once Regulation is in place this will provide firm guidance to the Planning Commission to ensure that Consent Conditions adequately address the risks and the costs of operating a solar farm.

Our Members strongly agree with LGNSW's position that full responsibility for large-scale solar projects needs to be vested with the project owner and/or host landholder and all aspects of the project including decommissioning and rehabilitation should be regulated from the outset, through the application phase to ensure that councils and communities are not left with a burden of legacy remediation.

We welcome the opportunity to provide feedback to the Department on this important issue and thank the Department for its flexibility in extending the submission date for us.

Xavier Martin
Vice President

2287OC

7 April 2022

Matthew Riley
Director, Energy and Resources Policy
Department of Planning and Environment
4 Parramatta Square
Parramatta NSW 2150

Via: matthew.riley@planning.nsw.gov.au

Dear Mr Riley,

RE: Large Scale Solar Energy Guidelines

Thank you for briefing our Working Group on the updated Large Scale Solar Energy Guidelines on 8 March 2022.

We understand that the revised Guidelines will set out how agricultural impacts need to be reported on in a proponent's EIS and instil clear thresholds and frameworks to guide how projects are assessed.
On the whole we consider the Guidelines to be a significant build on the previous guidelines, and particularly appreciate the increased consideration around visual impacts and agricultural land use. These changes help to establish agricultural land as a planning constraint and will incentivise better site selection.

Visual Amenity Impacts
We commend the development of a new framework to consider visual impacts resulting from solar developments. This framework legitimises visual amenity and creates consistent thresholds for the way these impacts are considered and mitigated.

Agricultural Land Use
As the Guidelines acknowledge, we have limited current data to categorise and map our state's agricultural assets at the property level. Work is currently being undertaken by the NSW Department of Primary Industries (DPI) to improve this data and we hope to have an accurate and agreed upon land mapping and classification system that may provide a basis for assessing impacts to agricultural land use in the future. We appreciate that in the meantime the Guidelines must use existing classification systems such as Biophysical Strategic Agricultural Land, Critical Industry Clusters and Land and Soil Capability Mapping.

Unfortunately, the Land and Soil Capability Mapping has been demonstrated to be of low accuracy and we have been made aware of many examples where land classed as 4, and in some cases 5, is being used for purposes closer to those expected in 1-3. The role of additional soil surveys, as outlined in the Guidelines, is essential to confirm soil capability at the property level. However, in lieu of accurate, accepted mapping, we request that both grade 4 and 5 land is captured within the additional survey requirements.

Renewable Energy Zone's bring the opportunity for much needed coordination and oversight in renewables planning. However, many non-REZ projects continue to enter the planning system. The SEARs process may be sufficient to assess a project on its individual merits and the revised Guideline will certainly improve the consideration of agricultural impacts. However, for projects outside of REZ's there is nothing to trigger consideration of cumulative impacts. We are interested in how the expertise of DPI could be utilised in this process. We understand DPI are given the opportunity to make submissions, however in the past there perhaps hasn't been enough weighting of agricultural impacts within the planning system to support objections. We are interested in investigating a formal role for DPI in the assessment of projects that are likely to impact land important to agriculture. There is a need for projects outside of REZ's to be considered within a regional and state land use context, not just assessed on ability to meet planning standards.

<u>Insurance Impacts</u>
For several years our members have been raising concerns about potential insurance impacts of neighbouring a renewables development ie. the risk that, for example, a fire originating on farm A passes onto farm B and damages multimillion dollar infrastructure will raise the public liability insurance of farm A. Such issues are emerging and our advice suggests, that as the insurance industry continues to catch up with these new risks, increased premiums for neighbours could become widespread. With a significant increase in the planned uptake of large scale renewables in the near future, this issue needs to be considered and planned for now.

Impacts to neighbouring property insurance should form part of the Agricultural Impact Assessment so that mitigation measures can be put in place if an increased premium eventuates. Any increased premium derived from proximity to neighbouring infrastructure should be underwritten by the developer and this should be mandated through the Guidelines. It is not acceptable for neighbouring farms to accept this burden which in many cases would make farming in the area prohibitive.

We would be happy to provide you with case studies to further illustrate these issues if need be.

<u>Infrastructure Contributions</u>
Local councils should receive contributions to address strain on infrastructure and increased waste management derived from energy projects. We support the adoption of consistent levy rates for solar projects but local government should be consulted with closely in determining the appropriate contributions.

<u>Regional Strategic Development</u>
We strongly encourage the mandating of the Guidelines at both the State Significant Development and Regionally Significant Development levels. Thereby capturing all developments at the value of $5 million and above.

Again, we appreciate the opportunity to comment on the guidelines and look forward to continuing to be engaged closely as they're further developed.

Yours sincerely

Xavier Martin
Vice President

NSW Farmers' Association
ABN 31 000 004 651 PO Box 459 St Leonards NSW 1590 Level 4 154 Pacific Highway St Leonards NSW 2065
Member Service Centre 1300 794 000 T 02 9478 1000 F 02 8282 4500 www.nswfarmers.org.au