EIA Consistency and the Potential Micro-Climate Impact of Solar Farms IAIA 2019

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First Solar Farms

- The world's first small solar farms – 1980's, California.
- Development slow until 2004.
- Financial incentives for solar power generation introduced in Germany - leading to development of larger solar farms.
- Largest solar farms in the world are now in India and China.

1MW Arco Solar – Solar Park, Hesperia, California

World's Largest Solar Farms

- The largest solar farm in the world – 1,500MW Tengger Desert Solar Park in China.
  - aka – the Great Wall of Solar
  - 43 km^2
  - Occupies 3.2% of the Tengger Desert.
- Larger 1.8 GW solar farm currently being constructed south of Cairo, in Egypt.

World’s Largest Solar Farms

Adani’s 648MW Solar Farm in Kamuthi, Tamil Nadu

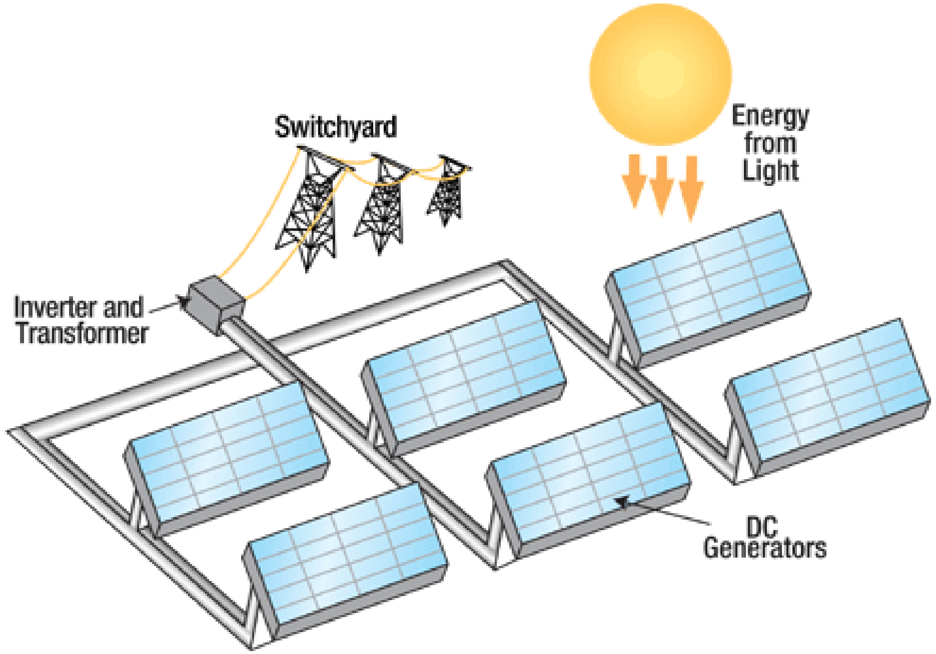
Desert Sunlight 550MW Solar Farm, California

China’s 850MW Langyangxia Dam Solar Park (27km²)

Datong County, China

Solar Farms

- Large-scale solar farms are a recent phenomenon - best-practice environmental planning and assessment processes are still to be established.
- Two types of solar energy: photovoltaic and thermal.
- A photovoltaic (PV) solar farm is an area of land on which large arrays of solar panels are used to capture light from the sun and convert it into electricity.
- Solar panels are made from toughened glass and are mounted on frames in long arrays.
- Frames are inclined at an angle above the ground to minimise shading and maximise solar efficiency.



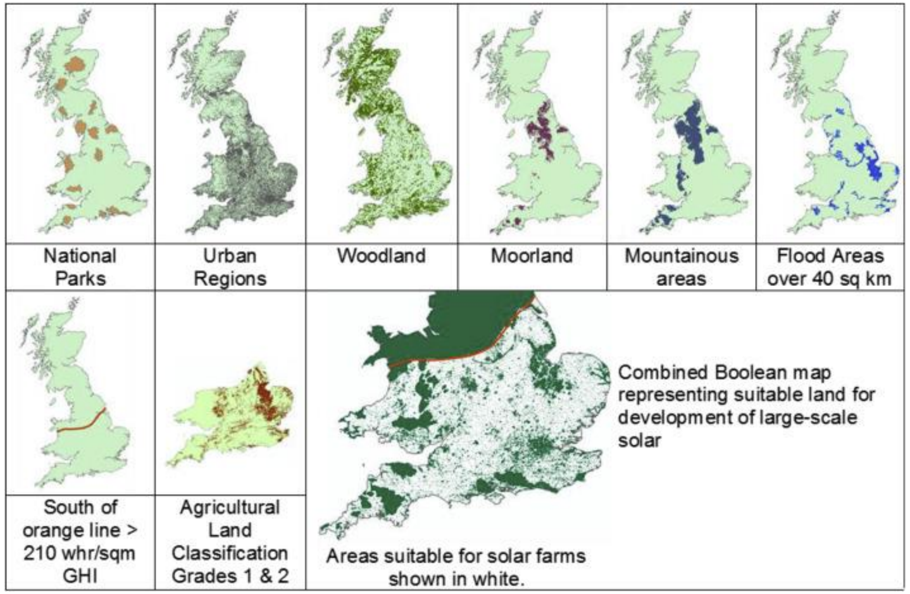
Solar Farms

- Solar potential is recognised to be at its highest in Australia and Africa.
- Issues associated with access to national electricity grids and general remoteness can limit site selection.
- Lack of comprehensive, consistent assessment guidelines.
- Lack of knowledge concerning some of the ‘intangible’ impacts of large-scale solar deployment.

Solar Farm Site Selection

Solar farm site selection processes have traditionally included the following factors:

- Sites should ideally comprise low-grade agricultural land
- Land should be flat or gently sloping
- Land should not be over-looked by residential properties or public vantage points
- Site should offer easy access for construction and maintenance
- Site should not be prone to flooding
- The site should be free of rights of way and easements
- There should be no underground pipes crossing the land
- The site should be in proximity to the grid
- The site should not be in an environmentally or culturally sensitive area
- The land should be available to lease for at least twenty years



Site-selection mapping, UK

EIA Consistency

- Environmental Impact Assessment involves the identification, prediction and mitigation of the environmental impacts associated with proposed developments.
- The origins of EIA can be traced back to the United States; '*National Environmental Policy Act 1969*'
  - Other countries implemented similar procedures soon after.
  - Australia was one of the first in the early 1970's.
- Australia's EIA procedures have changed significantly since that time
  - key objective of EIA is now to improve environmental outcomes through interaction with other regulatory regimes
  - EIA's potential lies in its capacity to improve outcomes by ensuring that all stakeholders have access to information about the impacts of developments.

EIA Consistency

Best-practice principles for achieving improved outcomes in Australia:

- Purposive: EIA should aim to improve environmental outcomes
- Cost-effective: EIA benefits should be at least cost to stakeholders
- High level: EIA should be undertaken at the highest policy and planning level, rather than project level
- Integrated: EIA should be integrated with other regulatory processes
- Focused: EIA should employ a risk-based approach
- Certain: EIA should provide certainty in all aspects of requirement and outcome
- Timely: EIA should be conducted in a timely manner
- Flexible: EIA should have sufficient flexibility to assess different projects and issues
- Participative: EIA should include requirements for engaging with all stakeholders; including the community
- Transparent: EIA should ensure that proponents and stakeholders have access to information and decision-making
- Consistent: EIA should require and promote consistency across and within jurisdictions
- Adaptive: EIA should promote adaptive environmental management
- Precautionary: EIA should promote and implement the precautionary principle (from Macintosh 2010)

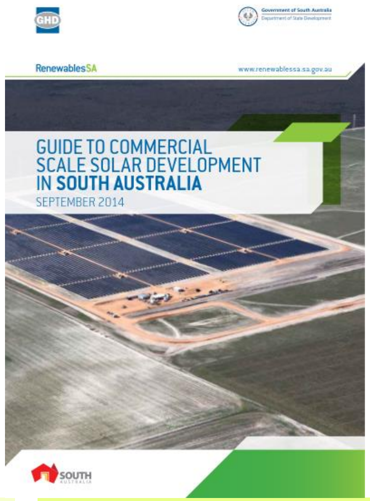
Solar Farm Regulation

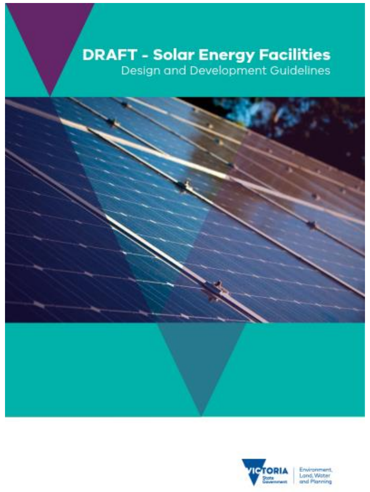
- Australia sees some industries heavily regulated (e.g. mining), whilst others are not (e.g. solar).
- Environmental impacts and planning approval requirements of energy infrastructure projects in Australia tend to be assessed *primarily* at the State or Territory level.
- In some states, solar energy infrastructure projects may even be assessed by local councils.
- Approval pathways and EIA requirements therefore differ for large-scale solar developments in different jurisdictions
  - For example, assessment and approval processes required in New South Wales, may not be the same as those required in South Australia.
  - What might be required in one region of a state (such as Victoria or Queensland), might not be required in the adjoining region.

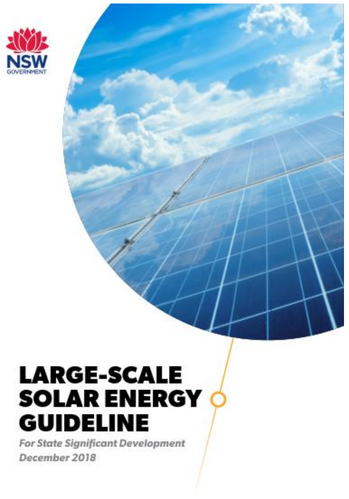
Solar Farm Guidelines

Australia does not have national guidelines that govern the development of large-scale solar farms. Most states of Australia have only recently prepared state guidelines.

- The *Guide to Commercial Scale Solar Development in South Australia (SA)*
- *Draft Solar Energy Facilities Design and Development Guidelines (Vic)*
- *Large-Scale Solar Energy Guideline for State Significant Development (NSW)*
- *Queensland Solar Farm Guidelines (QLD)*

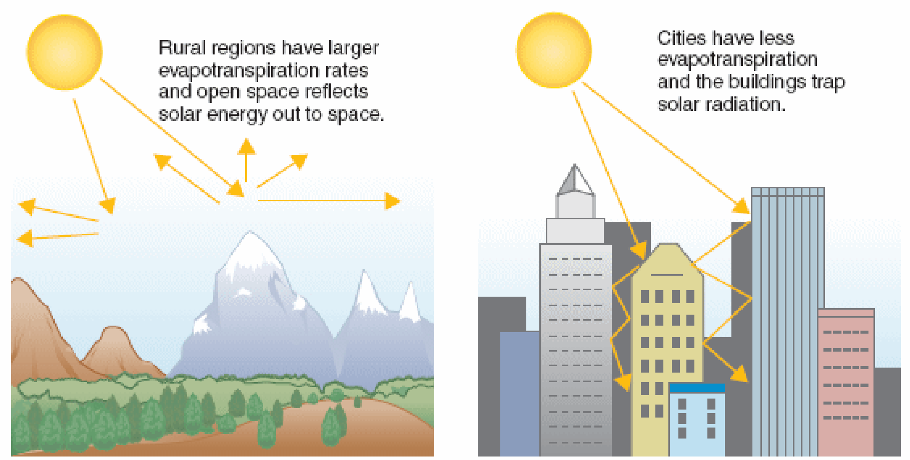






Micro-Climate Impacts

- Recent issue of community concern is the potential micro-climate impacts of large-scale solar farms.
- Solar panels are made of dark-coloured glass and cover large areas of land; therefore they potentially alter the solar reflectivity (albedo) of the ground surface.
- Generally, dark surfaces have a low albedo and light surfaces have a high albedo.
- The heat-island affect has traditionally been referred to in an urban context - the concept is now being considered in relation to the potential of large-scale soar farms to heat up an area or 'micro-climate'.
- Very little information on this topic exists.



Micro-Climate Impacts

- Literature review of academic research papers was undertaken.
- Only ten relevant published papers were identified.
- Several common findings have emerged:
  - Temperatures in the centre of a solar farm may be slightly higher than ambient
  - Temperatures return to ambient several metres above a solar farm
  - Temperatures may be slightly warmer directly adjacent a solar farm
  - Temperatures gradually return to ambient with distance away from the solar farm
  - Air temperatures at ground level underneath panels may be slightly cooler during summer months
  - Air temperatures directly above solar arrays may be slightly warmer at night and during warmer months

The Importance of EIA Consistency

- Best-practice EIA advocates for consistency across and within jurisdictions - important for those issues for which there is a lack of understanding.
- Consistency applies to:
  - Approach and methodology
  - The application of EIA across similar projects
  - Assessment procedures
  - Mitigation
  - Decision-making.
- This applies to national and cross-jurisdictional decision-making; particularly where different approval authorities are involved.
- Large-scale solar farms may create a heat-island affect, which could heat up the local micro-climate:
  - What about where a solar farm is developed in an area of high-value and sensitive agricultural production?
  - What about where several solar farms are proposed for an area of high-value agricultural production?
  - What if these projects are subject to several different approval authorities?

The Importance of EIA Consistency

	South Australia	Victoria	New South Wales	Queensland	Western Australia
Solar Farms Approval Documents Reviewed (in planning, construction or operation)	14	14*	15	54*	7*
Approval Pathway	Section 49 (Public Infrastructure)	General Scheme	State Significant Development (EIS)	General Scheme	General Scheme
Relevant Legislation	*Development Act 1993*	*Planning and Environment Act 1987*	*Environmental Planning and Assessment Act 1979*	*Planning Act 2016*	*Planning and Development Act 2005*
Relevant Authority	State Government	Local Councils	State Government	Local Councils	Local Councils
Environmental impact assessment	Yes	Yes	Yes	Partial	Yes
EPBC Referral Required	1	5	12	24	5
Consideration of micro-climate impacts	1	0	0	0	0
Consideration of mitigation for heat-island affects	No	No	No	No	No
Comments	Practically all renewable energy infrastructure projects sponsored under Section 49	Majority, but not all, of renewable energy projects assessed by individual local councils	All solar farm projects over $30 million deemed State Significant Developments and require an EIS	Majority, but not all, of renewable energy projects assessed by individual local councils	Solar projects assessed by local shire councils

* Not all approval documents available to review in detail. Stakeholder engagement material and council notifications may have been reviewed as an alternative.

Findings

- The exercise demonstrates the lack of consistency not only across Australia, but also within individual states.
- This in turn demonstrates the importance of consistent solar farm guidelines.
- There are currently no national Australian solar farm development guidelines and little uniformity between existing state solar farm guidelines.
- This is an issue not only for typical solar farm impacts such as ecological issues, visual amenity issues and loss of agricultural land, but particularly for poorly-understood issues such as potential micro-climate impacts.

Potential Mitigation of the Heat Island Effect of Solar Farms?

- Trees and parks reduce local temperatures.
- Trees that have a high leaf area density and a high rate of transpiration are the most effective at cooling the environment.
- The cooling effect of parks and vegetated areas is determined by species group, canopy cover, size and shape of the vegetated area.
- Heat-island mitigation studies have found that temperatures decrease with every percentage increase in tree canopy cover.
- *Eucalyptus*, *Acacia*, and *Olea* species are effective at cooling the local environment.
- Not a common practice in Australia to have solar farms screened with vegetation.
- But vegetated buffer areas could potentially mitigate against community concerns of micro-climate impacts.
- Would this be acceptable to the industry? Would this work?

Source: Powervault Mildura Solar Farms

Recommendations

The following high-level concepts are worth further consideration:

- Updating existing solar farm site-selection factors to mitigate for the potential micro-climate impacts of solar farms through the inclusion of vegetated buffer-areas.
- Incorporating treated buffer-areas around solar arrays and undertaking modelling to ensure that species selection and planting density do not impact upon the operating efficiency of the solar farm through shading.
- Incorporating requirements for treated buffer zones into development approval conditions.
- Investigating the value, applicability and statutory capacity for comprehensive and integrated national solar farm guidelines in Australia, which advocate for consistency in EIA.

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