



Australian Government



Large-scale solar and the race to net zero emissions

The CEFC has played a major role in accelerating the development of Australia’s critical large-scale solar sector, from crowding in substantial private sector investment to supporting the entry of new developers, contractors, suppliers and offtakers. This Investment Insight brings together some of the highlights of our work with ARENA in backing the growth of this critical renewable energy resource.



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With sunshine and space in abundance, Australia is the perfect country to capitalise on increasing levels of solar generation. Combining investment and innovation, we need to carve out a future that uses our vast natural, renewable resources to our advantage to drive emissions reduction and help combat the impact of climate change.”

Monique Miller
CEFC Chief Investment Officer,
Renewables and Sustainable Finance

A decade of solar investment

\$1.8b

CEFC commitments

34

projects

2.9 GW

capacity

Large-scale solar commitments to 31 December 2022

Powering a greener grid

Australia requires significant new investment to support a substantial uplift in renewable energy generation and storage. That is why the CEFC is investing in large-scale renewable energy developments, alongside critical grid transmission projects, landmark battery storage and innovative new technologies.

As with any new sector, early participants faced a range of challenges, from locking in long-term power purchase agreements to resolving construction and connection issues due to the unique characteristics of the Australian grid. Together with ARENA, the CEFC worked with developers, investors and regulators to resolve these issues, through our joint large-scale solar funding round.

The investors

The CEFC and ARENA effectively kick-started Australia’s large-scale solar sector in 2015, together announcing an unprecedented \$350 million in grants and finance to lift developer and investor confidence in the sector:

ARENA: Provided grant funding to improve the competitiveness of individual developments, enabling large-scale solar to become commercially viable without grant funding by May 2017.

CEFC: Provided patient capital to projects as they progressed from seeking finance, through construction and connection phases, to full grid energy generation and commercial offtake agreements.

Capturing Australia's solar potential

The push to net zero emissions represents a major growth opportunity for the Australian solar sector as we seek to achieve a decarbonised electricity system and capitalise on the competitive advantages offered by this least cost energy source.

In 10 years, large-scale solar has grown into a major component of Australia's clean energy mix. However, it is still a relatively new energy sector and there are still significant development and generation challenges related to grid connection timelines, construction risk, market price volatility and weather risk.

Using our finance expertise and experience in the sector we are helping deliver complex large-scale developments by working alongside a diverse range of global and Australian investors. We are continuing to lead the market, demonstrating the investment potential of new business models and technologies while drawing in additional private sector capital.

The commercial rigour of our investment approach has earned the trust of our co-investors and is helping spur the further development of a robust clean energy economy that is crucial for a decarbonised future.



CEFC Large-Scale Solar Program

The CEFC Large-Scale Solar Program, originally set at \$250 million, made investment commitments of more than \$370 million, accelerating projects with a total estimated value of \$900 million and a total generating capacity of more than 400 MW (AC). The program, launched in 2015, featured long-dated fixed rate finance, for projects with power purchase agreements (PPAs), as well as those with an element of merchant risk. In addition to accelerating project development, the CEFC aimed to fill the funding gap in the large-scale solar sector, acting as a co-investor in debt and equity to encourage greater participation by banks and other institutions as the sector developed a track record of proven credit and operational performance. The CEFC program attracted stronger-than expected market interest, with solar becoming progressively more cost-competitive and projects achieving stronger commercial viability.

ARENA Large-Scale Solar Funding Round

The ARENA Large-Scale Solar (LSS) Funding Round received 77 expressions of interest. Of these, 22 were shortlisted and invited to submit full applications. The LSS Round Projects received almost \$90 million of ARENA grant funding, which unlocked almost \$1 billion of commercial investment. Across New South Wales, Queensland and Western Australia, these projects created jobs and provided direct and indirect economic benefit to the rural and remote communities in which they operate. The projects have also helped to reduce the emissions of Australia's electricity grid. The 12 projects which received ARENA funding under the LSS Funding Round have an emissions abatement impact of 11.6 million tCO₂-e.

CEFC Large-Scale Solar Program

Projects	CEFC commitment (\$ million)	MW (AC)
Parkes Solar Farm, NSW		55
Griffith Solar Farm, NSW	150	30
Dubbo Solar Hub, NSW		25
Whitsunday Solar Farm, Qld		57.5
Hamilton Solar Farm, Qld	77	57.5
Gannawarra Solar Farm, Vic		50
Kidston Solar Project Phase One, Qld	54	50
Longreach Solar Farm, Qld	12	15
Oakey 1 Solar Farm, Qld	19.5	25
Collinsville Solar Farm, Qld	60	42.5
Total	\$372.5	407.5



Generator Operations Series

ARENA and the CEFC captured the experience of the large-scale solar sector in the Generator Operations Series, a comprehensive set of reports which analyse construction and performance across 44 large-scale solar projects Australia-wide, providing unique insights into how the projects have performed against initial expectations. The reports were prepared by ARENA, with input from the CEFC and the assistance of technical advisory firm, Ekistica.

List of reports

Insights from the first wave of large-scale solar projects in Australia, January 2020

Report One: Large-scale Solar Operations, May 2021

Report Two: Ramp Rates for Solar and Wind Generators on the NEM, August 2021

Report Three: Negative pricing and bidding behaviour on the NEM, October 2021

Report Four: Forecasts vs Actuals from the LSS projects, April 2022

Report Five: Benchmarking large-scale solar PV performance in Australia, August 2022

Report Six: Unlocking curtailed solar energy on the NEM through storage, November 2022

Visit the CEFC website/and or ARENA Knowledge Bank to read the reports.

CEFC Investment Insights

Shared challenges

The proponents of the LSS Round Projects were asked to identify the risks associated with their projects. The key challenges were identified as:

- 1 Lower operational revenue from adverse changes in Marginal Loss Factors (MLF) than that originally assumed by developers during project development
- 2 Connection delays and cost overruns due to requirements in Generator Performance Standards (GPS) and commissioning (including R2 validation testing) taking longer than originally assumed by project developers and EPC contractors
- 3 Delays caused by poor weather experienced during construction and commissioning
- 4 Close monitoring by proponents of progress and standards under the EPC agreements.

“The LSS Round Projects, and the projects that followed, have contributed to the transformation of Australia’s energy mix and have been a critical factor in reducing the emissions intensity of the Australian electricity grid. These projects also created billions of dollars of investment opportunities, significant economic activity and employment in rural and remote communities.”

Generator Operations Series

Shared insights

1 Batteries to address curtailment

Battery storage can capture renewable energy generation otherwise lost through curtailment, which reduces a solar project’s output from a forecast maximum. Technical consultant Ekistica, which used curtailment data at 44 large-scale solar generators over three years, estimated the potential of battery storage to reduce emissions on the National Electricity Market at more than 600,000 tCO₂-e a year. Curtailment has become an essential consideration for asset valuation, with the risk of curtailment growing through commissioning, network constraints and economics as more renewable energy generators connect to the grid.

2 Automated bidding to address negative pricing

More than 35 per cent of solar and wind farms use automated bidding software to optimise their market participation, respond to price signals and improve financial returns. Negative pricing increased threefold between 2016 and 2020, as a result of cheaper generation and lower demand. Becoming increasingly active market participants has helped generators avoid being dispatched during negative pricing intervals.

3 Benchmarking lifts performance

Work undertaken through the Generator Operations series has created a benchmark for stakeholders seeking to understand their project’s performance. The series examined the accuracy of satellite data and found it had improved significantly in recent years. A comparison of satellite information with ground-based measurements found the satellite data achieved levels of accuracy to a 95 per cent confidence level, making it useful for benchmarking and prospecting purposes. Data collected from the 26 farms for the comparison work sets a useful generator performance benchmark.



Forecasting constraints

Forecasting is a specialist and sometimes inexact science, especially where new technologies, development and revenue models are involved.

This proved the case with the accelerated development of the large-scale solar sector, where developers needed to respond to a range of new and unexpected challenges, impacting both forecast development costs and revenue projections. These challenges covered projected costs and revenue factors, some of which had material impacts on project outcomes.



Cost factors

Adverse weather conditions, impeding construction and commissioning timelines

Labour shortages and resourcing constraints in engineering, procurement and construction deliverables

Time requirements to meet generator performance standards and commissioning

Unexpected grid-connection delays



Revenue factors

Overestimates in solar irradiance levels

Adverse changes in the levels of marginal loss factors assigned to load centres and generators

Unexpected generation curtailment

CEFC finance in action

Flexible financing options

CEFC solar-related investment commitments span the investable universe, including large and small-scale developments, energy storage and grid enhancement, establishment and emerging technologies.

We finance projects at all stages of the merchant contracting cycle, including pre, partial and fully contracted. Finance options can include:

- Senior debt
- Mezzanine portfolio finance
- Non-consolidating equity finance
- Participation as a sole lender
- Participation as part of a debt syndicate.

A selection of case studies is included here. Visit our website to see the broader portfolio: cefc.com.au



Solar

Blue Grass Solar Farm

~\$37m

CEFC commitment

Blue Grass Solar Farm is an ultra-efficient Queensland solar project in the Darling Downs Renewable Energy Zone. It features 375,000 bifacial solar panels, which have an increased generation capacity compared with existing panels, as well as half-cut cell technology which reduces the cell to half the normal size. The Blue Grass Solar Farm is the first Australian project for experienced renewables developer X-Elio, bringing a substantial new investor into the Australian market. US tech giant Salesforce has committed to purchase 25 per cent of the solar output, in what is its first renewable energy offtake agreement in Australia.



Storage

Capital Battery

\$35.5m

CEFC commitment

The 100 MW Capital Battery will provide critical network support and help the ACT realise its 2045 net zero target. The Capital Battery is capable of storing up to 200 MWh of energy with up to two hours of power in reserve. The Capital Battery, which is located next to the TransGrid Queanbeyan substation, will provide a predictable supply of electricity to the grid through its ability to dispatch energy during peak demand times. Neoen has struck a seven-year 70 MW virtual battery contract with AGL Energy, which allows the electricity retailer to hedge its customer load by virtually charging or discharging the battery.

Blind Creek Solar and Battery

~\$4.2m

CEFC commitment

The Blind Creek Solar and Battery Project in NSW is a farmer-led project that combines understanding of the land, farming practices and knowledge of the local community with renewable energy expertise. The solar farm will co-exist with rotational grass-fed lamb production, allowing for short periods of intensive grazing. Suitable grass species will be planted immediately below the solar panels with panel spacing to allow tractor access and grassland enhancements. The project will also support regenerative agriculture, soil carbon sequestration, biodiversity restoration and green waste humus production. The agri-solar project won the 2022 Clean Energy Council Community Engagement Award.

Victorian Big Battery

\$160m

CEFC commitment

The 300 MW Victorian Big Battery is on track to be one of the largest energy storage facilities in the world and will provide a critical boost to Victoria's grid security, drive down power prices and support more renewable energy. The project is being developed by Neoen, one of the world's leading independent producers of exclusively renewable energy. The project is a world-class example of how large-scale batteries can help electricity networks support a higher penetration of renewable energy, providing dispatchable resources to underpin the increasing share of clean energy expected to power Australia in the future.



Grid

Southern Downs REZ

\$160m

CEFC commitment

Queensland's Powerlink is building new transmission infrastructure to unlock more than 1,500 MW of network capacity in the Southern Downs Renewable Energy Zone, of which 1,000 MW will support the MacIntyre Wind Precinct. The precinct, including the 103 MW Karara Wind Farm and the 923 MW MacIntyre Wind Farm, is set to be one of the world's largest onshore wind farms. The project marks the first time that generator contributions will cover the cost of building critical REZ assets. The CEFC capital will enable Powerlink to 'future proof' the REZ by developing it at scale while keeping down connection costs for the initial or foundation generators.

EnergyConnect

\$295m

CEFC commitment

EnergyConnect is essential grid infrastructure to unlock as much as 1,800 MW renewable energy generation across SA, NSW and Victoria. The CEFC commitment was via an innovative subordinated note instrument, contributing to the crowding in of further private sector debt. Following the CEFC investment in the 900 kilometre project, the Australian Government provided more than \$180 million in underwritten funds to build a component of EnergyConnect at a larger capacity, removing the need to duplicate lines for the VNI West interconnector, saving consumers hundreds of millions of dollars, while minimising the infrastructure impact on landholders.



Innovation

Sunman

~\$20m

CEFC commitment

Sunman is developing technology with the potential to revolutionise the use of solar PV in Australia, producing lightweight, flexible panels that can be used across a wider range of applications than existing glass panels. Its innovative eArc solar panels made from a lightweight polymer composite material, are 70 per cent lighter than a glass panel, making them cheaper to transport and easier to install because they can be glued to a surface. The eArc panels can be moulded to contoured surfaces offering potential for use beyond conventional rooftops, as mobile power generation for remote sites and vehicles, and in construction materials to encase buildings.

SunDrive

\$7m

CEFC commitment

SunDrive is a Sydney-based solar technology start-up that is working to reduce the cost of high-efficiency solar cells, while enhancing their performance and sustainability. The patented SunDrive technology uses copper as the conductive material to pull the electrical current from the cells, instead of the industry standard silver. Copper is nearly 100 times cheaper than silver and far more abundant. The technology has set solar efficiency world records, further expanding its commercial potential. Solar power represents one of the most efficient ways to reduce emissions from the energy sector as renewable energy accelerates its share of the electricity market.



“ Across the past decade we have worked closely with the industry and investors to identify the best ways to accelerate development of large-scale solar projects. We have used our experience and patient capital to lead investment and help projects reach financial close. We are now seeing solar generators securing contracts for their clean energy supply, integrating complementary firming and storage technologies, and ultimately refinancing their operating assets with mainstream financial institutions. It's the ultimate good news story when our finance is returned to us this way, so we can reinvest in new projects.”

Monique Miller
CEFC Chief Investment Officer,
Renewables and Sustainable Finance

A big role for the CEFC in Rewiring the Nation

Australia has abundant untapped potential for low cost and low emissions renewable energy, reflected in our substantial investment in solar and wind infrastructure. However, our aging and congested electricity grid is not well suited to the dynamics of distributed energy generation, highlighting the need for large-scale investment over long time frames.

These large-scale energy infrastructure developments, alongside the Australian Government Rewiring the Nation (RTN) plan, are critical to accelerating the integration of new clean energy generation to deliver on both grid reliability and security while underpinning cleaner, lower cost renewable energy.

RTN proposes \$20 billion of grid-related investment to drive least cost, reliable new energy production, revitalise traditional industries and support new sectors such as hydrogen and battery production. The program will support a substantial increase in renewable energy generation, requiring significant new investment in large-scale solar and wind projects Australia-wide.

The CEFC will lead the financial and investment aspects of RTN-related investments, working closely with the new Rewiring the Nation Office, AEMO, and the Australian Energy Infrastructure Commissioner, which will lead on non-financial related aspects.

Eligible RTN projects include large-scale transmission infrastructure, such as Tasmania's Marinus Link and the Victoria-New South Wales Interconnector West (VNI-West), as well as energy storage, renewable energy zones and large-scale hydro storage assets. The CEFC has been closely involved in shaping the proposed investment structures in the Tasmanian and Victorian interconnector projects.

AEMO has forecast in its 2022 Integrated System Plan, that Australia will need to install more than 10,000 kilometres of new transmission to connect consumers with geographically and technologically diverse, low-cost renewable generation and firming capacity.

With grid electricity demand expected to nearly double, to 320 TWh by 2050, AEMO is forecasting a nine-fold increase in grid capacity, from 16 GW of large-scale renewables to 44 GW in 2030 and 141 GW by 2050. At the same time, storage capacity would need to increase by a factor of 30, to 61 GW by 2050.

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Transforming our electricity grid is one of the most important investments we can make as we transition to net zero emissions, providing a critical pathway to bringing low-cost renewable energy to consumers. As Australia steps up its ambitions to decarbonise, the CEFC will help deliver a 21st century electricity grid, powered by clean energy and supported by the nation-building infrastructure that will enable it to thrive in the low emissions future economy.”

Ian Learmonth
CEO, CEFC



About the CEFC

The CEFC is a specialist investor at the centre of efforts to help deliver on Australia's ambitions for a thriving, low emissions future. With a strong investment track record, we are committed to accelerating our transition to net zero emissions by 2050. In addressing some of our toughest emissions challenges, we are filling market gaps and collaborating with investors, innovators and industry leaders to spur substantial new investment where it will have the greatest impact. The CEFC invests on behalf of the Australian Government, with a strong commitment to deliver a positive return for taxpayers across our portfolio.