Sunrun Installation Services Inc.
2309 South Mount Prospect Rd
Des Plaines, IL 60018

To Orland Park Development Services Department,

For Property: 11353 Longwood Circle, Orland Park, IL 60467

This letter certifies that Sunrun Installation Services Inc, has taken reasonable effort to comply with section 6-314.E.5.g of the Environmental Technology Standards: SES collector panels shall be placed such that concentrated solar radiation or glare shall not be directed onto nearby properties, roadways or public right-of-ways.

Sunrun Installation Services use LG and REC panels. LG is using anti-reflective technology on the glass and on the cells of the panels to ensure light is absorbed in the panel and not reflected. The study undertaken at SERIS demonstrates the advantage of AR-treated glass as used by REC. Please see the attached studies.

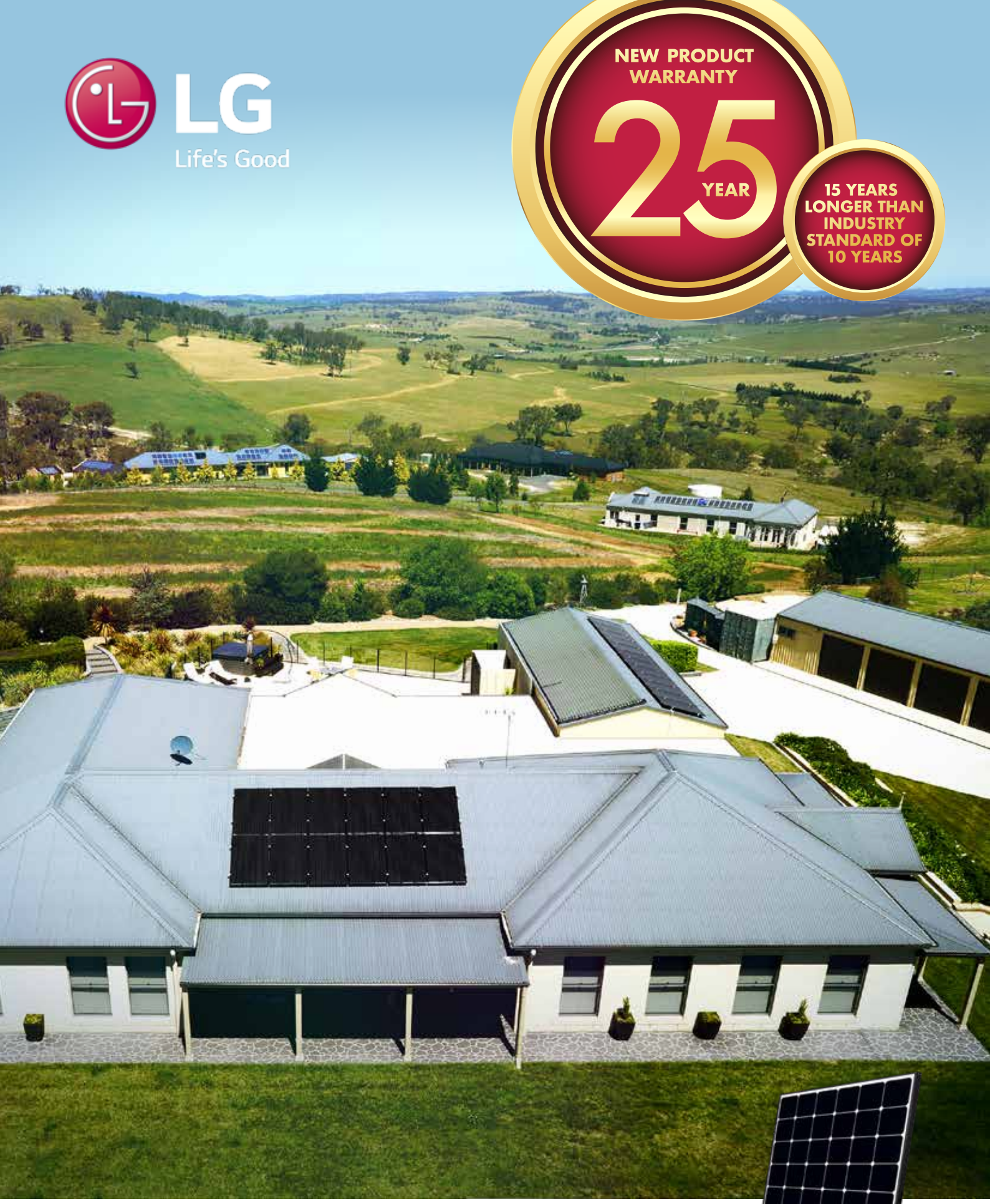
Thank you,

Sunrun Installation Services

LG
Life's Good

NEW PRODUCT WARRANTY
25 YEAR

15 YEARS LONGER THAN INDUSTRY STANDARD OF 10 YEARS



30 Panel Advantages

For more information visit | www.lgenergy.com.au
For enquiries contact | solar.sales@lge.com.au

30 LG PANEL ADVANTAGES AND THEIR BENEFITS FOR YOU

A solar panel harvests the sun and converts it into electricity and is together with the inverter the most important part of a solar system. A solar system only achieves a positive return on investment after a number of years. Contrary to some cheap panel sales spin, the fact is - Not all solar panels are built equal. Given that a solar panel is exposed to wind and weather and has to endure many temperature variations, while producing electricity, the built quality of a solar panel is very important.

With non branded cheaper panels, even within one manufacturer there are variations in built quality, depending on the destination of the product and the originating factory. LG panels all come from one factory in Gumi, South Korea and there are no variations as to the built quality meaning our panels shipped to Vietnam or Indonesia are the same as the ones exported to Germany, Japan, the US or Australia.

Choosing long lasting, high efficient LG solar panels and quality inverter solutions will ensure you will have a long lasting trouble free system. Longer lasting systems will provide a higher financial return than cheaper, poor quality systems, which in Australia have failed by the thousands after only a few years in service. So while LG panels initially cost more than some non-brand competitor panels over the life of the system LG panels can create one of the best financial and environmental results for you.

Peace of mind warranties

1 Twenty five (25) year parts and labour manufacturer's warranty

LG offers a 25 year parts and labour warranty which includes the cost of shipping panels for the NeON® 2 and NeON® R, as well as the labour cost of un-installing and re-installing the panel, compared to the 10 year manufacturer's warranty offered most other manufacturers, which is the current industry standard.

YOUR BENEFIT: You get a longer warranty than many other panels on the market (25yrs v 10yrs). Also some of the conventional panels do not cover labour and/or transport for replacement panels. LG has also developed a detailed customer friendly warranty brochure to help you, should there ever be a claim.

NeON® R
NeON® 2

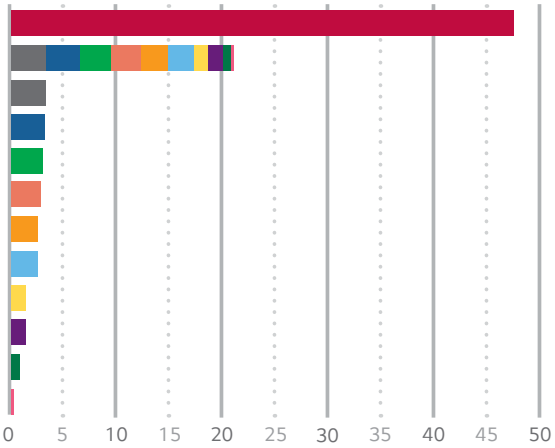
Extended Product Warranty
10yrs + 15yrs

2 Diversified manufacturer– stable and strong warranty

In mid 2016 there were over 220 panel manufacturers with panels registered for sale with the Clean Energy Council in Australia. It is likely that in future there may be a significant consolidation of solar manufacturers taking place with potentially only a fraction of these manufacturers operating in Australia long term. LG with its diversified manufacturing, strong bankability, diversified product portfolio and its multi-billion dollar size has a better opportunity that many others to be a leader in solar in decades to come.

YOUR BENEFIT: A peace of mind, strong warranty.

The warrantor's 2016 sales in billions of US dollars



LG Electronics	**$47.91bn**
All below combined	$20.14bn
Jinko Solar*	$3.20bn
Trina Solar*	$3.15bn
Canadian Solar*	$2.85bn
Sunpower*	$2.70bn
HavQCells*	$2.42bn
JA solar*	$2.41bn
Yingli*	$1.27bn
Suntech*	$1.24bn
REC Solar*	$0.82bn
Winaico/Win Win Precision Tech*	$0.08bn

*2016 Annual Financial Statements.

3 Warranty registration with LG Australia/NZ

LG offers a simple warranty registration process via lgenergy.com.au in Australia and New Zealand.

YOUR BENEFIT: LG has a record of your purchase details in case of a warranty claim.

4 Tier 1 Ranking by Bloomberg New Energy Finance

LG panels have been recognised by Bloomberg New Energy Finance as a Tier 1 Solar Manufacturer. The Bloomberg Tier 1 ranking is widely recognised within the industry as a measure for bankability of the manufacturer. It does not reflect built quality or longevity of the panels. Other manufacturers sometimes use the Tier 1 label as a sign of build quality or financial stability of the manufacturer – which IT IS NOT.

YOUR BENEFIT: Being a Tier 1 panel alone, does not guarantee a long lasting panel. It is the combination of many manufacturing aspects as demonstrated in these pages, that bears witness to LGs excellent solar panel quality.

Great Visual Appearance

5 Great looks for your roof

LG NeON® 2 and NeON® R panels have been designed with appearance in mind. Their black cells and black frames give an aesthetically pleasing uniform appearance. Standard competitor poly panels have blue cells and plain aluminium frames. For very aesthetic conscious customers LG is also offering a stunning looking complete black version of their NeON® 2 range.

YOUR BENEFIT: Ensuring you have panels that are high quality, attractive panels and make your roof look great and may preserve or increase the resale value for your home.

LG NeON® R

LG NeON® 2 Black

Why LG panels lead the pack

Higher Performance through winning technology

6 Proven field performance

LG and other companies, including the Australian consumer organisation Choice have been involved in a number of comparison tests of the LG modules against many other brand panels. LG NeON® 2 and NeON® R panels are consistently one of the highest performing panels in these tests. In the Choice test conducted between October 2015 and October 2016 the LG NeON® 300W won against 15 competitors as the highest output per watt panel.

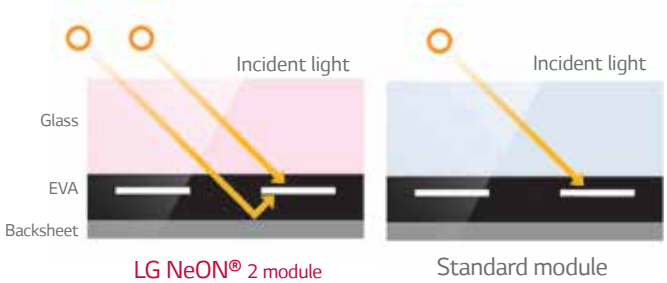
YOUR BENEFIT: Improved performance in all weather conditions.

LG panels and competitor panels comparison system, Sydney, Australia

7 Double sided cell structure for NeON® 2 panels

The LG NeON® 2 panel produces energy from both the front and the back of the cell. This innovative approach allows the absorption of light from the front and the back of the cell, which raises the panel's performance. The LG NeON® panel is the only panel in Australia offering this feature. In 2013 LG won the Intersolar Award in Germany for this innovation. Other NeON® panel innovations also won further Intersolar Awards in 2015 and 2016.

YOUR BENEFIT: Additional electricity generation from light hitting the edge and back of the solar cell



8 Maximising roof space for future expansions (More power per square Metre)

LG NeON® 2 panels are rated at 325/330/335W per panel, whereas many conventional panels achieve only a 260W rating. This equates to 26% more power for the NeON® 2 panel than many 260W panels that are the same physical size. The LG NeON® R can produce an even more impressive output with 360W and 365W per 60cell module.

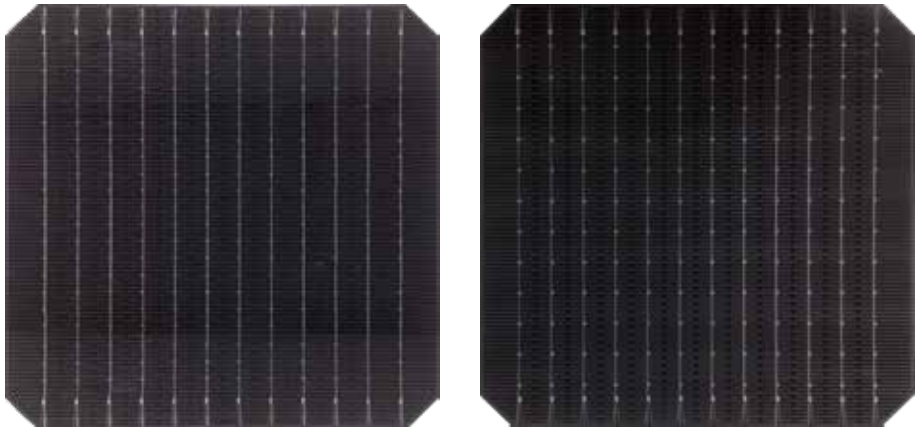
YOUR BENEFIT: You use less roof space for a given system capacity and/or have room for future system expansions for batteries and even electric car charging in years to come.

Higher Performance through winning technology

9 12 wire busbars ("CELLO" Technology Increases Power) with NeON® 2

LG's "CELLO" Multi wire busbar cell technology lowers electrical resistance and increases panel efficiency, giving more power per panel and providing a more uniform look to the panel. In 2015 LG won the Intersolar Award in Germany for this innovation.

YOUR BENEFIT: Higher electricity output than conventional panels in all weather conditions and latest technology ensures your panel stays relevant in future years.

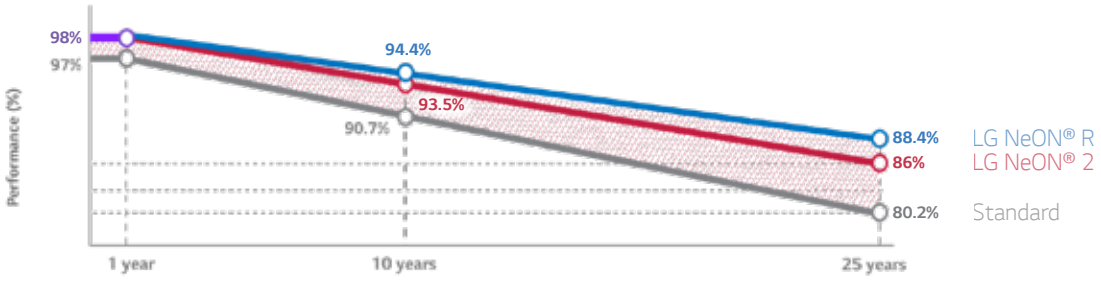


Front and rear of NeON® 2 cell

10 Lower degradation than industry standard

Solar panels degrade over their lifetime and produce less electricity each year. The NeON® 2 and NeON® R have a very low LID, due to the use of N type treatment of the cells which uses phosphorous as a replacement for Boron.

YOUR BENEFIT: Less degradation of electricity production than conventional panels as the panel ages.



11 Anti-reflective coating increases output

LG is using an anti-reflective coating technology on the glass and on the cells of our panels to ensure more light is absorbed in the panel and not reflected.

YOUR BENEFIT: More absorbed light means more electricity generation.

12 Improved High Temperature Performance

Solar panels slowly lose ability to generate power as they get hotter. On a very hot summer day panels can be as hot as 70 degrees Celsius which means for many panels a performance loss of over 20% over a panel that is only 25 degrees Celsius on a milder day. LG NeON® 2 and NeON® R have one of the best temperature performance characteristics, which means even in very high temperatures our panels will deliver higher output than standard panels.

YOUR BENEFIT: Better performance on hot days than most conventional panels means more power generated to use to run air-conditioning, pool pumps and fans for example.

LG invests heavily into solar research.

Higher Performance through winning technology

13 Excellent low light performance

Great performance under low light conditions due to LG technology and our own cell manufacturing with low tolerances, ensuring highly consistent performing panels. At 200W/m2 LG panel efficiency drop is -2% while many conventional panels reduce by -4%.

YOUR BENEFIT: Better performance on low light days including cloudy or early morning/late afternoon, the time when performance really counts.

14 Multi Award Winner

LG panels have won numerous awards over the past year. For example the NeON® panel range has won the Intersolar Award for Photovoltaic Innovation in Germany, three times since 2013. The LG solar brand has won the "Top Brand" in Australia Award in 2017 and 2016 and the Top Brand for many countries in Europe in 2017, 2016 and in 2015.

YOUR BENEFIT: Panels have been recognised as innovative and cutting edge by industry experts giving you confidence in the quality and performance of the product.

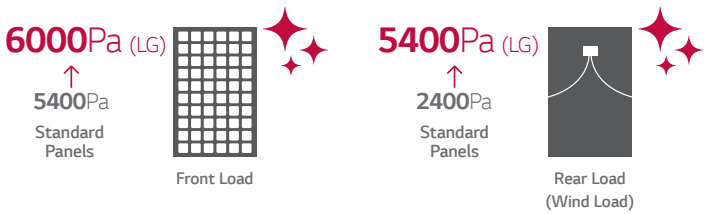
Quality built and testing for better reliability

Not all solar panels are built the same, and many struggle to achieve the LG build quality. In Australia & NZ some cheaper modules have failed in as little as 2-3 years. Reasons for failures and low output performance include hot spots, corrosion, water ingress, failed bypass diodes, poor sealants, delaminations and micro cracks.

15 Cyclone wind load resistance

LG modules have a strong double walled frame. When it comes to wind forces (rear load) many competitor modules are certified to 2400 Pascals. LG modules are certified to more than double, 5400 Pascals, making them very sturdy and one of the strongest on the market.

YOUR BENEFIT: Less likely issues with panel failure in extreme wind conditions and wind load exposure over many years.



16 Extensive testing program - up to 4 times international standard

One of LG's specialties is their focus on testing. In order to be sold in Australia solar modules have to be tested and pass the IEC standard tests once. LG solar panels are regularly tested up to 3 times the IEC standards by LG in-house testing laboratories. LG also chooses to spend a significant amount of money on research and development. In fact, 25% of their entire solar focussed workforce is dedicated to discovering new technologies and improving their solar technology.

YOUR BENEFIT: Confidence in the product and ensuring a very robust and longer lasting solar module.

17 Lightweight but strong

Even though LG panels having high wind stability, our 60 cell panels at 18kg are lighter than most of the competition panels.

YOUR BENEFIT: Less weight and stress on your roof structure, especially for larger systems.

18 High quality components

Our LG panels use quality junction boxes which are completely water proof (IP68) and use the original Swiss MC4 panel connection plugs, not copies, like some lower priced competitors do.

YOUR BENEFIT: Confidence in the product and ensuring a very robust and longer lasting solar module

19 Fully Automated production line

LG panels are manufactured in Gumi, South Korea in a fully automated factory. The wafers, cells and panels are manufactured in one seamless process production line, which emulates the air purity of semi conductor manufacturing environment.

YOUR BENEFIT: A consistent and high quality solar product.

20 Premium quality control on input materials and production

LG controls its supply chain very thoroughly to ensure a consistent and high quality solar module. During the fully automated standardised manufacturing process very low variation tolerances are allowed during the 500 quality control processes.

YOUR BENEFIT: A consistent and high quality solar product.

21 Anti PID technology for yield security

PID (Potential Induced Degradation) has been a more recent discovery that can affect the long term performance of the panel. LG panels are manufactured with anti PID technology and have been extensively tested by leading third party testing laboratories regarding PID and passed these tests.

YOUR BENEFIT: This means LG panels are more likely to give decades of clean power.

22 Positive tolerance (0/+3%)

If we sell you a 330 Watt rated solar panel then the flash test of this panel will show at least 330W and can be up to 339.6W. Some competitor panels have -/+ tolerance, so you could get a flash test result below the rated Watt, (e.g. a 250W panel may really only be 243W) meaning you pay for Watts you never get.

YOUR BENEFIT: Every Watt you pay for is delivered with LG solar, plus a little more.

23 Passed fire test

All LG modules have passed fire safety tests and contain flame retardant materials, meaning should any electrical malfunction occur the panel will not combust and catch fire, as required by Australian registration regulation.

YOUR BENEFIT: Safety for your home.

24 High compatibility with all quality inverter and racking solutions

LG modules are designed for residential, commercial and utility scale systems. The panels will work with all inverter and micro inverter solutions on the Australian and NZ market. The panels can be mounted for roof top or ground mount in vertical (landscape) and horizontal (portrait) installation position.

YOUR BENEFIT: Maximum system design flexibility, allowing a bigger system to be installed in some roof situation, due to landscape install option.

25 Micro crack testing

Two EL "flash" tests are performed on the LG module during production to ensure no cells with microscopic cracks are used. One test is conducted before lamination and one after lamination. An image of each micro crack free panel with serial number is stored in LG's database in case of any future warranty claim.

YOUR BENEFIT: A well built module without microcracks leaving the factory.

26 LG Testing Laboratory Certification

LG has had its internal testing facilities certified by 4 major international testing laboratories (VDE, UL, TUV Rheinland and Intertek) and to ensure the ongoing accuracy reliability of the internal testing processes. This is a first within the solar industry.

YOUR BENEFIT: Shows LG's commitment to producing panels of uncompromising quality.

Environmental leadership

27 Lower energy payback time

Energy payback is the time it takes for a solar panel to generate the power it took to manufacture, ship and install the solar system. LG has calculated the embodied energy in an LG solar panel as 297.65kg of CO_2 from resourcing of raw materials, to manufacture, and including transporting and installing product. In Brisbane, Australia, the average energy payback of a 330w NeON® 2 for example is under 1 year, 5 months as opposed to a standard 260w panel which is close to 2 years. Because LG panels are also built to last long, this means each LG panel can create more clean energy during their working life.

YOUR BENEFIT: Higher environmental benefits via LG panels in regards to CO_2 abatement compared to less efficient panels which use the same amount of raw materials.

28 Recognised Sustainable Leadership

LG was awarded 44th of the 100 most sustainable corporations in the world by Corporate Knights for 2016, up 7 spots from 2015. Corporate Knights uses a comprehensive measurement system to gauge the Sustainability of a company based on both environmental and societal outcomes.

29 No Ozone depleting gases in manufacturing process

LG Electronics runs a Homogenous Substance Management system to ensure that no ozone depleting substances are used in the manufacturing of the panels, or any of the materials supplied to LG for manufacturing of the solar panels.

30 LG panels part powering the Solar Factory

LG has installed a 3.2MW of solar power (over 11,000 panels) on the roof of our solar factory in Gumi, South Korea to generate some of the electricity to manufacture the panels. Since 2014 LG has installed over 18MW of Solar panels across its manufacturing facilities across Korea including electrical appliance and battery factories.

Solar factory, Gumi, South Korea with LG solar panels on the roof.

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18 Baile Road, Canning Vale, WA 6155

New Zealand
60 Highbrook Drive, Highbrook Business Park, East Tamaki, AKL 2013

For further information please see: LGenergy.com.au

LG Life's Good

The Canberra Times

NATIONAL ACT

Solar glare safe: CASA

By John Thistleton
13 November 2013 — 3:00am

Reflected light from a proposed new solar farm near Canberra Airport would not blind pilots of approaching or departing aircraft, and would reflect less than glass and similarly to a forest or a crop, the Civil Aviation Safety Authority says.

Opponents of the development, Canberra Airport and Qantas, said glare was a potential safety hazard and the solar farm should not be approved on land below the approach to runway 17 at the airport.

Airport managing director Stephen Byron previously quoted a US Air Force study that showed people exposed to bright light flashes took four to 12 seconds to recover vision to read instruments.

''On what planet do we have to be to work out that this is probably not a smart idea to allow the construction of this aviation safety hazard,'' Mr Byron said.

A consultation report from Commonwealth planning agency, the National Capital Authority, shows CASA had by this stage advised the authority the solar farm, on land near Mount Majura Winery, did not appear to be an aviation hazard. Undeterred, the airport requested the advice to be reviewed.

MYSTIFIED: Canberra Airport managing director Stephen Byron believes the solar farm a hazard.

Photo: Andrew Taylor

Proponent Solar Choice commissioned glare analysis reports from CBRE and Canadian Solar, which used a range of variables, such as height and angle of the sun in the sky, vantage points and heights of the viewer.

Both reports concluded some level of glare was to be expected from the solar arrays, but the impact to vehicles or aircraft was low and unlikely to be hazardous. ''The modelling used tends to overstate the likelihood of reflective glare because it does not take into consideration the prospect that the view of the panels from many locations will be obstructed by landscape features or other panels within the array,'' the CBRE report said.

The NCA's consultation report says aircraft issues had been resolved. The authority is now waiting for information on environmental matters before making a decision on works approval. Air Services Australia said the 4MW farm, which will take three months to build on 13.8 hectares, would not affect aircraft, nor the radar installation at Majura.

Initially concerned about safety of military aircraft, the Department of Defence was later satisfied with CASA's assessment.

Canberra Airport also criticised the proposed Mount Majura Solar Farm because it was on a major transport corridor, including for a possible high-speed train.

But the NCA said a second study on a high-speed train included a refined alignment south of the farm site.

John Thistleton

John Thistleton is a reporter for The Canberra Times.

Solar farm projects near airports: Is glare an issue?

by Solar Choice Staff on 19 September, 2013

in Commercial solar power,Positioning solar PV panels,ACT,Solar Farms

The Canberra Times recently published a piece about the concerns about potential glare from the solar panels of the proposed 4 megawatt (MW) Mount Majura Solar Farm, given its proximity to Canberra Airport. This article addresses concerns about glare from solar panels in aviation and examines a number of similar case studies both internationally and elsewhere in Australia.

1. Solar panels are designed to absorb light, and accordingly reflect only reflect a small amount of the sunlight that falls on them compared to most other everyday objects. Most notably, solar panels reflect significantly less light than flat water.

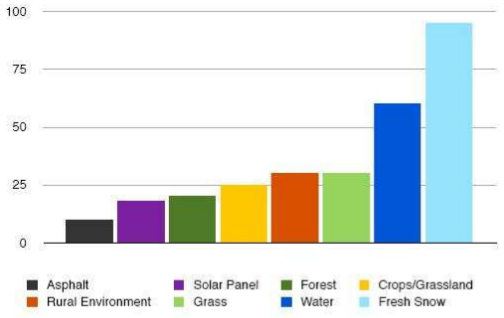
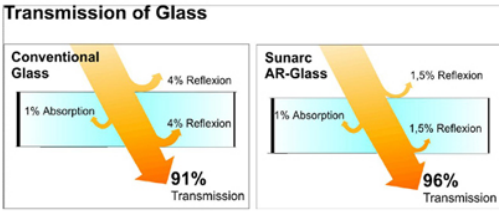


Figure 3: Comparative reflection analysis

In fact, glass, one of the uppermost and important components of a solar panel, reflects only a small portion of the light that falls on it– about 2-4%, depending on whether it has undergone an anti-reflective treatment. These days, to increase solar panel efficiency and power output, most panels are treated with some kind of anti-reflective coating. Below is an example of how Sunarc's antireflective technology– just one available on the market–can increase light transmission in glass and reduce reflection.



(Image via Sunarc.)

The chart below compares the reflectivity of smooth surfaces at different angles of sunlight. Solar panels treated with antireflective coating reflect a lower percentage of light than smooth water. Steel, a common building material, reflects far more incident sunlight than either.

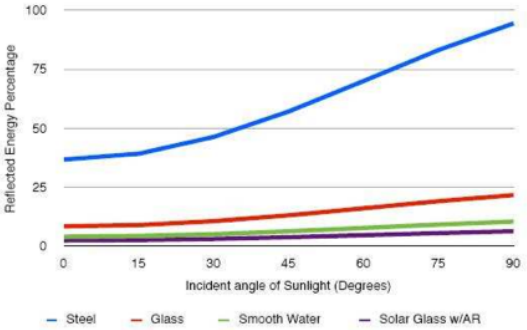


Figure 4: Analysis of typical material reflectivity with sunlight angle[3]

2. Of course, it may not seem fair to compare the quality of light reflected from grass to that reflected off of water or glass. Smooth surfaces such as glass and still water exhibit 'specular reflection'. This is when light hits the surface at one angle and 'bounces off' in another direction, much like a mirror. Specular reflection can be contrasted with 'diffuse reflection', which occurs when light reflects off of microscopically rough surfaces and scatters. Diffuse reflection is what happens when light hits virtually everything in our field of vision.

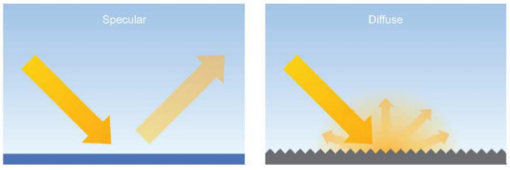


Figure 1: Specular vs diffuse reflections [Source: FAA]

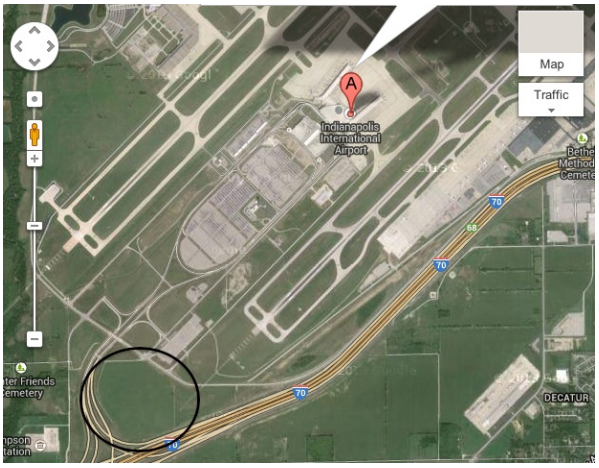
When the sun is reflected on a smooth surface, it can result in glint (a quick reflection) or glare (a longer reflection) for those who are on the 'receiving' angle. In both cases the light reflected is diminished by having first hit the substrate that reflected it–unless that surface is a perfect mirror. When the sun is the original source of the light reflected off a reflective surface, the time and position at which glare or glint might occur depends on the original position of the sun in the sky in relation to the location of the viewer.
Pilots are familiar with this sort of reflection, usually from bodies of water (which, as noted above, has a higher level of reflectivity than glass or solar panels). Airports are commonly found in close proximity to lakes and the ocean (Sydney's Kingsford Smith being one such case).

3. The biggest glare hazard in aviation is the sun itself–particularly when it is low on the horizon. In an international, comprehensive analysis of potential glare hazards (pdf – see section 7) in aviation from solar panels, the UK's Spaven Consulting points out that a trawl of UK and US aviation incident databases between the years 2000 and 2010 for accidents in which glare was cited as a factor reveals that in the overwhelming majority of these cases, the source of the glare was the sun itself. The handful of other cases were mainly related to glare from water on the tarmac or from a nearby body of water. In no case was glare from solar panels or 'similar facilities' cited as a contributing factor to an accident.

4. Numerous airports around the world have solar installations *located on their premises.* Among those in Australia that have installed large arrays are Adelaide Airport, Alice Springs Airport, Newman Airport (WA), and Ballarat Airport. Internationally, solar arrays have been installed at or near airports in Singapore's Changi Airport, London's Gatwick Airport, California's San Jose Airport, Germany's Dusseldorf Airport, the US's Denver International Airport, Nellis Air Force Base in Nevada, and Ontario's Thunder Bay Airport, to name a few. The preponderance of examples in which solar panels have been installed at, on or near airports is testament to fact that they are not automatically a hazard to pilots.

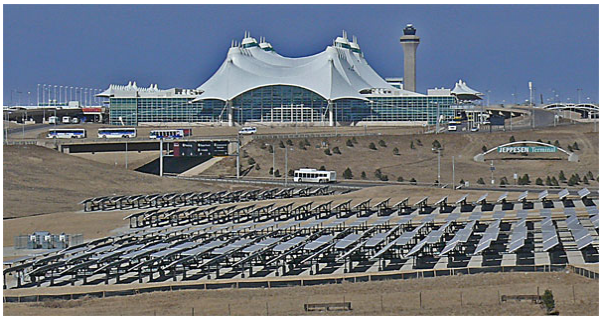
Particularly noteworthy and a close analogue to the Majura Solar Farm with regard to its position in relation to an airport is the Indiana Solar Farm. 2MW of solar panels facing due south are located under 1km south-west of runways. Stephen Barrett of US consultancy HMMH, which has undertaken glare assessments of numerous solar installations at or near airports across the US–including Indianapolis Airport–said that the majority of projects that HMMH had been involved in were developed by the airports themselves and were therefore careful to adhere to FAA guidance. He also noted that the FAA only requires glare assessments for developments that occur within 2 miles (about 3.22km) of touch-down.

The Indiana Solar Farm, less than 1km southwest of the landing strip at Indianapolis International Airport. (Photo by Alex Dierkman.)



The location (circled) of the Indiana Solar Farm in relation to Indianapolis Airport runways. Panels are not visible because the map is out of date. (Image via Google Maps.)

Dusseldorf International Airport, Germany (Image via AvaiationPros.)



Denver International Airport , Colorado, USA (Image via Worldwater & Solar.)

Nellis Air Force Base in Nevada, USA (Image via Nellis Air Force Base.)

The 8.5MW Thunder Bay Airport Solar Park (Image via Recharge News.)

Two Californian airports specifically noted in Spaven Consulting's report–Bakersfield and Oakland–have solar arrays directly adjacent to the tarmac or even between runways (images below). Both of these arrays underwent analysis during the planning process to ensure that glare was not an issue, and neither has reported complaints about glare from pilots since the arrays were installed.

Figure 5: Location of solar PV array at Oakland Airport

Figure 7: Bakersfield Airport showing location of solar array

5. The Spaven Consulting report notes that because of their low reflectivity solar developments 'en route' to an airport (but not actually located on the premises of an airport) are unlikely to warrant a glare analysis. In the event that such an analysis is deemed necessary, the above points (about the low reflectivity of panels) are should be taken into account. The Mount Majura Solar Farm will be located 7km north of the airport, making it unlikely that pilots flying in and out will experience any interference due to reflection of light from the panels. Furthermore, because the nose of a commercial aircraft is tilted slightly upwards prior to landing, should any light be reflected off the panels during a landing, it is more likely to fall on the underside of the plane than shine into its cockpit.

Further reading: Spaven Consulting's report on reflectivity & glare with solar panels (pdf)

Images via Spaven Consulting

Related Posts

- Adani are set to build a solar farm in Whyalla (28 Aug, 2018)
- Battery Storage Price Index – August 2018 (24 Aug, 2018)
- 30kW solar installation for Nepean Health Care (brokered by Solar Choice) (20 Aug, 2018)

Tagged as: adelaide, alice springs, ballarat, glare, majura, solar farms

{ 5 comments }

Ella 16 June, 2016 at 7:05 am

Can I ask about Figure 4? It looks wrong; as the angle of incidence approaches 90 degrees, for example, the percent of light reflected from glass gets very near 100%, not 25%. This is well known. Look:
http://research.vuse.vanderbilt.edu/bmeoptics/bme285/mainframes/module3/module3pics/m3pic26.jpg
I realize this article was posted years ago…

Chew c k 9 December, 2014 at 2:30 am

Any law suit about solar PV reflection?