

Large-scale Solar Portfolio: Evaluation Report

Australian Renewable Energy Agency

20 December 2019



NOTICE

Ernst & Young was commissioned by and engaged on the instructions of the Australian Renewable Energy Agency ("ARENA" or "Client") to undertake an evaluation of ARENA's large-scale solar portfolio of projects in accordance with a contract dated 16 April 2019. More specifically, this report provides an analysis of the impact that ARENA's large-scale solar portfolio has had on the development of the large-scale solar industry in Australia, the effectiveness of the Competitive Round as a procurement and funding mechanism for large-scale solar projects and ARENA's management of its large-scale solar portfolio ("Project").

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Our work commenced on 16 April 2019 and was completed on 21 February 2020. Therefore, our Report does not take account of events or circumstances arising after 21 February 2020 and we have no responsibility to update the Report for such events or circumstances.

Outside of publicly available information, the analysis relies on information provided by ARENA and collected through stakeholder consultations. Much of the cost data from the Competitive Round has been collected and analysed by Ekistica on behalf of ARENA. Where possible, source project data has been requested from ARENA to verify the analysis.

We do not imply, and it should not be construed that we have verified any of the information provided to us and obtained from public sources, or that our enquiries could have identified any matter that a more extensive examination might disclose. However, we have evaluated the information provided to us by ARENA as well as other parties through enquiry, analysis and review and nothing has come to our attention to indicate the information provided was materially mis-stated or would not afford reasonable grounds upon which to base our Report.

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1. Executive summary

About the evaluation

Ernst & Young has been commissioned by the Australian Renewable Energy Agency (ARENA) to evaluate ARENA's large-scale solar portfolio of projects (LSS Projects).

This report presents the findings from a review of the Large-scale Solar Competitive Funding Round (Competitive Round) and other ARENA-funded large-scale solar PV projects based on a set of evaluation questions co-developed and agreed to by ARENA and EY, covering:

- ▶ The impact that ARENA's large-scale solar portfolio has had on the development of the large-scale solar PV industry in Australia, in terms of meeting Competitive Round and broader program objectives
- ▶ The effectiveness of the Competitive Round as a procurement and funding mechanism for large-scale solar projects
- ▶ ARENA's management of its large-scale solar portfolio.

This evaluation assesses the LSS portfolio solely against its objectives set by ARENA.

The evaluation has sourced information from a combination of desktop research and feedback from stakeholder interviews. The purpose of this approach is that both qualitative and quantitative research, in combination, provide an opportunity to address the evaluation questions from a number of perspectives and minimises the possibility of 'gaps' in the information and data collected. Through interviews conducted by EY with representatives of a selection of funded project proponents, unsuccessful project proponents, banks, Clean Energy Finance Corporation (CEFC), Australian Energy Market Operator (AEMO) and ARENA, we have sought and considered opinions from a wide range of stakeholders impacted by ARENA's large-scale solar portfolio to enrich the evaluation. Based on the research and consultation undertaken, we have made recommendations that may be considered for implementation on future programs. Not all recommendations will be relevant and applicable to every future funding program. Not all recommendations could have been implemented during the Competitive Round as some issues are now evident only with the benefit of hindsight.

About ARENA's large-scale solar portfolio

Since 2012, ARENA has provided grant funding to 18¹ new grid-connected large-scale solar projects to simulate the market and remove barriers to entry in Australia. By international standards Australia had historically been a leader in the uptake of residential solar PV, but grid-connected utility-scale solar uptake lagged compared to international markets.

Twelve of these solar farms were funded by a total funding amount of approximately \$92 million² through a competitive process known as the Competitive Round, a two-stage process which commenced in September 2015. The remaining 6 projects outside (and prior to) the Competitive Round were funded under the Australian Solar Institute Initiative, the Advancing Renewables Program and Regional Australia's Renewables Initiative.

The objectives of the Competitive Round³ were to:

¹ ARENA, "Large Scale Solar PV Projects, 2017, [Online], Available at: https://arena.gov.au/assets/2017/06/AU21509_ARENA_Large_Scale_Solar_Brochure_v6-1.pdf [Accessed 8 Jul. 2019]

² ARENA, "Large Scale Solar PV Projects, 2017, [Online], Available at: <https://arena.gov.au/assets/2017/02/ARENA-MEDIA-FACT-SHEET-Historic-day-for-Australian-solar-as-12-new-plants-get-support.pdf> [Accessed 8 Jul. 2019]

³ ARENA, "Large-scale Solar PV Competitive Round, Updated Funding Announcement (Full Application Stage)", undated, provided by ARENA to EY

- ▶ Further reduce the cost of large-scale solar PV and provide a clear path for the technology to become competitive with other commercially viable forms of power generation in Australia (including wind power)
- ▶ Provide transparency and price discovery in relation to current and projected costs of large-scale solar PV through the sharing of forecast and actual costs of both successful and unsuccessful projects on an anonymous basis
- ▶ Demonstrate the ability to deliver a large-scale solar PV project at a cost below the Competitive Round levelized cost of electricity (LCOE) benchmark of \$135/MWh.

Under the ARENA funding agreement, proponents were required to share knowledge and lessons from the project as detailed in their Knowledge Sharing Plan.

Key Findings and Recommendations

The following key findings and recommendations are structured into five distinct categories, covering both the impact and process evaluation. Further details on findings and conclusions can be found on page 71 and 73 of the report, respectively.

1. Impact evaluation - the Competitive Round

The Competitive Round commenced in September 2015 and concluded in May 2017 with all 12 shortlisted projects reaching Financial Close by May 2017. The impact evaluation approach focused on determining whether the intended outcomes of the Competitive Round were achieved through a series of evaluative questions co-developed and agreed to by ARENA and EY. The analysis confirms that these objectives were met, in that the Competitive Round:

- ▶ Contributed to the development of the large-scale solar PV industry and cost reduction across all categories of installed cost for large-scale solar
- ▶ Provided transparency and price discovery benefits to facilitate competitive tension during the procurement phase through the sharing of forecast and actual cost by both successful and unsuccessful proponents
- ▶ Demonstrated the ability to deliver large-scale solar PV below the LCOE benchmark and at a competitive price when compared with other renewable technologies such as wind.

Further detail on these findings are presented below.

Characteristics of the market pre vs. post Competitive Round	LCOE values for the Competitive Round	Competitiveness with wind	Cost reduction	Impact of Competitive Round on achieving cost reduction	Price discovery and transparency
Existing, committed and proposed capacity in the NEM in May 2019 of...	Median LCOE at grant application stage for the 12 LSS projects of...	2018 minimum LCOE for LSS PV in Australia of...	EPC costs decrease in Australia from 2013 to 2018 of...	The cost differential between Australia and China in 2016 of...	Capacity-weighted average ARENA funding at Financial Close of...
27,463MW	\$108/MWh	\$50/MWh	43%	20%	\$0.18/W
...significantly above the figure for May-2015 (1,373 MW) and Dec-2017 (7,922 MW), with several LSS projects post Competitive Round proceeding without government funding	...which lies in the range of \$97.8/MWh to \$132.5/MWh demonstrating that all projects bid under benchmark of \$135/MWh.	...lower than the equivalent LCOE estimate for wind.	...driven by decreases in both module cost and balance of system (BoS) cost.	...which reduced from 110% in 2015, the largest differential reduction out of any country in the dataset.	...substantially lower than the \$0.54/W required at EOI stage.
<ul style="list-style-type: none"> All 5 Non-ARENA funded LSS PV projects prior to the Competitive Round had received government support through grant funding or feed-in tariffs Queensland dominates utility-scale solar generation Number of developers in Australia has increased from 12 to 30 	<ul style="list-style-type: none"> Benchmark represented significant discount to \$186/MWh solar benchmark set at ACT Reverse Auction Benchmark focused the market attention on cost reduction 	<ul style="list-style-type: none"> AEMO reports that solar LCOE dropped from \$186/MWh in 2015 to \$90/MWh in 2017 Assumed Weighted Average Cost of Capital (WACC) for solar (6.79%) is lower than the WACC for all other renewable energy generation sources (wind = 7.09%) 	<ul style="list-style-type: none"> ARENA funding likely to impact BoS and soft costs which are both country-specific ARENA funding has little/no impact on module cost which is sourced and priced internationally (China) and makes up approximately 70% of total EPC cost 	<ul style="list-style-type: none"> On balance, the Competitive Round has contributed to the development of the large-scale solar industry and cost reductions to a large extent, however, it was one of several factors that contributed. 	<ul style="list-style-type: none"> The Competitive Round has provided transparency and price discovery through sharing of project costs, but its usefulness for proponents and impact on forecast costs has been restricted by the rapidly decreasing cost climate of large-scale solar.

Sources:

- Existing, committed and proposed capacities sourced from 'AEMO Generation Information - May 2019'
- Competitive Round LCOE values sourced from Ekistica, ARENA's Large-Scale Solar Program: A look at Levelised Cost of Energy, 2018
- 2015 and 2017 wind and solar LCOE values have been sourced from AEMO's "South Australian Fuel and Technology Report" (2017), while 2018 LCOE values has been sourced from Bloomberg New Energy Finance (BNEF) "New Energy Outlook 2018" Report
- EPC cost reduction and cost differential with China calculated through EY Analysis, including use of a 2018 report by IRENA, "Renewable Power Generation Costs in 2017"
- Capacity-weighted average funding values sourced from Ekistica, "ARENA's Large-Scale Solar Program: A look at Levelised Cost of Energy", 2018

Aside from meeting the objectives of the Competitive Round as outlined above, there were some unintended consequences of the Competitive Round relating to broader system issues. These are described in point 3 below, "Impacts evaluation - broader impacts and unintended consequences across LSS projects".

2. Impacts evaluation - projects prior to the Competitive Round

A similar approach was taken to evaluate the impact of the large-scale solar projects prior to the Competitive Round. The analysis confirms that the objectives of the projects were achieved. Notably these were to:

- Develop a large-scale solar industry in Australia through funding and support for these projects in a relatively untapped market at the time

- ▶ Provide research infrastructure (AGL project only) for the long-term advancement of the large-scale solar industry in Australia
- ▶ Develop and share technical and economic knowledge from the program to build local knowledge, skills and capacity in the large-scale solar industry.

Findings show that Projects prior to the Competitive Round were largely successfully deployed and provided a “blue-print” for other projects to follow. Key highlights are shown below.

Projects prior to the competitive round achieved the intended outcomes

	<p>Develop a large-scale solar industry in Australia</p>		<p>The ARENA funded projects prompted industry development and cost reduction through knowledge and skills transfer from proponents to the local labour market, and development of a solar industry supply chain.</p>
	<p>Provide research infrastructure</p>		<p>The AGL project provided academic research infrastructure and developed intellectual property in solar generation through its partnership with the University of Queensland and the University of New South Wales.</p>
	<p>Develop and share technical and economic knowledge</p>		<p>The ARENA funded projects shared key project learnings and implications for future projects through the knowledge sharing reports published on the ARENA website. Key learnings focused on technical elements of project delivery.</p>

Aside from projects prior to the Competitive Round meeting their intended objectives as above, there were some unintended consequences of these Projects, relating to broader system issues. These are described in point 3 below, “Impacts evaluation - broader impacts and unintended consequences across LSS projects”.

3. Impact evaluation - broader impacts and unintended consequences across LSS projects

To ascertain a broader view on the impacts of LSS projects, evaluative questions were designed to explore the benefits and unintended consequences of the Competitive Round to the wider market. The analysis indicates that, aside from industry cost reduction, the ARENA funding of LSS projects provided broader benefits to the market that have contributed to the achievement of program objectives. It also demonstrates that unintended consequences have arisen partly from the influx of projects following a similar time trajectory, although some of the broader system issues that were exposed may have occurred anyway at some point in the future due to the increasing penetration of renewable generation in the system. On balance, the broader benefits have appeared to outweigh the unintended consequences, which are depicted below.

ARENA funding contributed to broader market benefits and impacts:

Advancement of skills,
capacity and knowledge



Advancement of local skills, capacity and knowledge of broader market participants, including Engineering, Procurement and Construction (EPC) contractors, Network Service Providers (NSPs) and Australian Energy Market Operator (AEMO).

Developed experience and capacity across the supply chain to develop and provide technology suited to Australian requirements

Improved ability to gain
finance



Gave commercial banks confidence in the commercial viability of the technology, resulting in greater support from commercial banks

Encouraged the global flow of capital to Australia

Supported the development of the corporate PPA market

Unintended
consequences



Exposed broader system issues including grid connection issues and declines in MLFs that may have occurred at some point due to the higher penetration of renewable generation in the system.

The co-ordinated nature of the Competitive Round helped facilitate the identification of solutions, or work-arounds earlier through ARENA's knowledge sharing.

4. Process evaluation - Competitive Round as a funding mechanism

Through stakeholder interviews and document review, the Competitive Round's effectiveness and appropriateness as a funding mechanism was explored. The Competitive Round has been effective as it has stimulated investment appetite, contributing solar technology cost reduction and creating competition.

The Competitive Round process also allowed ARENA to adopt a common framework across projects, which achieved a common risk allocation across projects and some contract management efficiencies. Given this context, a competitive process was a more effective mechanism than an individual application process would have been.

ARENA engaged with the market and CEFC prior to the Competitive Round's launch to test concepts such as process timing and commercial principles for the funding agreement. Requiring bid bonds and engaging third party advisers to support the assessment process facilitated robust assessment and the selection of high-quality projects. The evaluation also identified some areas for improvement in future processes.

Key findings and recommendations regarding this element of the Competitive Round's evaluation are shown below.

The Competitive Round process was a suitable funding mechanism

Maximised and achieved desired outcomes



Leveraged lessons learned from international and previous programs (eg projects not part of the Competitive Round and the Solar Flagships program)

Stimulated investment appetite to create competition and support cost reduction

Suitable given context and technology readiness



Enabled effective comparison of projects and accelerated large-scale solar development

Encouraged participation of early-stage projects and created a consistent framework

Structured effectively



Effectively used bid bonds and clearly communicated requirements

Actively engaged with participants and provided appropriate application timeframes

There are opportunities to improve subsequent processes

1

Collaborate more closely with CEFC and other agencies

- ▶ Engage early with CEFC, AEMO and participants, for example, to support program design, vet documentation, and allow government agencies to consider potential program impacts on their remits
- ▶ Consider partnering with other agencies to use ARENA's remaining \$279 million investment mandate in alternative ways

2

Consider impact of program from a broader perspective

- ▶ Consider the ability of the program to support grid stability and reliability objectives (noting this has been a key focus for ARENA over the last three years)
- ▶ Consider appropriateness of using an LCOE and ensure its use does not detrimentally affect achieving broader objectives

5. Process evaluation - Management of the Competitive Round

This element of the process evaluation explored ARENA's management of the Competitive Round. This included considerations regarding the application and selection process, knowledge sharing arrangements, contract management, resourcing, communication and governance structure.

The evaluation indicates that ARENA has employed adequate systems to ensure the appropriate expenditure of public funds, and capable personnel to manage the process while creating collaborative relationships with funding recipients. Some processes under the funding agreements could be improved in future.

Key findings and recommendations regarding this element of the Competitive Round's evaluation are shown below.

Management of the LSS Program has been competent

Appropriate governance and contract management systems



Monitoring and reporting was appropriate to ensure proper expenditure of funds

Contract management structures were consistently applied

Capable and responsive ARENA personnel



The program was resourced with **capable, responsive and experienced** personnel

Staff turnover **and transition** was managed well

Rigorous and well-structured assessment process



Sophisticated and thorough assessment process undertaken and high-quality projects selected

Timeframes for financial close were compressed but **extensions granted to meet emerging connection challenges**

Funding agreement development could have been improved in some respects

1

Vet project documentation in advance of program launch

- ▶ Market-test commercial principles to ensure their acceptability (eg intercreditor, and knowledge sharing obligations)
- ▶ Align due diligence and reporting requirements with those of financiers

2

Adopt a risk-based approach to funding withdrawal delegations

- ▶ Consider grant funding quantum and the existence of debt financier scrutiny in determining appropriate delegations
- ▶ Adopt a risk-based approach to funding withdrawal delegations

3

Make knowledge sharing insights more accessible and timely

- ▶ Adopt a more targeted approach to developing knowledge sharing requirements
- ▶ Consider how insights can be better located, promoted and communicated in a more timely manner

6. Recommendations from the Process Evaluation

As noted in the previous sections, EY identified five areas for improvement in terms of the Competitive Round process, and the management of the LSS Program. The following table sets out a summary of the recommendations to consider when designing and implementing future grant funding programs. Not all recommendations will be relevant and applicable to every future funding program, but they may provide a foundation for improving collaboration, processes, and program outcomes depending on the parameters of future ARENA grant funding programs.

ARENA's Competitive Round - Recommendations

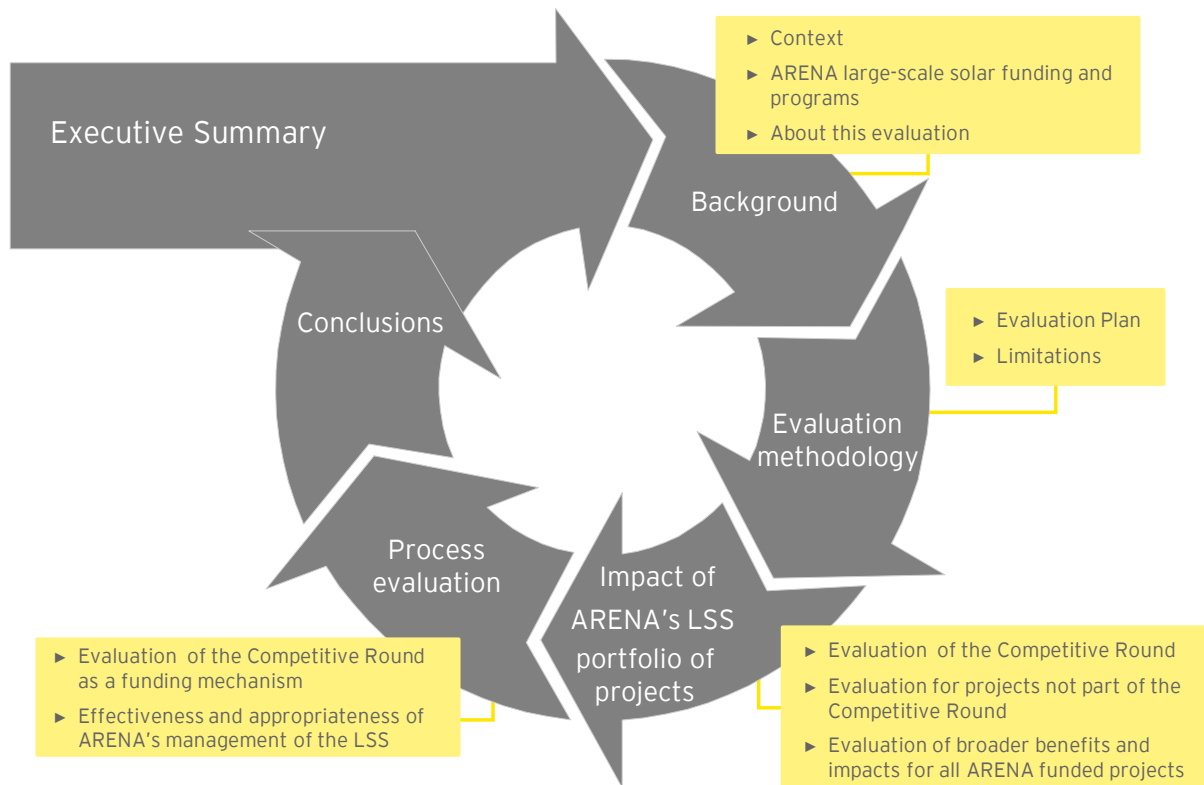
Effective achievement of objectives	<ul style="list-style-type: none"> ▶ Increased focus on assessment criteria other than a project's LCOE or funding gap is desirable to achieve greater geographical diversity and support grid stability and reliability in the NEM. ▶ The value to the market of capex and opex data could be improved through increased data granularity and categorisation. ▶ Liaising more with AEMO prior to program launch, and potentially considering a staged approach to offering grant funding, may have alleviated some of the delays encountered in projects achieving grid connection.
Leveraging lessons learned	<ul style="list-style-type: none"> ▶ This report provides recommendations which ARENA can leverage to support the success of future funding programs (also presented in this table).
Competitive Round versus alternative funding mechanisms	<ul style="list-style-type: none"> ▶ When designing a funding program, ARENA should retain its existing procedures which assess market and technology readiness to determine whether a Competitive Round or individual application process is suitable.
Timing	<ul style="list-style-type: none"> ▶ Ensure sufficient time and resourcing is allocated to ensure extensions of time for assessment or reaching Financial Close are not required.

ARENA's Competitive Round - Recommendations

	<ul style="list-style-type: none"> ▶ To streamline negotiations, undertake greater consultation with the market and CEFC to ensure that project documentation is commercially palatable.
Bid bonds and bid cost reimbursement	<ul style="list-style-type: none"> ▶ Assess whether bid bonds or bid cost reimbursement is worthwhile on a case by case basis. (Factors to consider include (inexhaustively) the quantum of the grant, the sophistication and financial capacity of the likely and desired applicants, and technology readiness). ▶ Use a similar approach to what was used in the Competitive Round to determine the quantum of bid bonds or bid cost reimbursement in future funding processes.
Other feedback	<ul style="list-style-type: none"> ▶ Consult with CEFC to a greater extent during the program design process. ▶ Consider partnering with CEFC to approach the market as a combined ARENA/CEFC team. ▶ As there is no new funding for ARENA, consider opportunities to formally partner with other agencies to use what remains of ARENA's \$2 billion investment mandate more effectively through greater and more open collaboration. ▶ Application submission methods should be able to support the types of formats that market participants typically use when preparing submissions.
Knowledge sharing	<ul style="list-style-type: none"> ▶ Adopt a more strategic approach to developing knowledge sharing requirements so they are aimed at eliciting information relevant to program outcomes. ▶ Leverage lessons learned from other ARENA programs that are exemplars in setting knowledge sharing requirements (such as ARENA's battery storage program). ▶ Ensure that knowledge sharing requirements are targeted, practical and practicable. ▶ Hold more informal knowledge sharing workshops, implement a structured timeline and agenda process for these workshops, and include involvement from parties such as AEMO, CEFC or NSPs. ▶ Consider introducing anonymous surveys or Chatham House Rules interviews to encourage participants to share important insights to which they may not want to be attributed. ▶ Consider alternative and more efficient methods of publishing knowledge sharing information, for example developing summary reports, slide-packs or video tutorials that highlight the key insights from a number of projects at similar stages and attach detailed knowledge sharing reports, similar to how ARENA reports on outcomes to knowledge sharing workshops. ▶ Consider how insights could be better located, promoted and communicated on ARENA's website, for example modify the knowledge bank website so that the information provided can be sorted in additional ways, including by funding program, media type, and key issues.
Communication with participants	<ul style="list-style-type: none"> ▶ Continue to resource programs with similar calibre personnel to those deployed for the Competitive Round. ▶ Share the positive feedback with ARENA personnel (within the program and beyond) to encourage continued strong performance and build similar performance in other teams.
Assurance, governance and contract management	<ul style="list-style-type: none"> ▶ Adopt a risk-based approach to delegations so that lower-level personnel can be approved as bank account signatories to facilitate prudent but expeditious withdrawal request approvals. ▶ Where participants secure debt financing, ARENA should align its reporting requirements more closely with the debt financier's requirements to minimise the administrative burden for participants. ▶ Subject to the recommendation above, consider developing monthly reporting and knowledge sharing templates to provide guidance to participants and enhance reporting consistency.
Application and selection process	<ul style="list-style-type: none"> ▶ Consider additional assessment criteria that support broader grid stability and reliability objectives. ▶ Undertake greater upfront engagement with CEFC and the market on commercial terms to ensure that project documentation is more likely to meet market risk appetite. ▶ Better align ARENA's due diligence processes and reporting requirements with those of financiers to streamline administrative requirements.

Structure of this report

The diagram below shows the structure of this report.



2. Background

Ernst & Young has been commissioned by ARENA to evaluate ARENA's large-scale solar portfolio of projects.

ARENA was established in 2012 by the Australian Renewable Energy Agency Act 2011 and inherited projects from the Australian Centre for Renewable Energy (ACRE). ARENA's purpose is to accelerate Australia's shift to affordable and reliable renewable energy⁴ by:

- ▶ Providing funding to researchers, developers and business
- ▶ Building and supporting networks
- ▶ Sharing knowledge, insights and data from funded projects.

In 2017, ARENA established an Investment Plan which listed accelerating solar PV innovation in Australia as one of ARENA's top four investment priorities. ARENA intends to drive efficiency and affordability of the technology by supporting ongoing research, development and demonstration, while helping to fulfil the government commitment to double clean energy R&D spending by 2020. Their involvement is also seen within a broader, long-term vision to drive down cost of large-scale solar PV to less than \$60/MWh as it becomes a major contributor to Australia's electricity generation⁵.

To achieve this investment objective, ARENA introduced a large-scale solar PV competitive round (the Competitive Round) as a competitive process under the Advancing Renewables Program (ARP) to fund a small number of large-scale solar PV projects.

This report presents the findings from a review of the Competitive Round and other ARENA-funded large-scale solar PV projects based on a set of evaluation questions co-developed and agreed to by ARENA and EY. In broad terms, the evaluation draws attention to the cost impact of the ARENA funded projects as well as the competitive process deployed by ARENA. Findings from this evaluation will potentially inform future funding rounds, performance reporting and continuous improvement for portfolio management.

2.1 Context

Until the commencement of the Competitive Round, large-scale solar was in its relative infancy in Australia. By international standards Australia had historically been a leader in uptake of residential solar PV, but grid-connected utility-scale solar uptake lagged comparable international markets.

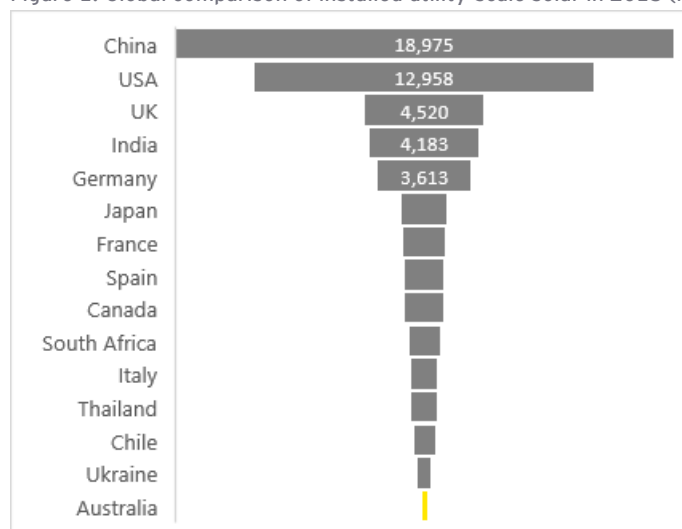
Only 4 projects had been commissioned in Australia and a further 4 were under construction at the time of announcement of the Competitive Round in 2015. By comparison, all countries listed in Figure 1 had both greater installed capacity and more plants contributing to the large-scale solar generation in 2015 than Australia, which holds true even when adjusting for the size of the relevant electricity sector. Further to this, in 2014, the required grant funding was a significant \$1.60 per Watt for Australian projects.⁶

⁴ ARENA, "Australian Renewable Energy Agency", [Online], Availed at: <https://arena.gov.au/> [Accessed 8 Jul. 2019]

⁵ ARENA, "Funding and investment plan", [Online] Available at: <https://arena.gov.au/about/publications/funding-investment-plan/> [Accessed 8 Jul. 2019]

⁶ ARENA, "Large-scale solar photovoltaics - competitive round", [online] Available at: <https://arena.gov.au/funding/programs/advancing-renewables-program/large-scale-solar-photovoltaics-competitive-round/> [Accessed 8 Jul. 2019]

Figure 1: Global comparison of installed utility-scale solar in 2015 (MW AC)



Source data: Wiki-solar, "Global utility-scale solar capacity exceeds 60 GW as 2015 delivers another record year", 2016

To make LSS PV a more viable form of generation in Australia, grant funding was necessary to bridge the gap between total project cost and available forms of financing such as equity and/or debt (referred to as "bridge funding" by ARENA⁷), until the technology became a commercially cost-competitive form of power generation.

2.2 ARENA large-scale solar funding and programs

Since 2012, ARENA has provided grant funding to 18 new grid-connected large-scale solar projects to stimulate the relatively untapped market and remove barriers to entry in Australia. These solar farms are connected to either the National Electricity Market or South-West Interconnected System.

The 6 projects outside (and prior to) the Competitive Round were funded under the Australian Solar Institute (ASI) Initiatives, ARENA's Advancing Renewables Program (ARP) and Regional Australia's Renewables (RAR) Initiative.

ASI, which was merged into ARENA in 2012, supported solar research to drive down the cost of solar energy and to accelerate its commercial deployment⁸. The RAR initiative supported renewable energy solutions in regional and remote Australia, focusing on hybrid and integrated systems in off-grid and fringe-of-grid communities. More recently, ARENA's ARP was designed to support a broad range of development, demonstration and pre-commercial deployment projects to deliver affordable and reliable renewable energy in Australia.

The remaining 12 solar projects were funded through a competitive process known as the Competitive Round. When the Competitive Round was announced in 2015, \$100m was made available for projects that met the objectives of the Competitive Round, among other criteria⁹. Specifically, these were to:

- Further reduce the cost of large-scale solar PV and provide a clear path for the technology to become competitive with other commercially viable forms of power generation in Australia (including wind power)

⁷ ARENA, "Large-Scale Solar", [Online], Available at: <https://arena.gov.au/funding/large-scale-solar/> [Accessed 5 Jul. 2019]

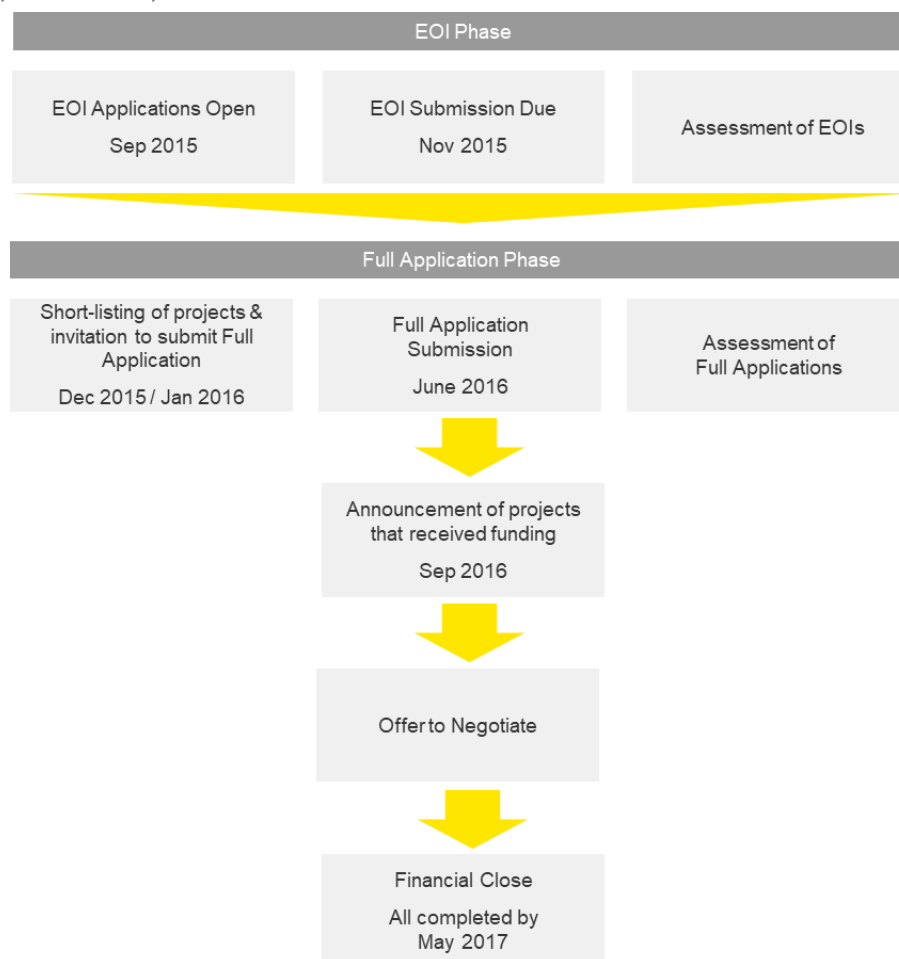
⁸ ARENA, "ASI Solar Highlights", 2017, [Online], Available at: <https://arena.gov.au/funding/australian-solar-institute/> [Accessed 5 Jul. 2019]

⁹ ARENA, "Large-scale Solar PV Competitive Round, Updated Funding Announcement (Full Application Stage)", undated, provided by ARENA to EY

- ▶ Provide transparency and price discovery in relation to current and projected costs of large-scale solar PV through the sharing of forecast and actual costs of both successful and unsuccessful projects on an anonymous basis
- ▶ Demonstrate the ability to deliver a large-scale solar PV project at a cost below the Competitive Round levelized cost of electricity (LCOE) benchmark of \$135/MWh.

The application process for the Competitive Round was a two-stage process consisting of an Expression of Interest (EOI) stage and ensuing Full Application stage for invited participants (shown in Figure 2).

Figure 2: Competitive Round process¹⁰



The competitive process invited applicants to submit an EOI in September 2015, while Full Applications opened December 2015. Eligibility and merit of the proposals was assessed at each stage of the process.

ARENA received 77 eligible EOIs for funding between September and November 2015 and shortlisted 22 projects in January 2016.¹¹ Shortlisted participants submitted Full Applications in June 2016 and 12 projects were selected to receive \$92m in aggregate grant funding. Project

¹⁰ ARENA, "Large-scale Solar PV Competitive Round: Updated Funding Announcement (Full Application Stage)", [undated], Provided by ARENA to EY

¹¹ ARENA, "ARENA selects 22 large-scale solar projects to take next step", 2016, [Online], Available at: <https://arena.gov.au/news/arena-selects-22-large-scale-solar-projects-to-take-next-step/> [Accessed 5 Jun. 2019]

commissioning date was anticipated towards the end of 2017 to early 2018 and within 12 months of Financial Close.

A key element of the Competitive Round projects is the Knowledge Sharing Plan (KSP). This plan details the information required from the Project during the project lifecycle. Applicants were required to provide a response to this plan with their Full Application. The purpose of the Knowledge Sharing element is two-fold:¹²

1. To lower the cost of LSS PV by supporting increased capacity
2. To assist the next wave of solar PV developers with increased efficiency and build confidence in the institutions that fund them.

2.2.1 Project requirements

The Competitive Round was open to proposals that met the following eligibility criteria:¹³

- ▶ Projects must generate all their electricity from solar PV
- ▶ Projects must meet or exceed the minimum project size of 5 MW (AC)
- ▶ The total grant funding requested for a project must not exceed A\$30 million
- ▶ Projects must be connected to the NEM or SWIS
- ▶ Projects must not involve behind the meter elements

Proposals that met the eligibility criteria were then assessed based on the following merit criteria:¹⁴

1. Contributes to Programme Outcomes
2. Applicant's capability and capacity
3. Activity, design, methodology, risk and compliance
4. Financial viability and co-funding commitment
5. Knowledge sharing

At the time of announcement in 2015, grant funding was intended to support only 200 MW of new solar PV projects.¹⁵ Since then, \$92m of funding has supported approximately 480 MW of solar development in total. The successful Competitive Round applicants are listed in Table 16.¹⁶

Table 1: LSS Competitive Round Projects

Proponent	Solar Farm	Size (MW AC)	Board Approved Funds*		Total Project costs	
			Funds per MW (AU\$/MW)	Total Funds (AU\$)	Project Cost per MW (AU\$/MW)	Total Project Cost (AU\$)
Origin Energy	Darling Downs Solar Farm	110	\$181,818	\$20,000,000	\$1,970,053	\$216,705,790
Whitsunday Solar Farm	Whitsunday Solar Farm	58.1	\$163,511	\$9,500,000	\$2,107,074	\$122,421,000
Neoen Australia	Parkes Solar Farm	50.6	\$148,221	\$7,500,000	\$2,132,806	\$107,920,000
Genex Power	Kidston Solar Project	50	\$177,000	\$8,850,000	\$2,577,580	\$128,879,000
Manildra Solar Farm	Manildra Solar Farm	42.5	\$256,471	\$10,900,000	\$2,571,866	\$109,304,287

¹² ARENA, "Large-scale solar knowledge sharing: How project data is collected and shared", Undated, [Online], Available at: <https://arena.gov.au/assets/2017/02/LSS-knowledge-sharing.pdf> [Accessed 5 Ju. 2019]

¹³ ARENA, "Large-scale Solar PV Competitive Round: Updated Funding Announcement (Full Application Stage)", [undated], Provided by ARENA to EY

¹⁴ ARENA, "Large-scale Solar PV Competitive Round: Updated Funding Announcement (Full Application Stage)", [undated], Provided by ARENA to EY

¹⁵ ARENA, "Historic day for Australian solar as 12 new plants get support", 2016, Available at: <https://arena.gov.au/news/historic-day-for-australian-solar-as-12-new-plants-get-support/> [Accessed 5 Jul. 2019]

¹⁶ ARENA, "ARENA LSS Round Applications", [undated], Provided by ARENA to EY

Proponent	Solar Farm	Size (MW AC)	Board Approved Funds*		Total Project costs	
			Funds per MW (AU\$/MW)	Total Funds (AU\$)	Project Cost per MW (AU\$/MW)	Total Project Cost (AU\$)
Ratch - Australia	Collinsville Solar PV Power Station Stage 1	42	\$226,190	\$9,500,000	\$2,282,500	\$95,865,000
Neoen Australia	Griffith Solar Farm	25	\$200,000	\$5,000,000	\$2,182,760	\$54,569,000
Canadian Solar (Australia)	Oakey Solar Farm	25	\$86,496	\$2,162,388	\$1,899,422	\$47,485,538
Neoen Australia	Dubbo Solar Hub	24.2	\$227,273	\$5,500,000	\$2,297,893	\$55,609,000
APT Pipelines (APA Group)	Emu Downs Solar Farm Project	20	\$275,000	\$5,500,000	\$2,360,963	\$47,219,264
Goldwind Australia	White Rock Solar Farm	20	\$300,000	\$6,000,000	\$2,254,099	\$45,081,985
Canadian Solar (Australia)	Longreach Solar Farm	15	\$85,911	\$1,288,667	\$1,912,776	\$28,691,634
TOTAL		482.4	\$2,327,891	\$91,701,055	\$26,549,791	\$1,059,751,498

* Note: The total grant funds provided to project proponents may differ from the Board approved funds due to changes during the contract negotiation phase.

2.3 About this evaluation

The evaluation has been commissioned by ARENA. The evaluation has been designed to address 26 questions covering:

- ▶ The impact that ARENA's large-scale solar portfolio has had on the development of the large-scale solar PV industry in Australia, in terms of meeting Competitive Round and broader program objectives
- ▶ The effectiveness of the Competitive Round to fund large-scale solar considering the procurement and funding mechanism used
- ▶ ARENA's management of its large-scale solar portfolio.

The evaluation assesses the LSS solely against its objectives.

The evaluation has been performed in part by desktop research of qualitative and quantitative data and stakeholder interviews. Through interviews conducted by EY with representatives of a selection of funded project proponents, unsuccessful project proponents, banks, AEMO, CEFC and ARENA, we have sought and considered opinions from a wide range of stakeholders impacted by the ARENA's large-scale solar portfolio to enrich the evaluation.

The report is structured in the following way:

- ▶ Section 1 provides an executive summary of findings
- ▶ Section 2 details the background to the ARENA LSS portfolio and Competitive Round
- ▶ Section 3 outlines the methodology adopted to perform the evaluation
- ▶ Section 4 provides an evaluation of the impact of ARENA's LSS portfolio on the development of the large-scale solar PV industry in Australia, in terms of meeting Competitive Round and broader program objectives
- ▶ Section 5 provides an evaluation of the process aspects, including the effectiveness of the Competitive Round as a procurement and funding mechanism for large-scale solar, and ARENA's management of the Competitive Round.

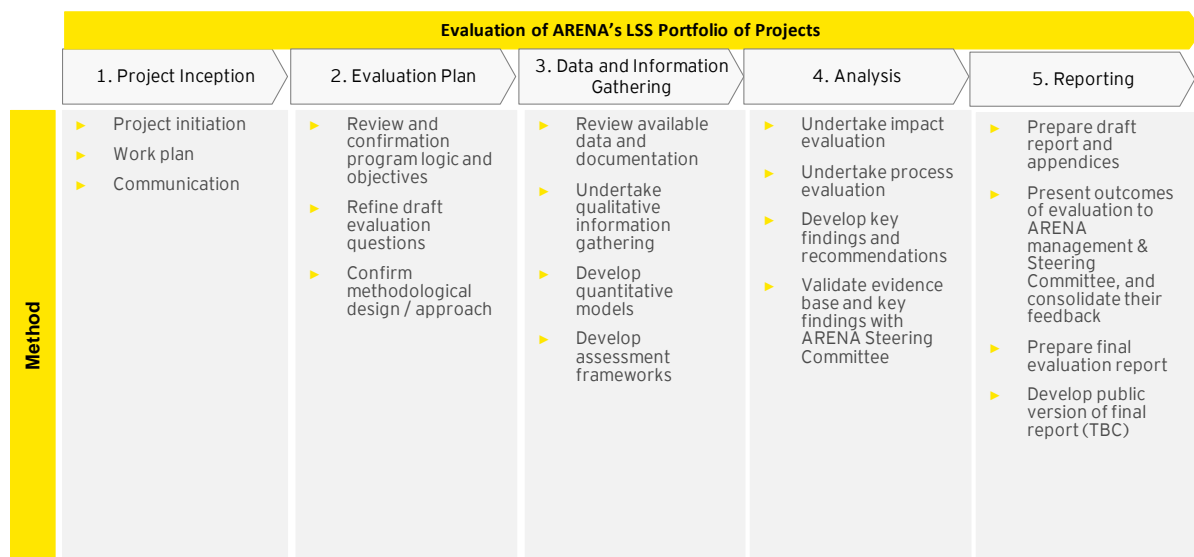
3. Evaluation methodology

The evaluation has applied a ‘mixed-methods’ approach designed to address 26 evaluation questions and to analyse the various sources of data available. A mixed methods approach is a methodology for conducting research and evaluation that involves collecting, analysing and integrating quantitative and qualitative data and information in a single study. The evaluation has sourced information from a combination of desktop research and feedback from stakeholder interviews.

The purpose of this approach is that both qualitative and quantitative research, in combination, provide an opportunity to address evaluation questions from a number of perspectives and minimises the possibility of ‘gaps’ in the information and data collected. A five-step approach was taken through the evaluation, as demonstrated in the diagram below.

A list of stakeholder interview questions and more detailed Evaluation Plan are also included in the Appendices.

3.1 Evaluation Plan



3.2 Limitations

Key limitations of the evaluation are detailed below, and as described in the transmittal letter. Where possible, mitigating factors have been described.

- ▶ Outside of publicly available information, the analysis relies on information provided by ARENA and collected through stakeholder consultations. Much of the cost data from the Competitive Round has been collected and analysed by Ekistica on behalf of ARENA. Where possible, source project data has been requested from ARENA to verify the analysis.
- ▶ In preparing this Report we have considered and relied upon information from a range of sources believed after due enquiry to be reliable and accurate. We have no reason to believe that any information supplied to us, or obtained from public sources, was false or that any material information has been withheld from us.
- ▶ We do not imply, and it should not be construed that we have verified any of the information provided to us, or that our enquiries could have identified any matter that a more extensive examination might disclose. However, we have evaluated the information provided to us by ARENA as well as other parties through enquiry, analysis and review and nothing has come to our attention to indicate the information provided was materially mis-stated or would not afford reasonable grounds upon which to base our Report.
- ▶ Large-scale solar PV has been in its infancy in Australia and therefore limited information and cost data about the industry exists, particularly prior to the Competitive Round. As a result, multiple sources have been used to collect solar LCOE in Australia, which limits its comparability between years due to the varying assumptions applied in calculating the figures, such as the assumed discount rate.
- ▶ Interviews were conducted with a select number of proponents and industry stakeholders. While chosen to represent a “whole of group” view, there is natural limitation of potential selection bias and misrepresentation of group-wide viewpoints, and interviewees’ viewpoints may not reflect ARENA’s own perspectives on the same issues.

4. Impact of ARENA's LSS portfolio of projects

This section addresses the first objective of the evaluation, which was to evaluate the impact of ARENA's large-scale solar portfolio on the development of the large-scale solar PV industry in Australia, in terms of meeting Competitive Round and broader program objectives.

4.1 Evaluation of the Competitive Round

4.1.1 Key findings and observations

The following graphic presents a summary of the key findings on the impact of the projects in the Competitive Round on meeting its objectives and more broadly supporting the development of the LSS PV industry.

Characteristics of the market pre vs. post Competitive Round	LCOE values for the Competitive Round	Competitiveness with wind	Cost reduction	Impact of Competitive Round on achieving cost reduction	Price discovery and transparency
Existing, committed and proposed capacity in the NEM in May 2019 of...	Median LCOE at grant application stage for the 12 LSS projects of...	2018 minimum LCOE for LSS PV in Australia of...	EPC costs decrease in Australia from 2013 to 2018 of...	The cost differential between Australia and China in 2016 of...	Capacity-weighted average ARENA funding at Financial Close of...
27,463MW	\$108/MWh	\$50/MWh	43%	20%	\$0.18/W
...significantly above the figure for May-2015 (1,373 MW) and Dec-2017 (7,922 MW), with several LSS projects post Competitive Round proceeding without government funding	...which lies in the range of \$97.8/MWh to \$132.5/MWh demonstrating that all projects bid under benchmark of \$135/MWh.	...lower than the equivalent LCOE estimate for wind.	...driven by decreases in both module cost and balance of system (BoS) cost.	...which reduced from 110% in 2015, the largest differential reduction out of any country in the dataset.	...substantially lower than the \$0.54/W required at EOI stage.
<ul style="list-style-type: none"> All 5 Non-ARENA funded LSS PV projects prior to the Competitive Round had received government support through grant funding or feed-in tariffs Queensland dominates utility-scale solar generation Number of developers in Australia has increased from 12 to 30 	<ul style="list-style-type: none"> Benchmark represented significant discount to \$186/MWh solar benchmark set at ACT Reverse Auction Benchmark focused the market attention on cost reduction 	<ul style="list-style-type: none"> AEMO reports that solar LCOE dropped from \$186/MWh in 2015 to \$90/MWh in 2017 Assumed Weighted Average Cost of Capital (WACC) for solar (6.79%) is lower than the WACC for all other renewable energy generation sources (wind = 7.09%) 	<ul style="list-style-type: none"> ARENA funding likely to impact BoS and soft costs which are both country-specific ARENA funding has little/no impact on module cost which is sourced and priced internationally (China) and makes up approximately 70% of total EPC cost 	<ul style="list-style-type: none"> On balance, the Competitive Round has contributed to the development of the large-scale solar industry and cost reductions to a large extent, however, it was one of several factors that contributed. 	<ul style="list-style-type: none"> The Competitive Round has provided transparency and price discovery through sharing of project costs, but its usefulness for proponents and impact on forecast costs has been restricted by the rapidly decreasing cost climate of large-scale solar.

Sources:

- Existing, committed and proposed capacities sourced from 'AEMO Generation Information - May 2019'
- Competitive Round LCOE values sourced from Ekistica, ARENA's Large-Scale Solar Program: A look at Levelised Cost of Energy, 2018
- 2015 and 2017 wind and solar LCOE values have been sourced from AEMO's "South Australian Fuel and Technology Report" (2017), while 2018 LCOE values has been sourced from Bloomberg New Energy Finance (BNEF) "New Energy Outlook 2018" Report
- EPC cost reduction and cost differential with China calculated through EY Analysis, including use of a 2018 report from IRENA, "Renewable Power Generation Costs in 2017"
- Capacity-weighted average funding values sourced from Ekistica, "ARENA's Large-Scale Solar Program: A look at Levelised Cost of Energy", 2018

4.1.2 Impact evaluation questions for Competitive Round

4.1.2.1 Characteristics of market

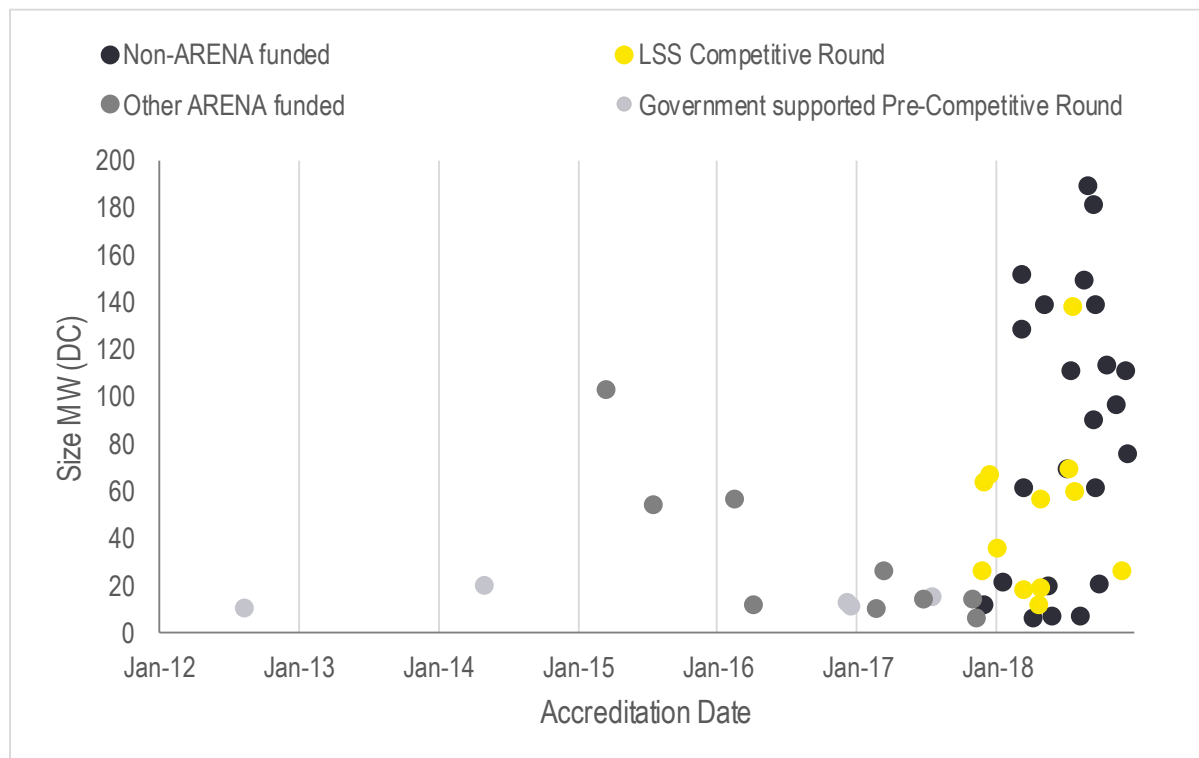
The following evaluation questions were considered in this section:

- ▶ What are the characteristics of the large-scale solar PV sector in Australia now compared with the characteristics of the large-scale solar PV sector in Australia prior to the Competitive Round?

Until the commencement of the Competitive Round, grid connected large-scale solar was in its infancy with only 4 projects commissioned and accredited. Only 241MW of capacity had been installed by the end of 2015, significantly lower than comparable markets abroad (Figure 1).

Figure 3 presents a historical plot of large-scale solar PV projects in Australia by accreditation date with the Clean Energy Regulator since 2012, categorised by funding source. Meanwhile, Table 2 captures the increase in actual and forecasted megawatt generation in the National Electricity Market (NEM) from prior to the Competitive Round (May-2015) to after the Competitive Round (Dec-2017 and May-2019).

Figure 3: Accredited Large-Scale Solar PV Projects in Australia



Source: Data from Australian PV Institute (APVI) Solar Map, funded by the Australian Renewable Energy Agency, accessed from pv-map.apvi.org.au on 25 June 2019.

Table 2: Total generation (MW) for existing and potential solar developments in the NEM

Status	May-2015	Dec-2017	May-2019
Existing	22	632	1,933
Committed	199	1,180	2,881
Proposed	1,152	6,109	22,649
Total	1,373	7,922	27,463

Source data: AEMO, Generation Information

Figure 3 demonstrates the significant uptake in large-scale solar PV in 2018 with over 2,359MW (DC)¹⁷ of capacity accredited across 31 projects. Prior to the first accredited¹⁸ large-scale solar PV from the Competitive Round - Emu Downs on 1 December 2017 - there were a total of 14 accredited solar PV farms with a capacity of 5MW (DC) and above. Nine of these projects were ARENA funded¹⁹ (dark grey dots in Figure 3), which accounted for 81% of total solar PV MW capacity.

All five non-ARENA funded projects prior to the Competitive Round (light grey dots in Figure 3) received some level of government support:

- ▶ First Solar's 10MW Greenough River Solar Farm in WA (2012) marked the first large-scale solar project in the country and was developed via a joint venture between GE Energy and Verve Energy, the Western Australian state-owned power utility. The State Government provided \$20m towards the \$50m project, which includes \$10m from the Royalties for Regions program.²⁰
- ▶ Three projects in ACT followed - FRV's 20MW Royalla Solar Farm (2014), Maoneng 13MW Group's Mugga Lane Solar Farm (2017) and Impact Investment Group's 11MW Williamsdale Solar Farm (2017) - these were all procured through the ACT government's reverse auction program with a minimum feed-in tariff guaranteed by the Government over a 20 year period at a price between \$178MW/h - \$186MW/h.²¹
- ▶ The last pre-Competitive Round project to be accredited was Queensland's 15MW Valdora Solar Farm in July 2017, which was developed by the Sunshine Coast Council.

In the past four years, the LSS PV market has significantly matured in Australia in terms of both installed and forecasted capacity. Registered installed capacity increased from approximately 69MW prior to the Competitive Round to 2,011MW after Competitive Round (black dots in Figure 3). Forecasted capacity in the NEM, which encompasses existing, committed or proposed projects (Table 2), has increased from 1,373MW prior to the Competitive Round in May 2015 to 7,922MW in December 2017, around the timing of Financial Close achieved by LSS Competitive Round projects. By May 2019, the forecast had increased to 27,463MW, including 22,530MW of capacity either committed or proposed.

Similarly, the Australian Energy Regulator reports that a further 22 solar projects, or 2,040 MW AC, across the NEM are expected to be commissioned by the end of 2020. Meanwhile, the Clean Energy Council estimates a further 59 large-scale solar projects were either under construction or financially committed in Australia (across the NEM and SWIS) at the end of 2018.²²

Further, the increased maturity of the market is also seen through the wider mix of market participants, with the number of developers of accredited solar PV farms increasing ~2.5x, from 12

¹⁷ Unless otherwise stated, MW capacities represent Direct Current (DC) as opposed to Alternating Current (AC)

¹⁸ Power stations, including large-scale solar PV farms, register with the Clean Energy Regulator to become an accredited power station under the Renewable Energy Target. Once accredited, the power station is eligible to receive Large Scale Generation Certificates (LGCs). Accreditation typically occurs just prior to Commercial Operations Date.

¹⁹ ARENA funded projects were funded through either the Advancing Renewables Program or Regional Australia's Renewables Program

²⁰ Government of Western Australia, Media Statements, "Australia's biggest solar farm feeds into grid", 2012, [Online], Available at: <https://www.mediastatements.wa.gov.au/Pages/Barnett/2012/10/Australia%E2%80%99s-biggest-solar-farm-feeds-into-grid.aspx> [Accessed 10 Jun. 2019]

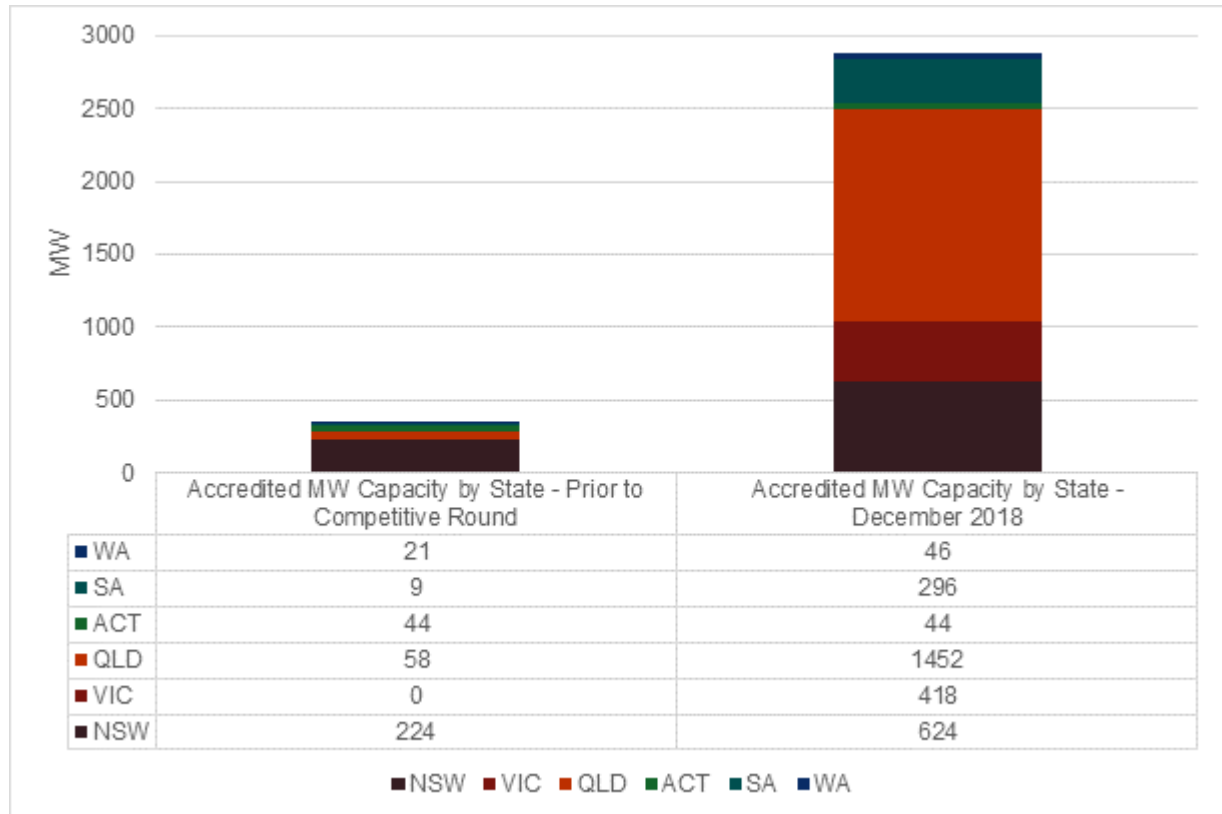
²¹ ACT Government, "Canberra 100% Renewable: Leading innovation with 100% Renewable Energy by 2020", undated, [Online], Available at: https://www.environment.act.gov.au/_data/assets/pdf_file/0007/987991/100-Renewal-Energy-Tri-fold-ACCESS.pdf [Accessed 10 Jun. 2019]

²² Clean Energy Council, "Clean Energy Australia Report 2019", 2019, page 64, [Online], Available at: <https://assets.cleanenergycouncil.org.au/documents/resources/reports/clean-energy-australia/clean-energy-australia-report-2019.pdf> [Accessed 10 Jun. 2019]

prior to the Competitive Round to 30 post Competitive Round. This highlights both the growth and widening of market supply.

Figure 4 presents the large-scale solar PV capacities breakdown by State prior to, and following the Competitive Round.

Figure 4: Accredited LSS PV MW Capacities Prior to Competitive Round vs. post Competitive Round



Source: Data from Australian PV Institute (APVI) Solar Map, funded by the Australian Renewable Energy Agency, accessed from pv-map.apvi.org.au on 25 June 2019.

Note: 'Prior to the Competitive Round' in this graph refers to prior to the first project in the Competitive Round gaining accreditation

Large-scale solar PV has seen the greatest uptake in the state of Queensland, which is now Australia's leading state with 63% of accredited solar PV capacity in 2018. Key findings are included below:

- ▶ Queensland has accredited 17 solar PV farms between 5MW to 180MW since December 2017, the largest being Daydream Solar Farm by Edify Energy.
- ▶ AGL's Nyngan and Broken Hill Solar Farms accounted for a significant portion of NSW's registered capacity prior to the Competitive Round, meanwhile Neoen's Coleambally Solar Farm remains NSW and Australia's largest solar PV farm with a capacity of 188MW.
- ▶ Major contributors also include NSW and VIC with 22% and 15% respectively, with each state adding approximately 400MW of registered capacity since December 2017.
- ▶ There continues to be a pipeline with 20 large-scale solar projects under construction or financially committed as of December 2018, representing 34% of equivalent projects in Australia.²³

Further to the growth of the LSS PV industry in terms of capacity and market players, there are significant other advancements to the industry since 2012. These relate to the reduction of barriers to increased LSS PV uptake, notably: reduced install cost; increased knowledge of key processes

²³ Clean Energy Council, "Clean Energy Australia Report 2019", 2019, page 64, [Online], Available at: <https://assets.cleanenergycouncil.org.au/documents/resources/reports/clean-energy-australia/clean-energy-australia-report-2019.pdf> [Accessed 10 Jun. 2019]

such as grid connection; and improved confidence of market participants in the technology, particularly commercial banks. A detailed discussion of these characteristics is considered in the following sub-sections within section 4.

Findings

The analysis above reveals the rapid growth of the LSS PV industry since the Competitive Round on both a state and national level, in terms of expansion of accredited and installed capacity, increase in number of projects, and widening of market supply. Several other developments to the LSS PV market have been identified and are considered in following sub-sections within Section 4, which address more targeted evaluative questions.

4.1.2.2 Cost trends

Ability to deliver LSS projects at a cost below the LCOE benchmark

The following questions were considered in this section:

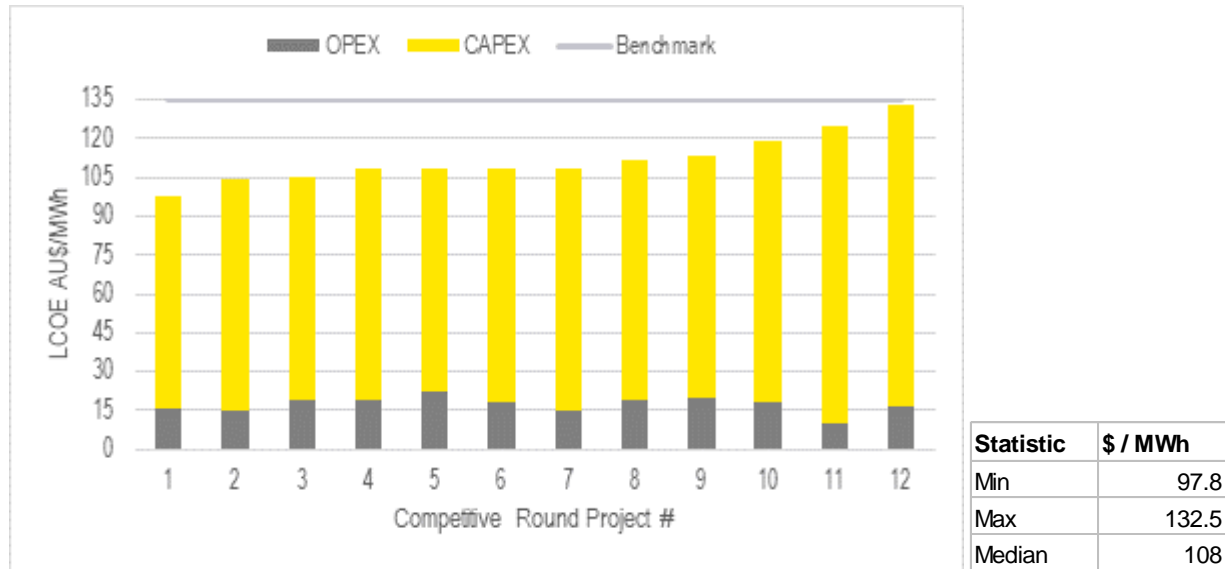
- ▶ Has the Competitive Round demonstrated the ability to deliver a large-scale solar PV project at a cost below the Competitive Round levelised cost of electricity (LCOE) benchmark of A\$135/MWh? What was the impact/flow-on effect?
- ▶ Has the Competitive Round further reduced the cost of large-scale solar PV and successfully provided a clear path for the technology to become competitive with other commercially viable forms of power generation in Australia (including wind power)?
 - ▶ To what extent can the cost reductions that have been achieved in the sector be attributed to ARENA's LSS Competitive Round?
 - ▶ To what extent has ARENA's LSS Competitive Round accelerated reductions in LCOE?

A key metric used to compare the cost of electricity among different projects and technologies is the Levelised Cost of Electricity (LCOE). LCOE values are measured on a \$/MWh basis and represent the average revenue required to cover the capital costs (CAPEX) and operational costs (OPEX) in present value terms.

Large-scale solar PV LCOE values have significantly reduced in Australia in recent years to become one of the lowest in the world and well below the global average. Solar farms require a greater portion of funding for initial capital costs (between 79% to 91% of LCOE for LSS projects) and are subsequently cost-effective to run with OPEX representing just 9% - 21% of total costs, which represents a relatively small proportion as compared to conventional generation (e.g. coal and gas).

Figure 5 presents LCOE values from all 12 projects in the Competitive Round compared to the Competitive Round LCOE benchmark. The data was sourced and analysed by Ekistica (on behalf of ARENA) via a combination of ARENA's LCOE spreadsheet, project financial models and projects' websites.

Figure 5: LCOE component values of LSS Projects in the Competitive Round



Source: data from Ekistica, *ARENA's Large-Scale Solar Program: A look at Levelised Cost of Energy*, 2018

Figure 5 demonstrates that all 12 LSS projects in the Competitive Round bid below the LCOE benchmark of \$135/MWh. These projects were all successful in securing financing and achieving Financial Close.

The range of values, as calculated using the ARENA LCOE Calculator which assumes a 10% pre-tax discount rate, was reported between \$97.8/MWh and \$132.5/MWh, with a median LCOE of \$108/MWh.²⁴

Impacts and flow-on effects of delivering below the benchmark

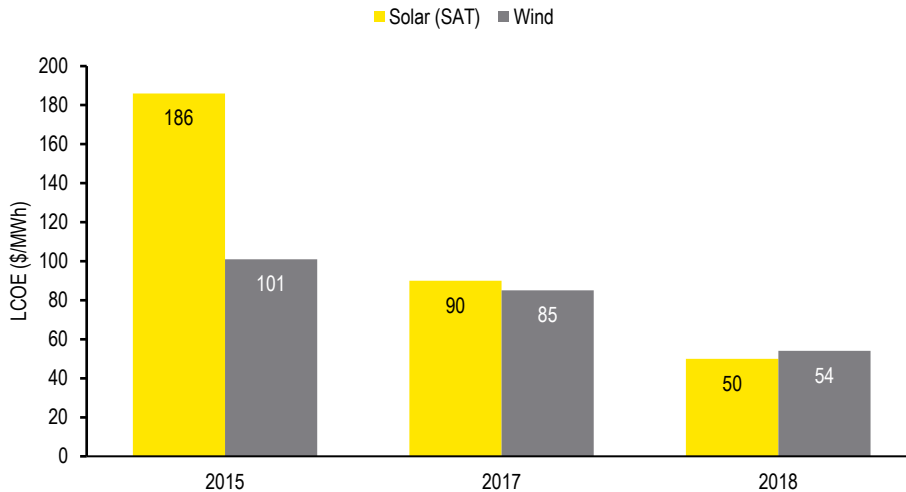
- ▶ Feedback from interview participants on the significance of the benchmark was mixed.
 - ▶ One participant indicated that the benchmark LCOE of \$135/MWh could have been more aggressive in hindsight. Two reasons exist for this, firstly the rapidly decreasing cost climate and secondly, the embedded 10% pre-tax WACC was higher than most sponsors' cost of capital and therefore was deemed easily achievable for sponsors by tailoring their bid models accordingly. Despite this, the benchmark still represented a significant discount to the \$186/MWh LCOE benchmark set in 2014 at the ACT Renewables Auction and preceding the Competitive Round.
 - ▶ Another participant indicated the benchmark was appropriate and ARENA undertook sufficient interaction with the market to set the benchmark, which was inherently a difficult decision given the quickly decreasing cost climate.
 - ▶ A key benefit identified by participants was that the LCOE benchmark focussed attention of the market on risk management and decreasing costs across the whole value chain.
- ▶ While LCOE measures the cost to build and operate a plant, a limitation of the metric is it does not consider the value of the plant's output to the grid, which can vary significantly between technologies given the different generation profiles. Given comparison of LCOE in the Competitive Round was only made between solar PV projects, LCOE was a sensible measure in this regard.

²⁴ Ekistica, "ARENA's Large-Scale Solar Program: A look at Levelised Cost of Energy", 2018, Provided by ARENA to EY

Competitiveness with other forms of generation

Against other commercially viable forms of power generation, the investment case for large-scale solar continues to improve and compare favourably. Prior to the Competitive Round, three wind projects were supported by the ACT Government through its Renewables Auction at prices between \$80/MW/h - \$90/MW/h, significantly lower than the \$178/MWh - \$186/MWh bid prices accepted for large-scale solar PV projects. However, rapidly declining costs of solar has translated into benchmark LCOE for solar comparable to that of wind from 2017 onwards (Figure 6).

Figure 6: Minimum LCOE figures for Solar PV (Single Axis Tracking) and Wind



Source data: 2015 and 2017 LCOE values have been sourced from AEMO's "South Australian Fuel and Technology Report" (2017), while 2018 LCOE values has been sourced from Bloomberg New Energy Finance (BNEF) "New Energy Outlook 2018" Report. Note, the trend in LCOE between years should not be extrapolated as BNEF and AEMO have different methodologies and assumptions to calculating minimum LCOE values.

A study by AEMO of LCOEs across various generation technologies indicates that Solar PV (specifically Single Axis Tracking) had one of the lowest LCOEs in the NEM in 2017.²⁵ In two years from 2015 to 2017 and over the course of the Competitive Round, the LCOE has dropped from \$186/MW to \$90/MW. Additionally, Bloomberg New Energy Finance (BNEF) have estimated a 2018 minimum LCOE for solar PV in Australia of US \$37/MWh (AU \$50/MWh), lower than the US \$40/MWh (AU \$54/MWh) estimated for wind.²⁶ This reflects findings from the CSIRO in December 2018 which also forecasted solar PV to become the cheapest form of generation by 2020 in terms of both capital cost and LCOE.²⁷

²⁵ AEMO, "South Australian Fuel and Technology Report", 2017, [Online], Available at: https://www.aemo.com.au/-/media/Files/Electricity/NEM/Planning_and_Forecasting/SA_Advisory/2017/2017_SAFTR.pdf [Accessed 10 Jun. 2019]

²⁶ Bloomberg New Energy Finance, "New Energy Outlook 2018", [Online], Available at: <https://bnef.turtl.co/story/neo2018>

²⁷ CSIRO, "GenCost 2018: Updated projections of electricity generation technology costs", 2018, [Online], Available at: <https://publications.csiro.au/rpr/download?pid=csiro:EP189502&dsid=DS1> [Accessed 10 Jun. 2019]

AEMO's WACC assumptions for all technologies in 2015

10%

The 2015 assumed WACC for all technologies, significantly higher than those in 2017

AEMO's WACC assumptions for Solar in 2017

6.79%

The 2017 WACC for Solar, lower than competing forms of generation and the greatest reduction since 2015

AEMO's WACC assumptions for Wind in 2017

7.09%

The 2017 WACC for Wind, in between assumed WACC for solar and pumped hydro

AEMO's WACC assumptions for Pumped Hydro in 2017

8.50%

The 2017 WACC for Pumped Hydro, the highest out of competing forms of generation

All WACC figures in this section are sourced from AEMO's "South Australian Fuel and Technology Report"²⁸. Rising confidence in the technology and reduced funding risk has contributed to reduced financing costs, reflected in the Weighted Average Cost of Capital (WACC) assumed by AEMO of 6.79%. This is lower than the assumed WACC for both wind and pumped hydro (the two most prevalent renewable energy generation sources in Australia), 7.09% and 8.50% respectively. The solar PV WACC also represents the largest decrease since the 2015 discount rate assumed by AEMO of 10%, which was applied across all renewable technologies.

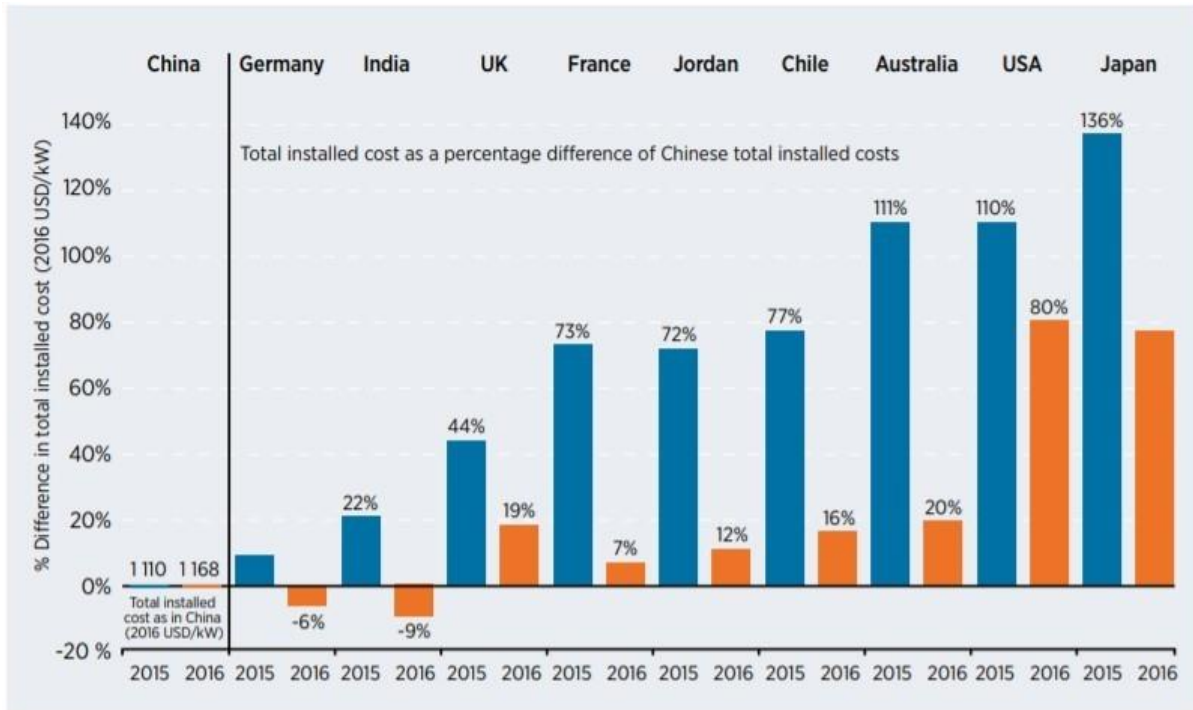
As evidenced by the declining values for large-scale solar LCOE and implied WACC assumptions, the technology has become competitive with other commercially viable forms of power generation in Australia.

²⁸ AEMO, "South Australian Fuel and Technology Report", 2017, [Online], Available at: https://www.aemo.com.au/-/media/Files/Electricity/NEM/Planning_and_Forecasting/SA_Advisory/2017/2017_SAFTR.pdf [Accessed 10 Jun. 2019]

Capital cost breakdown and global trends

A comparison of Australia to global markets provides insight into the existence of country specific factors contributing to the rapid cost reduction in large-scale solar. Analysis by IRENA depicts the closing gap between competitive markets and China from 2015 to 2016 (Figure 7).²⁹ Globally, costs of utility-scale solar PV were on the decline, but the magnitude of this change between Australia and China (from 111% to 20%) is greater than for all other countries presented below, and implies there were country specific factors in Australia contributing to this total cost reduction. For example, comparatively the USA showed a much smaller decrease in the cost differential between 2015 and 2016 (from 110% to 80%) given a similar starting point to Australia.

Figure 7: Estimated utility-scale solar PV system costs between China and other competitive markets, 2015-2016

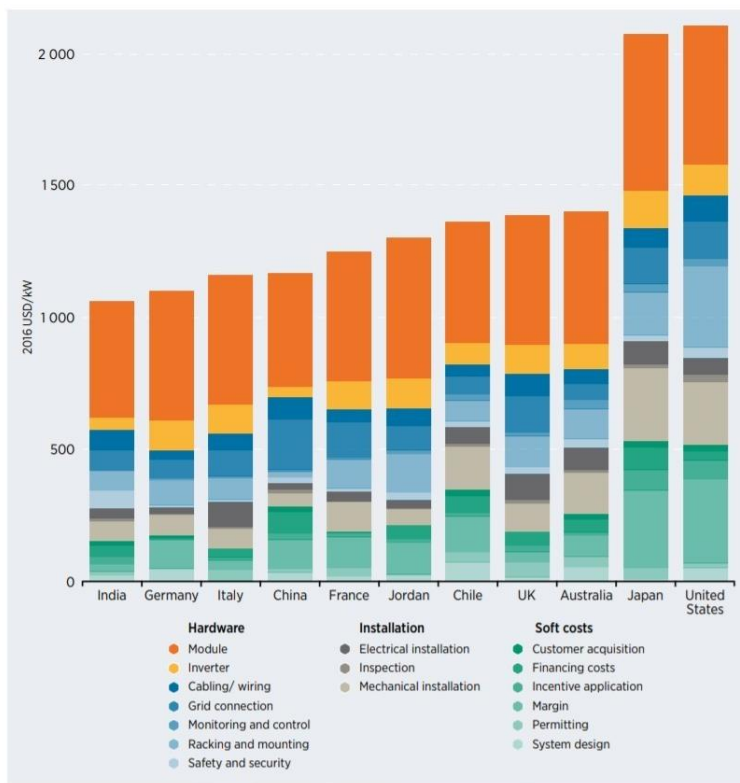


Source: IRENA, Renewable Power Generation Costs in 2017, page 66, 2018

A detailed disaggregation of costs is provided by IRENA and shown in Figure 8. This shows that a significant portion of the total costs for solar PV projects are CAPEX costs. Further, it indicates that the most significant cost differences between countries are in the CAPEX costs (other than Module and Inverter costs) and soft costs.

²⁹ The analysis provides a comparison of total installed cost in global markets to China, as China was cost leader in 2015.

Figure 8: Breakdown of utility-scale solar PV costs by country, 2016



Source: IRENA, Renewable Power Generation Costs in 2017, page 67, 2018

Given the substantial proportion of CAPEX costs to total costs for solar PV projects (between 79% to 91% of LCOE for LSS projects)³⁰, disaggregation into its component parts is key to understanding the drivers of the cost decreases that have occurred in Australia. Further, it will provide insight into the costs that are subject to impact from grant funding to determine the extent of the impact of the Competitive Round on these costs.

EY is an active participant in the LSS PV market in Australia, providing general commercial & financial advice to proponents as well as transaction advisory services for buy-side and sell-side clients. Based on EY's observations on market changes from 2013 to 2018, we have observed the following cost trends in the Australian LSS PV market:

- ▶ From 2013 to 2018, there has been an overall reduction in CAPEX costs (on \$ per megawatt basis), which are typically categorised into EPC and non-EPC costs.
- ▶ EPC comprise of the following costs: modules, mountings, power converters and inverters, civil works, engineering, electrical works, mechanical works, administration and soft costs.
- ▶ EPC costs decreased approximately 43% from 2013 to 2018.
- ▶ Extrapolating trends in sub-categories and individual line items is challenging and potentially misleading given differences in cost reporting between projects. However, key observations that can be drawn from the data set include:
 - ▶ Module cost represents approximately 70% of EPC costs.
 - ▶ The proportion of each of module cost, mountings, inverters and other equipment to total EPC remains relatively constant between 2016 - 2018, suggesting that all categories have experienced similar cost decreases.
 - ▶ Non-EPC costs decreased approximately 63% from 2013 to 2018. The major cost declines occurred in 2017 and 2018.
- ▶ Non-EPC costs comprise of the following cost categories and line items:

³⁰ EY analysis

- ▶ Other capital cost includes items such as land purchase, working capital and pre-construction preparation.
- ▶ Development capital cost include legal and advisory fees, transaction costs, financing expenses and pre-development costs.
- ▶ Other construction cost includes grid connection costs, project management and commissioning, development fees, and site costs.

IRENA analysis shows that solar PV modules have followed a downward cost trajectory globally, attributable to increased experience and efficiency of manufacturers. While the PV modules saw an 80% cost reduction between 2010 and 2016, the significant reduction rates occurred prior to 2013. In subsequent years, more modest cost decreases took place as the market matured and profit margins reverted to increasingly sustainable levels.³¹ Drivers of declining module cost have evolved from economies of scale to, more recently, improvements of production processes and efficiency gains with newer cell designs. Between 2015 and 2016, the cost reduction of solar PV modules in competitive markets was on average 18%, with variation between countries due to differences in import tariffs and preferences for module types.³²

Balance of System (BoS) costs, which comprise of all other capital cost excluding module and inverter cost, have followed a similar cost trajectory to PV modules and increasingly contribute to total system cost reductions, accounting for approximately 50% of installation cost. We can expect ARENA funding to have the greatest impact on BoS costs as they are country specific, as opposed to modules which are priced at an international level.³³ Further, by that logic declining BoS cost in Australia has largely driven the narrowing cost differential over China in recent years, and a significant portion of cost reduction can be attributed to the Competitive Round and other government initiatives supporting the development of renewable markets. While there is limited data on the magnitude of this BoS cost change, a 2015-2016 comparison of implied reduction in LCOE (30%)³⁴ and declining cost of solar PV modules (18%) implies that BoS costs experienced marked cost reduction (potentially upwards of 30%).

In breaking down BoS costs, a significant portion (approximately one third) can be attributed to soft costs. Key drivers of reducing soft costs include alleviating administrative hurdles associated with the approvals and permitting process, including grid connection.³⁵ Increasing the administrative burden on and backlog of approvals with the Network Service Provider (NSP) and AEMO have been identified by industry participants as key issues currently faced by the industry. The issue is reflected in costing data shared by proponents via the knowledge sharing reports; a comparison of forecast to actual AEMO registration costs show that in one instance the cost was approximately four times larger than expected.³⁶

While interviewees acknowledged the adverse impact on soft costs was inevitable, ARENA's funding round may have exacerbated this issue by stimulating the influx of investment in renewables within a short timeframe. However, ARENA has also been instrumental in finding work-arounds to these issues, through the knowledge sharing workshops, as the co-ordinated timing of the projects meant more information was shared amongst proponents. Shared knowledge, learnings and efficiencies to

³¹ IRENA, "Renewable Power Generation Costs in 2017", page 61, 2018, [Online], Available at: https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2018/Jan/IRENA_2017_Power_Costs_2018.pdf [Accessed 4 Jun. 2019]

³² IRENA, "Renewable Power Generation Costs in 2017", page 61, 2018, [Online], Available at: https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2018/Jan/IRENA_2017_Power_Costs_2018.pdf [Accessed 4 Jun. 2019]

³³ Journal of Cleaner Production, Volume 196, "Estimating the learning curve of solar PV balance-of-system for over 20 countries: Implications and policy recommendations", 2018, [Online], Available at: <https://www.sciencedirect.com/science/article/pii/S0959652618316652> [Accessed 4 Jun. 2019]

³⁴ Implied LCOE calculated using the CAGR between reported 2015 and 2017 LCOE figures in the following reference: AEMO, "South Australian Fuel and Technology Report", 2017, [Online], Available at: https://www.aemo.com.au/-/media/Files/Electricity/NEM/Planning_and_Forecasting/SA_Advisory/2017/2017_SAFTR.pdf [Accessed 4 Jun. 2019]

³⁵ IRENA, "Renewable Power Generation Costs in 2017", page 64, 2018, [Online], Available at: https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2018/Jan/IRENA_2017_Power_Costs_2018.pdf [Accessed 4 Jun. 2019]

³⁶ Confidential project data provided by ARENA to EY, which has been anonymised

processes because of the Competitive Round's knowledge sharing program will likely counterbalance this effect in the long run.

Impact of ARENA's Competitive Funding round to achieving cost reductions

Between 2012 and 2018, a number of government initiatives were in place to support the development of the renewable energy industry in Australia, including large-scale solar. These included:

- ▶ Renewable Energy Target (RET) - the RET scheme was introduced in 2001 and split in 2011 into Large Scale Renewable Energy Target (LRET) and Small-scale Renewable Energy Scheme (SRES) in 2011. LRET provides a financial incentive for uptake of large-scale renewable energy. In June 2015, the LRET was reduced from 41,000 GWh to 33,000 GWh by 2020 following a 15-month review of the policy³⁷
- ▶ Clean Energy Finance Corp (CEFC) Support - CEFC provides finance which support large-scale solar projects that are in the process of finalising Power Purchase Agreements (PPAs) or have entered into PPAs with entities outside of the investment grade energy companies³⁸. CEFC have provided direct debt funding to 9 of the 12 LSS Competitive Round projects, which includes an acquisition facility to New Energy Solar for its acquisition of Manildra Solar Farm.
- ▶ Various state government programs, including:
 - ▶ ACT Reverse Auction - Australia's first Solar Auction in 2012 which awarded a grant of feed-in-tariff for three projects in ACT, totalling approximately 40MW³⁹
 - ▶ Victorian Renewable Energy Auction Scheme (VREAS) - Another reverse auction scheme, which announced three successful large-scale solar farms in 2018 with a total installed capacity of 254MW⁴⁰
 - ▶ Queensland government has provided support for solar projects through:
 - ▶ long-term PPAs for three LSS Competitive Round projects: Whitsunday Solar Farm, Oakey Solar Farm and Longreach Solar Farm
 - ▶ 20 year Revenue Support Deed for Kidston Solar Farm.

Feedback from stakeholder interviews indicated that the 2015-16 Competitive Round stimulated large-scale solar investment, expedited market development and supported technology and EPC cost reductions. In particular, ARENA's Competitive Round:

- ▶ Turned international attention to Australia and attracted global EPC providers due to the focused attention on large-scale solar in the funding round. This helped international players develop an understanding of the Australian market and drove further cost competitiveness among local EPCs.
 - ▶ The LSS Competitive Round had a positive impact on Australia's reputation for solar.
 - ▶ Post GFC, feed-in tariffs had been wound back and funds for investment were tight, thus grant funding for successful participants differentiated Australia in the global solar PV market.
- ▶ Helped reduce costs across the entire value chain because of the focus on LCOE during the Competitive Round.
- ▶ Helped reduce EPC prices in Australia at a more rapid rate than its global counterparts, bringing forward the development of the large-scale solar industry in Australia.
 - ▶ Reduced EPC costs, generated through the learnings of the Competitive Round, allowed sponsors to proceed with their other projects (that did not bid into the Competitive Round) without ARENA funding following the Competitive Round.

³⁷ Clean Energy Regulator, "History of the scheme", 2016, [Online], Available at: <http://www.cleanenergyregulator.gov.au/RET/About-the-Renewable-Energy-Target/History-of-the-scheme> [Accessed 4 Jun. 2019]

³⁸ CEFC, [Online] Available at: <https://www.cefc.com.au/where-we-invest/renewable-energy/solar/> [Accessed 4 Jun. 2019]

³⁹ ACT Government Environment, Planning and Sustainable Development Directorate - Environment, "Large-scale solar", [Online], Available at: <https://www.environment.act.gov.au/energy/cleaner-energy/large-scale-solar> [Accessed 4 Jun. 2019]

⁴⁰ The State of Victoria Department of Environment, Land, Water and Planning, "VRET auction benefits", [Online], Available at: https://www.energy.vic.gov.au/_data/assets/pdf_file/0028/391159/VRET-Auction-fact-sheet.pdf [Accessed 4 Jun. 2019]

- ▶ Development of the industry has led to several large projects becoming operational in 2018 without government funding, a notable example being the 300MW Bungala Solar Project.

On balance, ARENA funding has contributed to the development of the large-scale solar industry and cost reductions to a large extent, however, it was one of several factors that contributed.

Findings

All 12 LSS projects in the competitive round successfully secured financing and reached financial close at a project cost below the LCOE benchmark of \$135/MWh. The LCOE benchmark focused the market attention on risk management and decreasing costs across the whole value chain.

The technology has seen both reduction in LCOE and installed cost to become commercially competitive with other viable forms of renewable generation in Australia, such as wind. While the evaluation has not been able to quantify the impact of the Competitive Round between the various government support programs present over the same period, the analysis found that ARENA funding has contributed to this cost reduction and development of the LSS industry in Australia to a large extent.

4.1.2.3 Price transparency and discovery

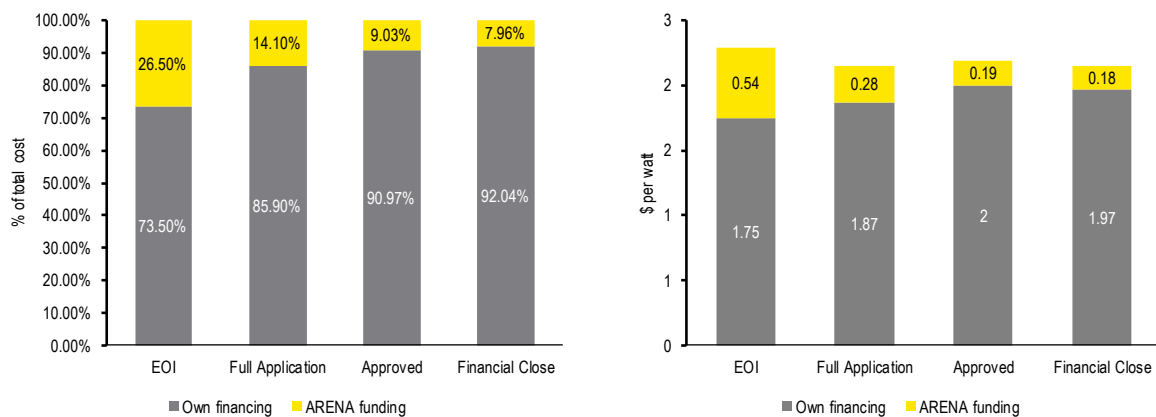
The following questions were considered in this section:

- ▶ Has the competitive round provided transparency and price discovery in relation to current and projected costs of large-scale solar PV through the sharing of forecast and actual costs of both successful and unsuccessful projects on an anonymous basis?
 - ▶ Has there been an impact on forecast costs?

As part of the Competitive Round, both CAPEX and OPEX cost data from successful and unsuccessful applicants was shared on an anonymous basis with the intention to provide transparency and price discovery.

Price transparency and discovery is evident in the Competitive Round (shown in Figure 9 on the right-hand side) via the reduction in overall projected project cost between the approximate 18-month period from \$2.29/W at EOI to \$2.15/W at Financial Close. Further, project funding appetite increases from \$1.75 per watt to \$1.97 per watt, whilst the required ARENA funding decreases from \$0.54 per watt to \$0.18 per watt. Across the 12 LSS projects, ARENA funding represented 26.50% of total funds required at EOI stage compared to 7.96% at Financial Close.

Figure 9: Average project funding sources as a proportion of total project costs over the LSS phases (left), and Capacity-weighted average system CAPEX costs over the LSS phases (right)



Source data: Herteleer et. Al, "LSS funding impact on utility-scale solar in Australia", undated, provided by ARENA to EY

Price discovery aspects of the Competitive Round are further exemplified by the reduction of min-max spread of project costs from \$1.28/W at EOI to \$0.67/W at Financial Close.⁴¹

Interviewees were mixed in their assessment of the impact of shared forecast and actual costs from both unsuccessful and successful projects. One participant supported the achievement of price discovery and transparency, as evident by their aggressive bid pricing through the Competitive Round, which was, in part, attributable to the price competitiveness generated through publishing cost data. However, another participant contended that the shared cost information did not impact their bid as the rapidly decreasing cost climate meant that the cost information remained relevant for only a short period of time. One interviewee further expressed that the cost data was in fact outdated by the time it was published, and therefore did not drive price transparency and discovery.

Participants were less optimistic on the impact on forecast costs, claiming that proponents cannot rely on shared anonymised costs as they are each impacted by site specific metrics. Further, active

⁴¹ Herteleer et. Al, "LSS funding impact on utility-scale solar in Australia", undated, provided by ARENA to EY

developers run EPC tenders relatively frequently and therefore maintain a current view of market EPC pricing. This argument was supported by another participant who claimed that CAPEX and OPEX data is more relevant and provides price discovery and transparency benefits to potential proponents entering the market, as opposed to incumbent players.

Findings

Overall, the Competitive Round has provided transparency and price discovery through sharing of project costs, but its usefulness for proponents and impact on forecast costs has been restricted by the rapidly decreasing cost climate of large-scale solar.

4.2 Evaluation for projects not part of the Competitive Round

The following questions were considered in this section:

- ▶ Were the ARENA-funded large-scale solar projects that were not part of the competitive round successfully deployed?
 - ▶ Were their intended outcomes achieved? Intended outcomes were:
 - ▶ Develop a large-scale solar industry in Australia
 - ▶ Provide research infrastructure (AGL-only)
 - ▶ Develop and share technical and economic knowledge from the program
 - ▶ What flow-on effect or impact did they have?

The following 6 projects⁴² were considered under this 'projects not part of the Competitive Round' (Table 3). All projects were successfully developed and are now operational with the latest projects to reach Commercial Operations Date in February 2018, being the Gullen Solar Farm and Lakeland Solar and Storage Project.

Table 3: ARENA funded large-scale solar (grid connected) not part of the LSS Competitive Round

Projects	Developer	MW Capacity (AC)	Accreditation date	Opening date / COD	ARENA funding (\$m)	Total Project Value (\$m)
AGL Solar Project (Nyngan & Broken Hill)	AGL	155	Mar-2015 and Jul-2015	Jan-2016	\$166.70	\$439.08
Moree Solar Farm	FRV	56	Feb-2016	Feb-2016	\$101.70	\$164.00
Gullen Solar Farm	Goldwind	10	Jun-2017	Feb-2018	\$9.90	\$28.82
Normanton Solar Farm	Scouller Energy and Canadian Solar	5	Nov-2017	Dec-2017	\$8.38	\$13.97
Barcaldine Remote Community	Elecnor	20	Mar-2017	May-2017	\$22.80	\$70.10
Lakeland Solar and Storage Project	Lakeland Solar & Storage Pty Limited, a subsidiary of Conergy	10.8	Nov-2017	Feb-2018	\$17.41	\$42.50

Sources: ARENA project websites and accreditation date data sourced from Australian PV Institute (APVI) Solar Map, funded by the Australian Renewable Energy Agency, accessed from pv-map.apvi.org.au on 25 June 2019.

⁴² AGL Solar Project, which occurred in two locations (Nyngan and Broken Hill), is considered as one project for the purpose of this evaluation.

4.2.1 Key findings and observations

Projects prior to the competitive round achieved the intended outcomes

	Develop a large-scale solar industry in Australia		The ARENA funded projects prompted industry development and cost reduction through knowledge and skills transfer from proponents to the local labour market, and development of a solar industry supply chain.
	Provide research infrastructure		The AGL project provided academic research infrastructure and developed intellectual property in solar generation through its partnership with the University of Queensland and the University of New South Wales.
	Develop and share technical and economic knowledge		The ARENA funded projects shared key project learnings and implications for future projects through the knowledge sharing reports published on the ARENA website. Key learnings focused on technical elements of project delivery.

4.2.2 Achievement of intended outcomes

4.2.2.1 Large-scale solar industry

A key objective of ARENA was to establish a large-scale solar industry in Australia. Large-scale solar had lagged international counterparts and the Australian Energy Regulator attributed part of this to the high cost per megawatt hour of the technology compared to other commercially viable forms.⁴³

Prior to these ARENA funded projects, there were only two utility-scale solar PV projects accredited in Australia: First Solar's 10MW Greenough River Solar Farm in WA (2012) and FRV's 20MW Royalla Solar Farm in ACT (2014). The latter was built with significant de-risking from the ACT government's Big Solar program, in which FRV won a reverse auction to receive a 20-year unindexed payment of \$186/MWh.⁴⁴ The former was a result of equity contributions from GE and Verve Energy (on behalf of State government) and did not involve finance from Australian banks.

ARENA has spent approximately \$327m on the 6 projects, with significant investment (over \$100m) allocated to the 155MW AGL Solar Project (Nyngan and Broken Hill)⁴⁵ and 56MW Moree Solar Farm⁴⁶. These initial two projects, all located in NSW, represent the first projects to be commissioned on the NEM. In total, the 6 ARENA funded projects prior to the Competitive Round (listed in Table 3) represented over three-quarters of total accredited capacity in the market at the time⁴⁷.

The objective to develop a large-scale solar industry in Australia was primarily driven by the first ARENA funded projects which reached commercial operations in early 2016: AGL Solar Project and Moree Solar Farm. Key benefits of the projects identified by ARENA include industry development

⁴³ AER, "State of Energy Market Report 2015", [Online], Available at: <https://www.aer.gov.au/publications/state-of-the-energy-market-reports/state-of-the-energy-market-2015> [Accessed 4 Jun. 2019]

⁴⁴ FRV, "FRV's 20MW Royalla Solar Farm achieves financial close", 2013, Available at: <https://frv.com/en/frvs-20mw-royalla-solar-farm-achieves-financial-close/> [Accessed 6 Jun. 2019]

⁴⁵ ARENA, "AGL Solar Project, [Online], Available at: <https://arena.gov.au/projects/agl-solar-project/> [Accessed 6 Jun. 2019]

⁴⁶ ARENA, "Moree Solar Farm, [Online], Available at: <https://arena.gov.au/projects/moree-solar-farm/> [Accessed 6 Jun. 2019]

⁴⁷ EY analysis

and cost reduction through knowledge and skills transfer from proponents (AGL and FRV) to the local labour market, and development of a solar industry supply chain.

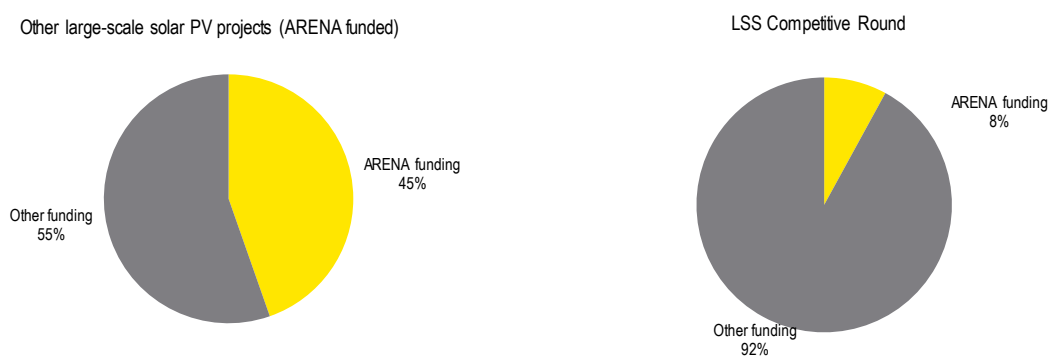
Moree Solar Farm - case study

A 'landmark' project being the first large scale solar project in Australia to use single-axis tracking system, with PV modules that track the sun's path from east to west during the day. The project was initially financed on a merchant basis, but later secured a 15-year PPA with Origin in March 2016 (during the Competitive Round process), covering 100% of the output. Feedback from a participant highlighted this project as a "blueprint" for others to follow, giving other developers confidence to apply for funding initially on a merchant basis. A notable example is Swan Hill Solar Farm in Victoria, which was initially developed on a merchant basis and without a PPA has secured \$16.5 million in debt funding.

Sources: information provided by interview participants, and verified online through Moree Solar Farm project announcements⁴⁸

To stimulate investment in large-scale solar PV connected to the grid, both the AGL Solar Project and FRV's Moree Solar Farm received significant ARENA funding of \$166.7m and \$101.7m respectively, representing approximately 38% and 62% of the total cost⁴⁹. This is each greater than the combined funding provided for all 12 projects in the Competitive Round. In general, ARENA funding represented a significantly larger portion of total project cost in projects prior to the Competitive Round (Figure 10). EY stakeholder engagement found that funding removed key barriers to entry, brought in industry players (both domestically and internationally) and instilled confidence in market participants that the technology could become commercially viable and competitive among other generation sources.

Figure 10: ARENA funding in other large-scale solar PV projects (ARENA funded) vs. LSS Competitive Round projects



Source: data provided by ARENA and gathered through ARENA website

The creation and achievement of a large-scale solar industry in Australia is shown in Figure 3 where an influx of 29 non-ARENA funded projects gain accreditation approximately two years following the two landmark projects.

4.2.2.2 Research infrastructure (AGL Solar Project)

As part of the Australian Solar Institute Initiative program objectives, the aim of the AGL Solar Project research component was to "position Australian solar research and development for the

⁴⁸ Moree Solar Farm, "FRV announces Moree Solar Farm opening and confirms future for solar in Australia", [Online], Available at: <http://www.moreesolarfarm.com.au/announcements/frv-announces-moree-solar-farm-opening-and-confirms-future-for-solar-in-australia> [Accessed 7 Jun. 2019]

⁴⁹ ARENA, *Project websites*, [Online], Available at: <https://arena.gov.au/> [Accessed 7 Jun. 2019]

longer term through investments in research infrastructure and in the skills of the next generation of solar research leaders"⁵⁰.

The AGL Solar Project provided academic research infrastructure and developed intellectual property in solar generation through its partnership with the University of Queensland (UQ) and University of New South Wales (UNSW) under the Education Investment Fund. Under the education fund, UQ built both a 3.275MW Grattton Solar Research Facility to test tracking technologies and performance, energy storage, and operational strategies and a data analysis centre. The solar research facility was commissioned in March 2015 and includes various solar technologies for research purposes including fixed tilt, single axis tracking, dual axis tracking, and battery storage system. The facility has also completed and published findings from three research projects to date on network integration. Key benefits of the infrastructure include⁵¹:

- ▶ Providing voltage and power factor support to the local network
- ▶ Supplying power to the UQ campus
- ▶ Providing research to advance power system engineering, economics and public policy⁵²
- ▶ UNSW developed new energy modelling techniques to assist in the design and integration of solar power stations in the grid

Case study: insights on grid connection from AGL

Issue: Being the first large-scale solar project to be connected to the AEMO grid, the key issue was being able to define the amount and location of additional reactive plant to support the network during a voltage collapse.

Process undertaken: AGL worked with the NSP to conduct detailed modelling of the grid network to demonstrate that a 4 MVar of dynamic reactive plant installed at the Nyngan Substation would be sufficient to stabilise the network during a voltage collapse between Nyngan and Dubbo.

Key learning: negotiating with a NSP to establish grid connection is technically and commercially challenging, and may require extensive modelling.

Implication for future projects: early and regular engagement with the NSP is key to review the progress of technical studies and define commercial arrangements.

Knowledge gap: AEMO may be able to bridge the data gap to demonstrate impacts of large-scale solar plants on the network using knowledge gained from the AGL Solar Project.

4.2.2.3 Technical and economic knowledge

Besides the development of a large-scale solar industry, a common objective among the initial ARENA funded projects was to develop and share technical and economic knowledge with market participants to improve industry capability and improve future project delivery.

As in the Competitive Round, proponents were required to agree to a Knowledge Sharing Plan prior to receiving funding from ARENA. The plan identifies the form and content of the knowledge sharing deliverables, and the data that will be produced from the project.

⁵⁰ ARENA, "Australian Solar Institute", [Online], Available at: <https://arena.gov.au/funding/australian-solar-institute/> [Accessed 7 Jun. 2019]

⁵¹ University of Queensland, "GSRF projects completed to date", [Online], Accessed at: <https://gci.uq.edu.au/gsrp-projects-completed-date> [Accessed 6 Jun. 2019]

⁵² University of Queensland, Solar Energy, [Online], Accessed at: <https://solar-energy.uq.edu.au/about> [Accessed 6 Jun. 2019]

Key knowledge sharing reports for projects can be found online, via either the ARENA project website or ARENA Knowledge Bank. Information has also been disseminated through forums, workshops, conferences, and site visits.

Technical and economic knowledge gained from the projects' knowledge sharing reports are summarised and captured in the table below.

Table 4: A snapshot of key technical and economic learnings from ARENA funded projects not part of the Competitive Round

Topics	Knowledge Sharing – key project learnings and implications for future projects
SCADA and communications	<ul style="list-style-type: none"> ▶ Coordination and early planning with all stakeholders (particularly NSP) has been identified as critical to the smooth commissioning of the plant ▶ Standardising system design and process - suggestion to standardise core requirements for meteorological data and plant output, or AEMO to provide a guideline for solar power plant similar to the existing guidelines for semi-scheduled generators.
Inverters	<ul style="list-style-type: none"> ▶ Commissioning of inverters were improved by selecting a local inverter manufacturer/supplier and ensuring spare components were readily available ▶ Main knowledge gap exists around inverters which are unique for solar power. Details of the inverter fault-ride-through behaviour were misunderstood. ▶ Australia's modelling and validation process appears to be more rigorous than in overseas markets. Other developers and inverter manufacturers who lack experience in utility-scale solar in Australia will face similar challenges unless they invest in early and sustained engagement with experienced local firms and directly with AEMO. ▶ Inverter parameter list should be submitted early and with a clear map between inverter model setting and firmware settings to ensure consistency between simulated and actual performance. ▶ Important to establish early that harmonic current distortion, which can be amplified in rural areas, does not exceed requirements of the NSP through adequate design of the solar farm. ▶ Recommend use of power blocks - which integrate the inverter, step-up transformer and power protection in the same enclosure - as they allow for factory assembly and therefore improve installation times and quality control.
Switchgear (PVCS and PVIS)	<ul style="list-style-type: none"> ▶ Changes to the Generator Performance Standards (GPS) that impact inverter protection may require coordination with third parties to revise and test relay protection settings ▶ Recommend single-person hinged access doors as they provide better protection against dust and weather conditions than a roller door design.
Coordination with NSP during Commissioning Generation	<ul style="list-style-type: none"> ▶ Active engagement with NSP, establishing timeframes in the commissioning plan and testing procedures with NSP is recommended to mitigate time delay due to: ▶ limited availability of NSP personnel; and ▶ lack of experience with solar between parties, which is different to other forms of technology as commissioning is modular and control requirements are different given the variable output
AEMO Requirements	<ul style="list-style-type: none"> ▶ Extra time needs to be allowed for development (multiple iterations) of commissioning and GPS compliance test plans with the NSP, particularly for projects in remote locations. ▶ Detailed design review meetings with the NSP and AEMO during modelling stage of the project is required to ensure consistency between the GPS and intended design of the plant
Minimum Capacity Test	<ul style="list-style-type: none"> ▶ An industry-wide standard capacity test is advisable to drive consistency in procedures to confirm installed capacity of solar PV plants, and ensure plants are built to deliver their intended AC capacity under normal operating conditions.
PV modules	<ul style="list-style-type: none"> ▶ Important to understand the manufacturer's certification of the PV module to ensure they are compliant with various IEC standards (construction, performance, reliability and durability). ▶ Ensure PV module suppliers provide testing records for module degradation (and its various forms) as this affects output over time.

Topics	Knowledge Sharing - key project learnings and implications for future projects
Tracker (single-axis)	<ul style="list-style-type: none"> ▶ A key consideration of tracking systems is that they command greater ongoing costs and flatter sites than fixed structures.
Electricity market modelling and Marginal Loss Factors (MLFs)	<ul style="list-style-type: none"> ▶ Engage a top tier consultant in early stages to perform market analysis, sensitivity testing and to choose a suitable project size as this impacts the MLF, which directly impact future project revenues. ▶ Reductions in MLFs of over 10% in 3 years (2015-2018) were common for solar farms in Fringe-of-Grid regions due to rapid influx of large-scale solar
Project Finance	<ul style="list-style-type: none"> ▶ Government backed debt financing is achievable through innovative debt structuring and risk allocation, even if financed as a merchant asset.
Compatibility with gas (Barcaldine only)	<ul style="list-style-type: none"> ▶ Key lessons on the impact of the solar farm on the transmission network and existing gas generation (Barcaldine's incumbent power supply was a gas-powered generator, which operates as a peaking plant, meaning it only runs when there is a high demand for electricity): ▶ There was a reduction of line losses when the solar farm came into operation, and minimal detriment from reverse power flow ▶ Solar generation had no detriment to stability and little impact on the average voltages observed ▶ Gas plant operators indicate that the solar farms are compatible with the gas plant operation

Sources: AGL, "ARENA Knowledge Sharing Report, Feedback and areas for improvement - Nyngan and Broken Hill Solar PV", 2016, [Online], Available at: <https://arena.gov.au/assets/2016/07/AGL-Solar-Project-KS6-Report.pdf>

FRV, "ARENA - Lessons Learned in the Development of Moree Solar Farm", 2017, [Online], Available at: <https://arena.gov.au/assets/2017/05/MSF-Lessons-Learned-FINAL.pdf>

Ekistica (on behalf of ARENA), "Lessons from the fringes: Australian fringe-of-grid projects in ARENA's portfolio", 2019, Available at: <https://arena.gov.au/assets/2019/06/lessons-from-the-fringes-australian-off-grid-projects-arena-portfolio.pdf>

Findings

Projects prior to the Competitive Round were successfully deployed and provided a "blue-print" for other projects to follow. Intended outcomes of the projects were achieved in terms of developing a large-scale solar industry in Australia, providing research infrastructure, and developing and sharing technical and economic knowledge from the projects.

4.3 Evaluation of broader benefits and impacts for all ARENA funded projects

The following questions were considered in this section:

- ▶ What other broader benefits, impacts (e.g. learnings to the market, industry, system operator) and unintended consequences have been realised as a result of ARENA funded projects?

4.3.1 Key findings and observations

ARENA funding contributed to broader market benefits and impacts:

Advancement of skills, capacity and knowledge



Advancement of local skills, capacity and knowledge of broader market participants, including Engineering, Procurement and Construction (EPC) contractors, Network Service Providers (NSPs) and Australian Energy Market Operator (AEMO).

Developed experience and capacity across the supply chain to develop and provide technology suited to Australian requirements

Improved ability to gain finance



Gave commercial banks confidence in the commercial viability of the technology, resulting in greater support from commercial banks

Encouraged the global flow of capital to Australia

Supported the development of the corporate PPA market

Unintended consequences



Exposed broader system issues including grid connection issues and declines in MLFs that may have occurred at some point due to the higher penetration of renewable generation in the system.

The co-ordinated nature of the Competitive Round helped facilitate the identification of solutions, or work-arounds earlier through ARENA's knowledge sharing.

4.3.2 Benefits and impacts

Given the context of the large-scale solar industry in Australia at the time and particularly its relative immaturity compared to international markets, ARENA's LSS funding programs were a key step in the industry's move toward commercial viability. Prior to 2015 and the Competitive Round, significant barriers to large-scale solar uptake existed domestically. These included:

- ▶ High costs that made it uncompetitive against other forms of technology
- ▶ Lack of skills, capacity and knowledge in Australia
- ▶ Inability to gain debt finance

The impact of ARENA funding on industry cost reduction has been discussed in section 4.1. This section will focus on broader impacts, which have come about from reducing these other barriers to increased uptake.

4.3.2.1 Advancement of Skills, Capacity and Knowledge

The Competitive Round has facilitated the advancement of skills, capacity and knowledge in the broader market via their knowledge sharing program with ARENA. For projects prior to the Competitive Round, these learnings focused more on early technical and economic knowledge gained from deploying a project, which in many cases were the first of its kind. A discussion of some of these learnings for early projects (prior to the Competitive Round) has been discussed in the previous section. Key learnings for projects in the Competitive Round have had a greater focus on broader market learnings, optimising process and reducing associated time delays, particularly in the grid connection process. An example of how ARENA has contributed to broader industry learnings is provided in the below case study.

Case Study: ARENA's contribution to broader industry learnings around grid connection

Issues identified by proponents around the grid connection process:

1. *It is a technical and time intensive process*
 - ▶ No clear timeframes provided by AEMO and NSP
 - ▶ Applicants have to queue for capacity
 - ▶ There is more capacity fringe-of-grid
 - ▶ NSP can not divulge much information on competing generators
 - ▶ Poor handover between AEMO and NSP staff, causing delays to the project
2. *No commercial accountability in the scoping study*
 - ▶ Cost variations, limited basis of estimate/assumptions
3. *Inflexibility*
 - ▶ Connection application locks developers into specific inverters early on
 - ▶ A change of inverter requires restarting the application

Key benefits realised from the ARENA funding program:

Knowledge sharing facilitated by ARENA during the development phase enabled earlier resolution of issues:

- ▶ Sharing of knowledge between project proponents, and broader market participants, including AEMO, enabled earlier identification of solutions or work-arounds to achieve grid connection earlier
- ▶ Facilitated greater networking between solar developers, enabling greater sharing of insights into how to successfully navigate development issues

All grant recipients interviewed for this evaluation have indicated that there has been an advancement of local skills, capacity and knowledge as a result of the ARENA program. The Competitive Round brought in overseas expertise, particularly EPC providers, who could draw on their experiences abroad with large-scale solar. One local interviewee also stated that the funding round gave them the opportunity to network with these developers and develop insights into how to successfully navigate processes and development issues. A more detailed discussion of the effectiveness of the knowledge sharing arrangements of the Competitive Round is detailed in the following chapter.

4.3.2.2 Improved ability to gain finance

A key barrier to developing a strong pipeline of large-scale solar was the inability to secure bank financing. ARENA funding bridged this initial funding gap and gave commercial banks a period of time to develop experience and knowledge necessary to provide future debt funding. One ARENA interviewee commented that the transparent nature of the financing and commercial structures of each LSS project in the Competitive Round enabled banks to become more comfortable with the investment case. Another interviewee indicated the program encouraged the global flow of capital

to Australia, as evidenced by the number of international sponsors providing equity in the projects. Above all else, the program gave commercial banks confidence in the technology and its drive toward self-sufficient commercial viability. A notable example of achievement of commercial viability has been the 220MW Bangala Solar Farm, which was developed without any direct government support (excluding LGCs) and connected to the grid in 2018. As a result of the de-risking that has occurred, commercial banks started to support large-scale solar projects in Australia.

The Competitive Round has also supported the development of the PPA market. The Moree Solar Farm was one of the first projects to receive a PPA and signalled a turning point in the market (refer to case study in previous section). One interviewee also indicated that the information released on costing and financing structures in the Competitive Round helped stimulate the corporate PPA market. It did so by showing the wider market that solar pricing on a per MWh basis was starting to become competitive with prices commanded by a retailer or another power station.

4.3.3 Unintended consequences

Interview participants have indicated that ARENA funded projects, and particularly the Competitive Round, have exposed broader system issues including grid connection issues and declines in MLFs.

The Competitive Round saw 12 large-scale projects being progressed at the same time, resulting in a backlog of approvals and commissioning, where 11 of 12 LSS projects failed to meet expected timeframes and were on average 8.5 months behind schedule in terms of reaching commercial operation.⁵³ Further to this, the Clean Energy Regulator recognised grid connection and network access as the biggest problem facing new solar projects (as well as wind and storage projects) in 2018.⁵⁴ Interviewees have echoed this as the main problem impeding the industry and called on continued focus on improving these issues.

Feedback from participants has largely identified inexperience or insufficient resourcing of NSPs and AEMO to deal with multiple projects striving for commissioning at the same time as the main driver causing the delay to reach grid connection. One participant commented that they often had to wait 'a few weeks' for commissioning and testing works to be performed as the relevant subject matter expert (or equivalent) was offsite on another project, often in a remote location.

Complicated connections processes and rigorous modelling requirements in Australia, which are more demanding than comparable markets overseas have also been identified as another factor causing delay. Contributing to this complicated process is the connections requirements for projects in the pipeline being impacted by each approval of a new generator, which can cause many iterations of revised modelling. Additionally, AEMO has proposed more detailed modelling requirements and more thorough inspections to the review process in response to the South Australian blackout in September 2016.⁵⁵

Grid connection issues have also been reflected in declines to MLFs. There have been notable challenges to proponents in predicting MLFs, specifically the extent to which new generators will connect proximally, and the timing of their construction. This is evidenced by an overestimated MLF in 10 of 12 LSS Competitive Round projects resulting in average yield deficit of 6% in first year of operations.⁵⁶ Interviewees have indicated that the issue has been exacerbated by LSS projects being located in similar parts of the grid, notably in Queensland and New South Wales.

⁵³ Ekistica, Topic 7.2: Policies and Scenarios for Renewables, Societal and Global Challenges, Lessons from utility-scale PV in Australia: Experience from ARENA's LSS portfolio

⁵⁴ Clean Energy Council, "Clean Energy Outlook Confidence Index 2018," 2018. [Online]. Available: <https://assets.cleanenergycouncil.org.au/documents/resources/reports/clean-energy-outlook/Executive-confidence-index-2018-A4.pdf>. [Accessed 6 Jun. 2019]

⁵⁵ Ekistica, Topic 7.2: Policies and Scenarios for Renewables, Societal and Global Challenges, Lessons from utility-scale PV in Australia: Experience from ARENA's LSS portfolio

⁵⁶ Ibid

The following case study discusses MLF reductions at AGL's Broken Hill Solar Farm⁵⁷, one of the projects to receive ARENA funding prior to the Competitive Round.

Case study: MLF reductions for AGL's Broken Hill Solar Farm

MLF changes

The AGL Broken Hill Solar Farm initially opened in January 2016 with a nameplate capacity of 53 MW. In each of the past two years, data from AEMO reveals that the project has experienced the largest MLF reduction across renewable energy generators in the NEM with decreases of 21.4% and 22.7% for FY19 and FY20 respectively.

MLF explained from AEMO

"The MLF for a connection point represents the marginal electrical transmission losses in electrical power flow between that connection point and the regional reference node (RRN) for the region in which the connection point is located. An MLF below 1 indicates that an incremental increase in power flow from the connection point to the RRN would increase total losses in the network. An MLF above 1 indicates the opposite. If the MLF for a connection point is 0.9 then the effective values of electricity purchased or sold at that connection point will be 90% of the regional reference price", directly impacting generator's bottom-line.

Drivers of MLF reductions at Broken Hill

This corresponds to an MLF drop from 1.25 to 0.76, which implies that, during initial years of operations, it was deemed by AEMO that the project had a net benefit to the grid. Substantial increases in projected power flow (wind and solar generation) toward the RRN has since reduced this net benefit to become a net loss. AEMO accounts that in general, MLFs for connection points in south-west NSW have decreased by 11.5% on average for FY20. South-west NSW has strong access to renewable resources, but the network is electrically weak and remote from the RRN. These reductions in MLFs have been exacerbated by the high correlation in generation profiles.

It was evident in interviews with both funding applicants and funding providers (ARENA and CEFC) that the true significance of the grid connection and MLF issues were not foreseen prior to the Competitive Round. Issues were often discovered by grid authorities as they occurred for the first time instead of foreseen and planned for, highlighting the rapid growth of the industry and shared learnings between all parties during this time period. However, the co-ordinated nature of the Competitive Round helped facilitate the identification of solutions earlier through the knowledge sharing organised by ARENA.

Findings

The ARENA funding of LSS projects provided broader benefits to the market that have contributed to the achievement of program objectives, notably reduction in the barriers to LSS PV uptake. Two key benefits identified (aside from industry cost reduction) include the advancement of skills, capacity and knowledge as well as the improved ability to gain finance for LSS PV projects. However, there have also been unintended consequences that have arisen from the influx of projects following a similar time trajectory. ARENA funded projects, and particularly the Competitive Round, have exposed broader system issues including grid connection issues and declines in MLFs.




⁵⁷ AEMO, "Updated Regions and Marginal Loss Factors: FY 2019-20. A report for the National Electricity Market ", 2019, [Online], Available at: <https://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Security-and-reliability/Loss-factor-and-regional-boundaries> [Accessed 1 Aug. 2019]

5. Process evaluation

5.1 Evaluation of the Competitive Round as a funding mechanism

5.1.1 Key findings and observations

The Competitive Round process was a suitable funding mechanism

Maximised and achieved desired outcomes	Suitable given context and technology readiness	Structured effectively
		
<p>Leveraged lessons learned from international and previous programs (eg projects not part of the Competitive Round and the Solar Flagships program)</p> <p>Stimulated investment appetite to create competition and support cost reduction</p>	<p>Enabled effective comparison of projects and accelerated large-scale solar development</p> <p>Encouraged participation of early-stage projects and created a consistent framework</p>	<p>Effectively used bid bonds and clearly communicated requirements</p> <p>Actively engaged with participants and provided appropriate application timeframes</p>

There are opportunities to improve subsequent processes

- 1 Collaborate more closely with CEFC and other agencies**

 - ▶ Engage early with CEFC, AEMO and participants, for example, to support program design, vet documentation, and allow government agencies to consider potential program impacts on their remits
 - ▶ Consider partnering with other agencies to use ARENA's remaining \$279 million investment mandate in alternative ways
- 2 Consider impact of program from a broader perspective**

 - ▶ Consider the ability of the program to support grid stability and reliability objectives (noting this has been a key focus for ARENA over the last three years)
 - ▶ Consider appropriateness of using an LCOE and ensure its use does not detrimentally affect achieving broader objectives

5.1.2 Competitive Round process overview

ARENA received 77 eligible EOIs for funding between September and November 2015, for a total capacity exceeding 2.8 GW. Following EOI assessment, ARENA announced 22 shortlisted projects in January 2016. Shortlisted participants submitted Full Applications in June 2016 and 12 projects were selected to receive \$92 million in aggregate grant funding, representing 482 MW of utility-scale solar projects.

EOI applications that met the eligibility criteria were assessed against five merit criteria (see section 2.2.1). Full Applications were assessed on the same basis.

For the EOI, ARENA established an assessment team and assessment team personnel were provided with guidance on how to assess and score applications. Personnel prepared assessment summaries of the projects they were assigned, which were subsequently evaluated by ARENA's Business Development Manager. With approval from the ARENA CFO, low merit projects were eliminated early in the assessment process. ARENA also leveraged an advisory panel (the ARENA Advisory Panel or AAP) of renewable energy sector experts to assess the remaining projects.

External advisors were engaged to provide financial and technical due diligence support during assessment. These third-party advisers prepared separate reports and their assessments were considered in preparing the assessment team's project summaries. Following assessment moderation, the projects were ranked, with the highest scoring projects invited to proceed to the

next stage. Probity and CEO approvals were required before inviting applicants to progress to the Full Application stage.

The Full Application process followed a similar process to the EOI. Following assessment, the ARENA Board approved the final list of 12 projects and successful parties were issued an Offer of Funding or Offer to Negotiate. Bid bonds were requested at this stage to incentivise successful parties to reach Project Financial Close. All 12 projects approved for ARENA funding reached Financial Close by May 2017.

5.1.3 Effectiveness of the Competitive Round as a funding mechanism

5.1.3.1 Effective achievement of objectives

The following questions were considered in this section:

- ▶ Has the competitive round been an effective and efficient way of maximising achievement of outcomes? This includes the process for awarding funds, approvals and contract management.

Stakeholder consultations revealed that:

- ▶ ARENA's Competitive Round process has supported cost reduction and increased competition
- ▶ ARENA's Competitive Round process has supported broader market development and de-risking of solar projects
- ▶ There were some unintended consequences of the Competitive Round process

These findings are explored further in the tables below.

ARENA's Competitive Round process has supported cost reduction and increased competition.

<p>Macro market competition</p>	<ul style="list-style-type: none"> ▶ At the time the funding round commenced, the global economy was rebounding from the Global Financial Crisis. Around the world, feed-in tariffs were being unwound and the depressed economy was dampening investment appetite. ▶ In this economic climate, the LSS Funding Round was welcomed as an opportunity to stimulate investment through an additional funding source other than equity or debt. Participants observed that the costs of large-scale solar technology were already reducing globally at the time, but the offer of grant funding drew attention to Australia as a supportive location for investment, helped stimulate solar investment in Australia and accelerated the pipeline of solar projects. ▶ The Competitive Round encouraged international developers, EPC and O&M providers and Original Equipment Manufacturers (OEMs) to enter the Australian market as they saw opportunities for growth. This growth stimulated competition and, as market entrants have developed their understanding of the Australian solar landscape, they have developed efficiencies, contributing to cost reductions. This has resulted in EPC pricing, for example, reducing at a more rapid rate than it otherwise would have without the funding program. ▶ As ARENA was clear in its deliverability and project timeline requirements, participants also found that the Competitive Round process drove them to compete not only for available funding but also on their proposed timelines. This focussed their attention on undertaking development activities that would improve the appeal of their projects to ARENA.
<p>LCOE benchmark</p>	<ul style="list-style-type: none"> ▶ The process to award funds involved participants submitting projects with an LCOE at or below a benchmark. The extent to which the LCOE benchmark drove competition and cost reduction was contested during stakeholder consultation. ▶ Some participants proffered that it was an achievable benchmark but one which tested industry limits. It acted as a useful tool to compare projects, encouraged cost reduction right across the value chain and required participants to consider alternative methods to manage risk. To reach the benchmark required participants to consider ways to lower their cost of capital through considering different avenues of capital raising and changing equity investors' return expectations, requiring them to assume greater risk at an earlier stage. ▶ Another observation was that the LCOE benchmark also helped other parts of the business community leverage solar and renewables in other ways. For example, the LCOE benchmark

ARENA's Competitive Round process has supported cost reduction and increased competition.

	<p>supported development of the corporate PPA market. Lower solar pricing per MWh made PPA pricing more competitive, making it more worthwhile investigating PPA options.</p> <ul style="list-style-type: none"> ▶ Other participants felt that sophisticated players could easily tailor their project models to beat the LCOE benchmark and that costs were already trending downward, so the LCOE did not specifically contribute to cost reductions. ▶ Some participants also mentioned that focussing on an LCOE benchmark may have contributed to the limited geographical spread of projects that ultimately received funding. The projects that received funding were constructed in Queensland (6), New South Wales (5) and Western Australia (1).⁵⁸ No projects were funded in Victoria, South Australia and Tasmania. Participants suggested that projects located in these jurisdictions may have been disadvantaged by the LCOE benchmark and that an inadvertent consequence of the LCOE benchmark is that the concentration of projects in Queensland and New South Wales may have contributed to NEM congestion. ▶ In future, it was suggested that a greater focus on the value of projects to the grid might be better than a strong focus on an LCOE. Such metrics might include grid location and impact on grid stability. Greater liaison with AEMO prior to launching a funding round could help establish criteria to support grid stability and reliability objectives.
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<p>Publication of capex and opex data</p>	<ul style="list-style-type: none"> ▶ Participants considered that ARENA's publication of capex and opex data supported cost reduction to a limited extent. They considered their own competitive EPC and O&M tender processes were more likely to have contributed to cost reduction. ▶ Participants also considered that cost reduction was more likely supported by the networking opportunities facilitated informally by ARENA's workshops and by participants naturally establishing their networks. As participants developed their networks, market intelligence was shared between developers, OEMs, PV panel importers and global EPC providers, allowing participants greater visibility of their and their competitors' pricing. This created pricing expectations and encouraged cost reduction through competition. ▶ Participants generally considered that the published data was useful as a high-level reference point but that the data was too high-level to provide a basis for market players to make cost comparisons. Key issues with using published cost data are that: <ul style="list-style-type: none"> ▶ It becomes out of date very quickly ▶ Site-specific issues can influence cost data greatly ▶ Data needs to be more granular to provide a useful basis for comparison (for example, costs need to be broken into categories such as owner's costs, grid costs, EPC costs etc) ▶ Participants felt that the published cost data was probably more useful for a new market entrant or other industry participants (such as banks) rather than existing market players. They considered it would help a new market entrant understand whether its planned projects were feasible or not. This view is supported by Herteleer et al; they assert that media coverage with financiers indicated that publication of the capex and opex data "provided crucial detailed benchmark information on utility-scale PV, in an immature market that had previously had a vacuum of such benchmark data both in the public domain and in private firms' databases."⁵⁹ ▶ Participants acknowledged that ARENA's collection of capex and opex data was obtained from a sufficient pool of participants to ensure that the collected data was anonymised and could not identify particular projects. This is important to market participants who are asked to share their cost information.
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ARENA's Competitive Round process has supported broader market development and de-risking of solar projects.

<p>CEFC involvement</p>	<ul style="list-style-type: none"> ▶ Prior to the Competitive Round, the Solar Flagships program had encountered difficulties establishing their feasibility due to a lack of offtakes in the market at the time. ARENA was keen to ensure that this did not create a barrier to project success for the Competitive Round. As such, managing merchant risk was a key concern for the program. ▶ Similarly, at the time of the Competitive Round's launch, the Commonwealth had reduced the Renewable Energy Target (RET) and there was ongoing discussion regarding whether the RET would be repealed entirely. ▶ These factors contributed to uncertainty in the market, making investment risky. ▶ Through involving CEFC, ARENA could remove merchant risk as a key concern for projects. CEFC offered participants a debt product not available through commercial banks, which alleviated merchant risk, assuring ARENA and project sponsors that submitted projects could achieve Financial Close. The concessional finance CEFC offered also supported equal
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⁵⁸ ARENA Large-scale solar photovoltaics - competitive round
<https://arena.gov.au/funding/programs/advancing-renewables-program/large-scale-solar-photovoltaics-competitive-round/>

⁵⁹ Herteleer et al, "ARENA's Large Scale Solar funding impact on utility-scale solar in Australia", undated, provided by ARENA to EY

ARENA's Competitive Round process has supported broader market development and de-risking of solar projects.

	<p>opportunity for projects as the projects were supported irrespective of whether they were contracted. It was an upside for a project if it were subsequently able to secure an offtake agreement. (It eventuated that most projects were able to secure offtakes, typically between selection after the Full Application phase and Financial Close.)</p> <ul style="list-style-type: none"> ▶ CEFC's involvement also provided projects a better platform for having subsequent discussions with commercial banks regarding additional debt finance. CEFC was amenable to this and allowed participants to negotiate CEFC's debt terms where additional private finance was sought.
<p>Other risk reduction</p>	<ul style="list-style-type: none"> ▶ At the time, foreign exchange fluctuation was a key risk for projects as many EPC prices were floating and provided by international EPC providers. While this risk did not materialise, the grant funding provided a buffer for the debt component against this risk. If exchange rates had moved, increasing EPC prices, ARENA's grant funding acted as a contingency to help absorb the cost increase without having to seek additional funds from equity. ▶ The Competitive Round stimulated investment appetite and CEFC's concessional finance helped mitigate against key risks present in the market at the time and promoted utility-scale solar as a proven and viable renewable technology. Capex and opex data published after the EOI process provided the broader public and financiers with a reference point for utility-scale solar costs and their trajectory. From a financing perspective, the Competitive Round helped banks develop the skills and experience require to better manage the risks associated with utility-scale solar, enabling them to become more comfortable financing such projects and contributing to utility-scale solar cost reduction.

There were some unintended consequences of the Competitive Round process.

<p>Unintended consequences</p>	<ul style="list-style-type: none"> ▶ Construction timeframes for solar are short (compared with wind projects, for example) and there are lower barriers to entry. As such, utility-scale solar development likely accelerated faster under the Competitive Round than other technologies might have, leading to some unforeseen issues particularly in relation to the speed with which AEMO could review and approve grid connection applications. ▶ The Competitive Round process expedited growth in large-scale solar projects at a similar point in time. In addition, the feasibility of projects outside the program improved due to technology costs decreasing, the Commonwealth Renewable Energy Target and the impact of the Competitive Round. The confluence of these factors likely contributed to an unforeseen increase in the number of applications for AEMO to review and approve, placing pressure on AEMO resourcing. ▶ Further, AEMO's approval of each new generator requires changes to be made to the connection requirements of other generators awaiting connection. This results in a cascade of alterations that applicants must make, such as revised modelling, and leads to delay. The unforeseen increase in the number of connection applicants would likely have compounded this issue. ▶ Participants also identified that there were some technical and grid issues that arose, which AEMO and NSPs were unable to foresee or were identified only during a project's grid connection. ▶ Given the grid connection issues encountered, which remain a challenge today, participants suggested that: <ul style="list-style-type: none"> ▶ A staged approach to the Competitive Round may have helped to stagger grid connection applications to minimise bottlenecks and AEMO's resourcing pressures ▶ Liaising with AEMO to a greater extent prior to the Competitive Round's launch may have resulted in some changes to the process' design (for example, assessment metrics and staging, desirable inverter or transformer technologies), which may have reduced the impact of some of the unintended consequences.
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Findings

The Competitive Round process was an effective and efficient method of maximising ARENA's desired outcomes. The offer of grant funding stimulated investment appetite, supporting cost reduction and increased market competition in the large-scale solar sector. The process also supported risk reduction in areas of key concern to the market at the time the process was run. The LCOE benchmark provided a reference point for participants to target and may have encouraged participants to consider alternative capital raising strategies and alter their risk appetite. Published capex and opex data was likely to be more valuable to new market entrants and to other industry participants (such as banks) than to funding participants.

Recommendations

- ▶ Increased focus on evaluation metrics other than a project's LCOE or funding gap is desirable to achieve greater geographical diversity and support grid stability and reliability in the NEM
- ▶ The value to the market of capex and opex data could be improved through increased data granularity and categorisation
- ▶ Liaising more with AEMO prior to program launch, and potentially considering a staged approach to offering grant funding, may have alleviated some of the delays encountered in projects achieving grid connection

5.1.3.2 Leveraging lessons learned

The following questions were considered in this section:

- ▶ To what extent did the competitive round leverage lessons learnt from ARENA's large-scale solar projects that preceded the competitive round?

Stakeholder consultations revealed that ARENA:

- ▶ Effectively leveraged the lessons learned from previous funding programs such as the Solar Flagships program
- ▶ Considered lessons learned from international jurisdictions when designing the Competitive Round

These findings are explored further in the table below.

ARENA effectively leveraged lessons learned from previous funding programs and other jurisdictions.

Lessons from the Solar Flagships program

- ▶ At the time the Solar Flagships program was run, solar PV was not sufficiently developed, and this meant the funding process became protracted as project feasibility and deliverability became challenging to ensure. There was a lack of offtakes in the market at the time, further impacting project feasibility (see discussion in section 5.1.3.1 on CEFC involvement in the Competitive Round process).
- ▶ Given this experience, ARENA sought to alleviate merchant risk exposure through involving CEFC which offered a concessional finance product and did not require an offtake agreement to be secured.
- ▶ ARENA also engaged technical advisers to support an assessment of project deliverability to give ARENA more comfort that a short time between Contract Close and Financial Close could be achieved. Bid bonds also incentivised achieving compressed Financial Close timeframes.

ARENA effectively leveraged lessons learned from previous funding programs and other jurisdictions.

International jurisdictions were considered	<ul style="list-style-type: none">▶ In designing the Competitive Round, ARENA considered other similar international programs. From this analysis, ARENA determined that it should take projects requesting grant funding 2-3 times the total grant funding available through to the Full Application stage. Funding applicants would view themselves as still having a reasonable chance of success and would have the confidence to continue spending money on their projects.▶ It also gave ARENA a buffer so that if any projects collapsed prior to Financial Close, there were other projects waiting to be selected.
AGL and FRV lessons learned	<ul style="list-style-type: none">▶ After EOI, ARENA ran a knowledge sharing workshop with AGL and FRV (successful participants funded prior to the Competitive Round). Shortlisted Competitive Round participants were invited to attend and AGL and FRV shared lessons learned from their past experience.▶ Participants indicated they found that the insights shared were beneficial to development of their projects and navigating development challenges that they encountered.

Findings

ARENA effectively leveraged lessons learned from previous funding programs and other jurisdictions. ARENA deployed strategies to mitigate against the risk that participants might not have secured offtakes through involving CEFC. ARENA engaged third party technical advisers during evaluation to ensure the projects most likely to reach Financial Close were selected. International precedents were considered in determining how many projects were to proceed to the Full Application stage. AGL and FRV were asked to share insights from their experiences to assist participants shortlisted for the Full Application process.

Recommendation

- ▶ This report provides recommendations on page 73, which ARENA can leverage to support the success of future funding programs

5.1.4 Appropriateness of the Competitive Round as a funding mechanism

5.1.4.1 Competitive Round versus alternative funding mechanisms

The following questions were considered in this section:

- ▶ Was the use of a competitive round compared with other potential procurement or funding mechanisms appropriate as a means to generate competitive tension?
- ▶ Were the LSS competitive round administration costs appropriate?

Stakeholder consultations revealed that:

- ▶ The Competitive Round was a suitable and effective funding mechanism to drive competitive tension amongst market participants
- ▶ The Competitive Round was likely more effective and efficient than an individual application process given the nature and maturity of the technology supported
- ▶ The Competitive Round provided a common framework to apply across projects which streamlined internal administrative processes

These findings are explored further in the tables below.

The Competitive Round was a suitable and effective funding mechanism to drive competitive tension.

Competitive tension

- ▶ Participants considered the Competitive Round to be an appropriate funding mechanism in the circumstances because there were numerous similar technology projects at similar development stages. This created a group of realistic grant funding competitors helping to generate competitive tension.
- ▶ The process was open, clearly designed, and large enough to attract most industry stakeholders, also driving competition.
- ▶ The LCOE benchmark provided a reference point for participants to target, stimulating competition. The LCOE benchmark may also have encouraged participants to consider alternative capital raising strategies and more competitive risk allocation.

The Competitive Round process was effective and efficient given the nature of the technology supported and the objectives sought.

Administrative costs and processes

- ▶ Given the similarity of technology sought and technology readiness, participants considered that the Competitive Round was more useful than the typical application process as it provided a common framework to apply across projects, which simplified and streamlined ARENA's internal administration processes, and may have contributed to lower administrative costs, improved efficiency and greater process simplicity. This observation needs to be tempered with the additional expense of undertaking a rigorous technical and financial assessment involving third party advisers, which may not be required where individual applications are submitted.
- ▶ Participants observed that similar project documentation was developed across projects to achieve similar risk allocations, impose similar obligations on parties and create administrative efficiencies in contract management (such as similar reporting and withdrawal request practices).
- ▶ While ARENA chose the Competitive Round process to generate supply chain experience in the large-scale solar market to drive cost reductions, participants agreed that the process helped to reduce internal ARENA administration.
- ▶ The case for a Competitive Round is not as strong where there are disparate or novel technologies, or projects in the market are at widely different development stages. It could be difficult for such projects to meaningfully compete in a competitive funding round process. A "one size fits all" approach is not always appropriate, so ARENA's more bespoke funding processes remain an important funding mechanism.

Findings

The Competitive Round was an appropriate funding mechanism to drive competition compared with a process that would have involved projects applying individually for funding. Technologies were at a similar stage of development so projects could compete on a relatively even playing field. The process provided a common framework to assess projects supporting internal administration, process and potentially cost efficiencies.

Recommendation

- ▶ When designing a funding program, ARENA should retain its existing procedures which assess market and technology readiness to determine whether a competitive round or individual application process is suitable.

5.1.4.2 Competitive Round timing

The following questions were considered in this section:

- ▶ Was the Competitive Round process timing appropriate?
- ▶ Was the Competitive Round process implemented on time and on budget?
- ▶ Was the application process and selection process implemented on time?

Stakeholder consultations revealed that:

- ▶ The timing of the Competitive Round was overall appropriate given the economic context
- ▶ However, some tight timeframes contributed to resourcing pressure for ARENA
- ▶ There were also unforeseen project delays

These findings are explored further in the tables below.

The timing of the Competitive Round was generally appropriate though some tight timeframes contributed to resourcing pressure.

<p>Economic context</p>	<ul style="list-style-type: none"> ▶ The Competitive Round process was conducted during a global economic slowdown and sluggish investment appetite. In this context, ARENA's grant funding was welcomed by investors, brought international attention to Australia and encouraged international parties to enter the Australian large-scale solar market. ▶ Solar technology was sufficiently advanced to be developed on a large scale; cost and electricity prices were the barrier to its feasibility. ▶ Whether by chance or design, the ARENA Competitive Round process was timed well given the scarcity of investment funds and appetite, technology readiness, and prevailing market conditions in Australia, and internationally. ▶ A similar funding round for solar now would be less effective due to the current prevailing market conditions.
<p>Application timeframes</p>	<ul style="list-style-type: none"> ▶ ARENA conducted industry consultation prior to the Competitive Round's launch to inform process development and timeframes. The personnel involved in designing and implementing the Competitive Round process were also experienced in running large infrastructure projects so were aware that complexity, scale and market maturity influence program timeframes. ▶ The process spanned 1 year from EOI release to announcement of successful projects, and allowed participants 6 months to prepare their Full Applications. Participants considered this was appropriate given the market context at the time. ▶ The large-scale solar market was in its infancy and, at the time of the Competitive Round's launch, projects were relatively undeveloped. The timetable proposed by ARENA allowed early stage projects to submit funding applications and continue project development work to meet more rigorous requirements by the time it reached Full Application stage. This approach created demand for the funding, stimulated competition and allowed for projects to establish themselves as high-quality funding contenders.
<p>Timeframes from assessment to Financial Close</p>	<ul style="list-style-type: none"> ▶ Some participants recalled ARENA required extensions to its proposed assessment timetable suggesting ARENA had been too optimistic in the timeframes it had set itself. ▶ However, participants were relatively unperturbed by this delay. They proffered that the extension to assessment timeframes was likely necessary to properly evaluate the participants' responses, particularly given the number of responses received and the detailed content provided. ▶ Similarly, participants observed that timeframes for achieving Financial Close were challenging to meet and appeared to place pressure on ARENA and CEFC resourcing. ▶ This was particularly the case given the challenges encountered in negotiating and agreeing changes to project documentation, in particular the tripartite deed dealing with intercreditor arrangements. This issue is discussed further in section 5.2.2.4 (questions pertaining to the application and selection process). ▶ While participants were generally comfortable with the timing and the few delays that occurred, participants observed that they bore the risk of ARENA delays during the EOI or Full Application phases. For example, the EPC prices they receive have defined validity periods, and are often subject to change due to macroeconomic variables such as fluctuation in foreign exchange rates. Some participants implemented hedging strategies to manage foreign exchange risk, but the longer delays are, the more risk participants are exposed to and so ARENA should endeavour to implement realistic timelines and engage sufficient resourcing to reduce the likelihood of delays arising.
<p>Internal ARENA budget</p>	<ul style="list-style-type: none"> ▶ While an internal ARENA administration budget is not disclosed, ARENA estimates that it allocated resourcing of between 4 to 5 Full Time Equivalents. ▶ This appears consistent with other resourcing estimates for comparable assessment processes.

There were unforeseen project delays.

Delivery timeframes

- ▶ There were some logistical challenges in ARENA being able to meet the timeframes required to authorise funding withdrawal requests due to the bank account signatory authorisations being personal to the ARENA CEO and CFO (see section 5.2.2.3).
- ▶ While ARENA engaged technical advisers to support assessment of participants' projects and identify those projects most likely to achieve Financial Close within the proposed timeframes, grid connection proved a challenging and time-consuming process for many participants. Many projects encountered delays in this regard, contributing to delays in commissioning projects.

Project delays

- ▶ The LSS projects took "on average, 19 months to reach commercial operation from Financial Close and were, on average, 8.5 months behind schedule, with the increased complexity associated with grid connection being the leading cause of significant delays and increased costs."⁶⁰
- ▶ One participant observed that the market's immaturity at the time likely contributed to delays. Many participants were new to the Australian market and unfamiliar with the grid connection process. Exacerbating this, AEMO was making rule changes relating to system strength and Generator Performance Standards, making it more difficult for participants to develop a concrete understanding of the grid connection process.
- ▶ Further, acceleration in the project pipeline as a result of the Competitive Round likely led to an increased number of grid applications being submitted to AEMO. AEMO may have encountered challenges in expeditiously handling an increase in grid applications resulting from pipeline growth. McLeod et al's work supports this view and indicates there has been an increase in the number of grid connection applications and that it has become increasingly difficult for AEMO and Network Service Providers to review enquiries and applications.

Findings

The ARENA Competitive process was timed well given the economic climate at the time. Prior to launching the Competitive Round, market participants were consulted regarding timeframes so that timeframes required were achievable for funding applicants. Two aspects of the process required additional time: evaluation of applications and negotiations. The Financial Close process also had a compressed timeframe.

Recommendations

- ▶ Ensure sufficient time and resourcing is allocated to ensure extensions of time for evaluation or reaching Financial Close are not required
- ▶ To streamline negotiations, undertake greater consultation with the market and CEFC to ensure that project documentation is commercially palatable

5.1.4.3 Bid bonds and bid cost reimbursement

The following questions were considered in this section:

- ▶ Is the use of bid bonds or bid cost reimbursement for final stage applicants appropriate in further driving reduction in cost of solar PV?
 - ▶ Should these mechanisms continue to be used in future funding programs?
 - ▶ If so, would it be value for money for ARENA?

Stakeholder consultations revealed that:

⁶⁰ McLeod et al, "Lessons from utility-scale PV in Australia: Experience from ARENA's LSS portfolio", undated, provided by ARENA to EY.

- ▶ The use of bid bonds was viewed favourably as it engaged serious bidders and likely excluded incapable parties
- ▶ Bid cost reimbursement was generally viewed favourably though it was potentially unnecessary and could have reduced effectiveness of the bid bonds.

These findings are explored further in the tables below.

The use of bid bonds was viewed favourably as it engaged serious bidders and likely excluded incapable parties.

<p>Use of bid bonds</p>	<ul style="list-style-type: none"> ▶ Participants were not discouraged by having to provide bid bonds if their projects were offered funding after Full Application assessment. No concerns were raised with ARENA in relation to the bid bond requirement. ▶ Participants considered that it was a sensible approach to ensure that the funding applicants were serious about their projects. They considered that less serious parties would not want to commit funds via bid bonds and would retire from the process. ▶ The quantum of the bid bonds was considered reasonable and participants indicated that they did not try to recoup the cost of them through seeking a higher amount of grant funding.
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Bid cost reimbursement was generally viewed favourably though it was potentially unnecessary and could have reduced effectiveness of the bid bonds.

<p>Bid cost reimbursement</p>	<ul style="list-style-type: none"> ▶ Participants expressed that bidding is an expensive exercise and bid cost reimbursement can incentivise participation. However, excessive bid cost reimbursement diminishes the incentive to produce a high-quality bid. ▶ Participants considered that ARENA pitched bid cost reimbursement well. The quantum was not excessively generous, but it offered some protection to participants about participating in the process. ▶ Bid cost reimbursement also gave participants some comfort in spending money on consultants during the Competitive Round process because it would help offset such expenses. In turn, this supported the rigour of the Competitive Round process as participants were more inclined to undertake development work and commission relevant studies to support their applications, rather than submit unsupported funding applications. ▶ However, others considered that bid cost reimbursement should be treated with caution. Expenditure on consultants and other project development activities is a risk participants should assume in the ordinary course of business. Offering bid cost reimbursement lowers the barriers for participation and could encourage less serious and capable parties to participate, negating, to some extent, the rationale for introducing bid bonds. ▶ Where ARENA seeks capable, sophisticated funding recipients, the case for bid cost reimbursement is weaker; the case for bid bonds is stronger. The converse would likely apply if ARENA was offering small research grants in relation to an emerging technology.
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Findings

Participants considered that the use of bid bonds was sensible, encouraged serious, capable bidders and appropriate bidder behaviours. It gave bidders more confidence to participate and spend money on development and connection activities during the process. The quantum was not excessive so was not built into the grant funding requested.

The quantum of bid cost reimbursement was considered reasonable but could potentially negate the use of bid bonds as vetting process. Participating in competitive processes is a cost of doing business so bid cost reimbursement should be offered with caution.

Recommendations

- ▶ Assess requesting bid bonds or offering bid cost reimbursement on a case by case basis. Factors to consider include the quantum of the grant, the sophistication and financial capacity of the likely and desired applicants, and technology readiness
- ▶ Use a similar approach to determine the quantum of either in future funding processes

5.1.4.4 Other feedback

The following questions were considered in this section:

- ▶ Do you have any other feedback regarding the appropriateness of the competitive round funding process?

Stakeholder consultations revealed that:

- ▶ Collaboration between CEFC and ARENA was beneficial and could be enhanced in future processes
- ▶ The Competitive Round supported projects to become as bankable as possible
- ▶ Some assessment systems and documents requested could be improved

These findings are explored further in the table below.

Other feedback provided additional insights with respect to stakeholder collaboration, bankability and assessment systems.

<p>Collaboration with CEFC and other participants</p>	<ul style="list-style-type: none"> ▶ Overall, there was productive collaboration between CEFC and ARENA, due to the close physical proximity of the offices and the open approach that was adopted to discuss issues together. ▶ CEFC was heavily involved in reviewing early drafts of the Funding Agreement which was discussed with both ARENA and lawyers. ▶ However, CEFC expressed that there could have been more opportunities for formal collaboration between ARENA and CEFC as the two parties were siloed and operated separately but concurrently. An example provided was developing a partnership with CEFC to work together where a debt financing opportunity could be beneficial. ▶ It was also suggested that as there is no new funding for ARENA, it may be beneficial to find other ways of utilising grant funding more effectively, such as partnering with another agency with confidentiality in place. ▶ Participants also considered ARENA to be open, responsive, capable, and generally well-resourced during the Competitive Round process as well as during delivery of the projects. One participant identified some communication and collaboration breakdown during negotiations to the extent that the contract closing process became fractious. However, this was an exception and the relationship has been rebuilt subsequently which reflects ARENA's ability to establish and manage relationships.
<p>Bankability of projects</p>	<ul style="list-style-type: none"> ▶ Debt financiers believed that the projects were bankable, irrespective of the grant funding, as projects were becoming de-risked considerably from getting offtake agreements, development approvals and the overall reduction of costs. ▶ Some participants reflected that the Competitive Round was the ideal grant program because it supported projects so they could be as bankable as possible, allowing parties to operate commercially with limited reliance on grant funding. ▶ Considering project MLF forecasts was particularly challenging for ARENA and CEFC when evaluating projects. The number of successful projects and their size was unexpected and so MLF assumptions made in forecasts submitted by projects were usually quite different from the actual MLFs. This affects projects revenues and feasibility but continues to be a challenge when evaluating renewable energy projects.
<p>Plans and systems</p>	<ul style="list-style-type: none"> ▶ There was a criticism of the portal that ARENA used for submission of responses. Participants produced responses in Word format and pdf, but these documents could not be submitted on the portal. Participants felt that the system should have supported the types of documents that respondents would need to prepare and submit for assessment. ▶ Participants queried whether submitting Australian Industry Participation (AIP) plan was necessary or valuable. The projects were seen to support the labour market's knowledge and experience in large-scale solar but, given the large-scale solar market is dominated by international players, having to prepare and submit an AIP plan felt like a bureaucratic "tick-box exercise".

Findings

ARENA established collaborative relationships with CEFC and other market participants during the Competitive Round process and during project delivery. The grant funding supported the bankability of projects though some bankability issues such as MLF remain a challenge in the market. The portal that was used to receive bidders' funding applications was inflexible and difficult for participants to use.


Recommendations

- ▶ Consult with CEFC to a greater extent during the program design process
- ▶ Consider partnering with CEFC to approach the market as a combined ARENA/CEFC team
- ▶ As there is no new funding for ARENA, consider opportunities to formally partner with other agencies to use what remains of ARENA's \$2 billion investment mandate more effectively through greater and more open collaboration, for example by undertaking joint or co-ordinated funding with other agencies similar to the co-funding approach taken with the South Australian Government under the Grid Scale Storage Fund
- ▶ Application submission methods should be able to support the types of formats that market participants typically use when preparing submissions.

5.2 Effectiveness and appropriateness of ARENA's management of the LSS

5.2.1 Key findings and observations

Management of the LSS Program has been competent

Appropriate governance and contract management systems	Capable and responsive ARENA personnel	Rigorous and well-structured assessment process
		
<p>Monitoring and reporting was appropriate to ensure proper expenditure of funds</p> <p>Contract management structures were consistently applied</p>	<p>The program was resourced with capable, responsive and experienced personnel</p> <p>Staff turnover and transition was managed well</p>	<p>Sophisticated and thorough assessment process undertaken and high-quality projects selected</p> <p>Timeframes for financial close were compressed but extensions granted to meet emerging connection challenges</p>

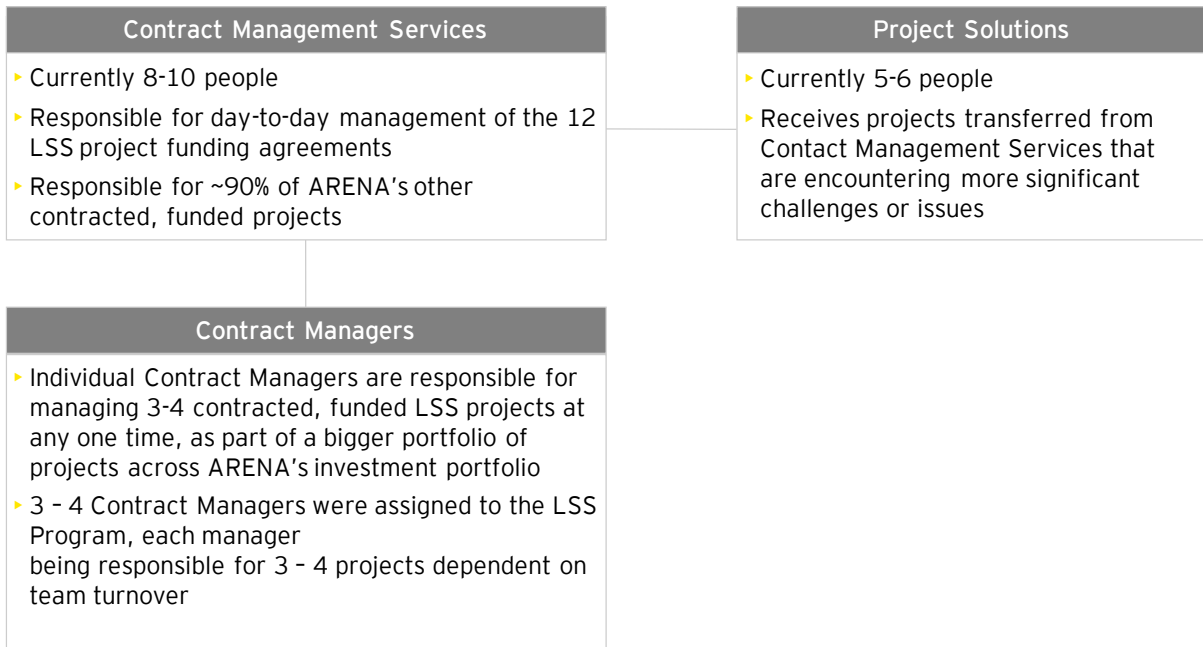
Funding agreement development could have been improved in some respects

- Vet project documentation in advance of program launch**
 - ▶ Market-test commercial principles to ensure their acceptability (eg intercreditor, and knowledge sharing obligations)
 - ▶ Align due diligence and reporting requirements with those of financiers
- Adopt a risk-based approach to funding withdrawal delegations**
 - ▶ Consider grant funding quantum and the existence of debt financier scrutiny in determining appropriate delegations
 - ▶ Adopt a risk-based approach to funding withdrawal delegations
- Make knowledge sharing insights more accessible and timely**
 - ▶ Adopt a more targeted approach to developing knowledge sharing requirements
 - ▶ Consider how insights can be better located, promoted and communicated in a more timely manner

5.2.2 Management process overview

The LSS Competitive Round was run over the period 2015 to 2017. Projects have been commissioned over the course of 2017 to 2019. For projects that have been commissioned, knowledge sharing obligations continue until 3 years post-commissioning. Given the program has spanned several years, there have been some internal ARENA governance changes which have influenced how the funding agreements have been managed. However, the structure has typically involved several personnel being assigned a few projects which they are individually responsible for managing.

A high-level overview of the current structure, which has been in place since July 2017, is shown in the diagram below. The Contract Management Services (CMS) team is responsible for day-to-day management of the 12 funding agreements. The CMS team assumed responsibility for managing funded projects once a grant funding agreement was signed. ARENA's Grant Management System (GMS) is used to track grant expenditure on the projects. Projects encountering troubles are transferred to the Project Solutions team for more intense monitoring. As at 30 June 2019, no Competitive Round projects have been transferred to Project Solutions.



The funding agreements for the LSS projects contained provisions to ensure the:

- ▶ Appropriate withdrawal and expenditure of ARENA grant funds
- ▶ Ongoing financial capacity of the funding recipient and its ability to deliver the relevant funded project

The key mechanisms to ensure the above were various conditions precedent and monitoring and reporting provisions.

Table 5 shows the types of conditions precedent and their purposes.

Table 5: Conditions precedent

Funding Conditions Precedent (FCP)	Initial Conditions Precedent (ICP)	General Conditions Precedent (GCP) & Ongoing Conditions Precedent (OCP)	
<p>Description</p> <p>FCPs to be met before ARENA would deposit grant funds into the bank account set up for the project (ARENA Financial Close).</p>	<p>Description</p> <p>ICPs to be met to:</p> <ul style="list-style-type: none"> ▶ Achieve Project Financial Close ▶ Permit the drawdown of funds ▶ Entitle funding recipient to the return of any bid bonds provided 	<p>Description</p> <p>GCPs and OCPs to be met in order to entitle the funding recipient to withdraw funds from the bank account</p>	
<p>Example FCPs</p> <ul style="list-style-type: none"> ▶ Evidence of a bank account being opened ▶ Substantial final draft project documents ▶ Equity commitment letters ▶ Project financial model ▶ Knowledge sharing plan 	<p>Example ICPs</p> <ul style="list-style-type: none"> ▶ Executed project documents and various legal, technical and commercial due diligence reports ▶ Risk management and community consultation plans 	<p>Example GCPs</p> <ul style="list-style-type: none"> ▶ A Withdrawal Request in relation to project costs to be funded by grant funds and debt contributions ▶ Evidence that funds withdrawn would not exceed the project bank account balance ▶ Evidence that grant and debt funding to be withdrawn would be deposited into the recipient's construction proceeds account 	<p>Example OCPs</p> <ul style="list-style-type: none"> ▶ An unqualified Independent Certifier certificate from the Independent Certifier confirming that project costs to be funded from a withdrawal were properly incurred and payable ▶ Confirmation the Cost to Complete Test was satisfied and the commissioning date would likely occur as planned ▶ Updated legal or financial documents if required

Source: funding agreements provided by ARENA to EY

Figure 11 shows the key monitoring and reporting processes.

Figure 11: Monitoring and reporting obligations



Source: funding agreements provided by ARENA to EY

5.2.2.1 Knowledge sharing

The following questions were considered in this section:

- ▶ Is the Knowledge Sharing element an effective way to gather knowledge, insights and data for the advancement of the broader solar industry in Australia?
 - ▶ Is it achieving its objectives of sharing knowledge and lessons learnt with the broader market?
 - ▶ How can it be improved?

Stakeholder consultations revealed that:

- ▶ Knowledge sharing is generally effective though its benefits could be further improved
- ▶ Participants valued informal knowledge sharing more than formal knowledge sharing due to its timeliness, ability to provide participants with networking opportunities and a forum to share views on sensitive issues
- ▶ Improvements in the timeliness and format of knowledge sharing, and ARENA's approach to requesting knowledge, would be beneficial.

These findings are explored further in the tables below.

Knowledge sharing is generally effective though its benefits could be further improved.

<p>Formal knowledge sharing avenues</p>	<ul style="list-style-type: none"> ▶ Participants acknowledged that knowledge sharing is an important element of ARENA's mandate and helps disseminate market intelligence, information on topical issues and processes, and solutions to challenges encountered. ▶ They recognised that ARENA has published lessons learned regarding construction and grid connection. This is regarded as beneficial. However, the timeliness and format of such knowledge sharing and approach to requesting knowledge could be improved. ▶ Participants considered they prepare a great deal of formal knowledge sharing collateral but that the insights they communicate are no longer topical or relevant by the time the information is published. Market participants are likely to have already encountered and navigated the challenges before the knowledge sharing is published. ▶ The primary beneficiaries of formal knowledge sharing are likely to be the public, market regulators and new market entrants who are seeking to enter the industry. ▶ Further, formal knowledge sharing that is published is hard to locate on ARENA's website and participants do not have time to review the reports in the format in which they are published.
<p>Knowledge sharing requirements</p>	<ul style="list-style-type: none"> ▶ Participants indicated that the EOI and funding agreement had a lengthy list of knowledge sharing requirements, reflecting a "catch all" position. Participants did not consider this approach efficient or practical. ▶ Some requirements were so contentious that ARENA issued a revised funding agreement to capture the feedback it had received during negotiations to address participants' concerns. Participants considered that this sort of engagement should have been undertaken earlier in the process to minimise time and cost incurred during the negotiations phase. ▶ Potentially, these issues could be minimised if ARENA modified its approach to developing its knowledge sharing requirements. More upfront thought and planning should be given to what ARENA really needs to elicit from the knowledge sharing process. ▶ While acknowledging this can be difficult because ARENA and participants cannot foresee the topical issues where knowledge sharing will be most beneficial, participants considered that initial planning regarding what ARENA seeks to achieve from the knowledge sharing could improve the effectiveness of knowledge sharing in future. ▶ One participant cited ARENA's approach to knowledge sharing requirements on a battery storage project as exemplary in that requirements were targeted, practical and practicable. The timing of knowledge sharing reports was known in advance, staged appropriately and provided in a timely manner. For example, a report was required shortly after grid connection, construction completion and operations commencement. It was suggested that a similar framework for other programs may be workable.
<p>Informal knowledge sharing</p>	<ul style="list-style-type: none"> ▶ Participants viewed informal knowledge sharing as more valuable to them than the formal knowledge sharing arrangements. ▶ Informal knowledge sharing was seen to help de-risk projects as participants began sharing insights regarding the major commercial risks associated with large-scale solar projects, particularly in relation to process and connection issues. ▶ Participants considered that the workshop with AGL and FRV enabled AGL and FRV to impart knowledge, experiences and lessons learned with shortlisted participants who were new to the market, and unfamiliar with the NEM and solar development and processes in Australia. The workshop helped develop market knowledge and helped participants avoid some pitfalls which would otherwise have caused delay or increased cost. ▶ The LSS Funding Round also stimulated informal networking in the market, which helped participants establish relationships and an understanding of how to successfully navigate Australian regulatory and development processes. ▶ Participants noted that ARENA collected some information (such as complaints) in an anonymous way, which facilitated more open communication with bidders. ▶ While participants appreciated the knowledge sharing workshops that ARENA organised, participants considered that there could have been more workshops at regular intervals with structured agendas. For example, ARENA could schedule several meetings during the year. Agendas could be provided prior to the meetings and topics could cover common or high-impact issues of which ARENA is aware from holding the monthly Project Review Meetings.
<p>Knowledge sharing with other parties</p>	<ul style="list-style-type: none"> ▶ Participants observed that other parties have also benefited from knowledge sharing processes. These include AEMO, CEFC, Network Service Providers (NSPs), Original Equipment Manufacturers and the public. ▶ For example, one participant encountered issues relating to inverter product issues and negotiating grid connection with AEMO and NSPs. The participant shared these issues and solutions with others and those participants were better able to navigate similar problems. ▶ ARENA has shared beneficial lessons learned during the process have been shared with AEMO and CEFC. Feedback indicates information shared has played, and continues to play an

Knowledge sharing is generally effective though its benefits could be further improved.

	<p>important role in improving the parties' understanding of the market, its development and trends.</p>
<p>Areas for improvement or continued emphasis</p>	<ul style="list-style-type: none"> ▶ Participants recalled that the CEC and CEFC attended a couple of workshops and this was beneficial. Participants considered that, particularly, the CEFC, could attend more workshops, and play a more active role. ▶ ARENA did not play a role in connecting developers with EPC contractors or inverter manufacturers. Some participants considered that ARENA could have expanded its role through facilitating introductions. This could have supported developing market maturity particularly given there were so many new market entrants at the time. ▶ Knowledge and experiences from the Competitive Round have been, and continue to be, beneficial to market participants, regulators and other government agencies. Participants urged ARENA to continue producing knowledge sharing materials, while improving the timeliness of their publication and considering how best to communicate the insights. Topics of current interest could include lessons learned relating project operations, curtailment and system strength. ▶ Some participants were aware that ARENA published information and knowledge sharing reports but found the information difficult to locate on ARENA's website. ARENA could reconsider the way it publishes knowledge sharing information, both in terms of where the information is located and promoted on its site, and the format of the publications.
<p>Improving cost transparency</p>	<ul style="list-style-type: none"> ▶ Most stakeholders considered that there are knowledge sharing limitations with respect to sharing cost information. They mentioned that EPC and O&M are unlikely to be transparent with project sponsors and that participants were less inclined to openly share information or data relating to project costs due to its commercially sensitive nature. ▶ While complete cost transparency is unlikely achievable, participants suggested potential methods to improve sharing information on costs. For example, participants considered that interviews might be a better way of eliciting cost or other sensitive information. This includes obtaining information regarding mistakes participants might have made as they learn about the development process or how to handle interpersonal issues that might arise with regulator personnel. ▶ Participants observed that they are likely to be less guarded during interviews or through other means (e.g. surveys) where information is anonymised, than in formal written reports where personal and company names may be attributed. ▶ Participants found the published capex and opex data useful as a market reference point to understand market pricing trends but more granularity regarding cost categories would be beneficial to aid cost comparison.

Findings

Participants understood the need for formal knowledge sharing but considered that the timeliness and format of knowledge sharing, and approach to determining knowledge sharing requirements could be improved. Formal knowledge sharing was considered to benefit new market entrants, the public, regulators and other market participants more than program participants. Informal knowledge sharing such as workshops, conferences and seminars were considered more valuable for program participants as it encouraged more open participation.

Recommendations

- ▶ Adopt a more targeted approach to developing knowledge sharing requirements so they elicit information that is relevant to parties for whom ARENA considers the knowledge should benefit
- ▶ Leverage lessons learned from other ARENA programs that are exemplars in setting knowledge sharing requirements (such as ARENA's battery storage program)
- ▶ Ensure that knowledge sharing requirements are timely, targeted, practical and practicable
- ▶ Hold more informal knowledge sharing workshops, implement a structured timeline and agenda process for these workshops, and include involvement from parties such as AEMO, CEFC or NSPs
- ▶ Consider introducing anonymous surveys or Chatham House Rules interviews to encourage participants to share important insights to which they may not want to be attributed
- ▶ Consider alternative and more efficient methods of publishing knowledge sharing information
- ▶ Consider how insights could be better located, promoted and communicated on ARENA's website

5.2.2.2 Effective communication with participants

The following questions were considered in this section:

- ▶ How effective was the communication of the funding process by ARENA to participants?

Stakeholder consultations revealed that:

- ▶ Communication from ARENA throughout the process was clear, open and effective
- ▶ ARENA personnel were responsive, competent and strongly engaged with participants

These findings are explored further in the table below.

Communication throughout the Competitive Round process was open and effective.

Strong engagement with the participants

- ▶ ARENA engaged clearly and actively with participants before the Competitive Round launch, during the process and continues to engage with participants throughout delivery and operations.
- ▶ For example, ARENA consulted with market participants prior to launching the LSS Competitive Round in relation to the timing and development of projects to ensure that project requirements could realistically be met by the market.

Communication throughout the Competitive Round process was open and effective.

	<ul style="list-style-type: none">▶ ARENA organised a lessons learnt workshop with shortlisted participants and FRV and AGL, who were successful participants funded prior to the Competitive Round). Participants found this workshop useful and it likely supported shortlisted participants' ability to submit higher quality Full Applications.▶ Stakeholders indicated there was a steady flow of Requests for Clarification submitted during the Competitive Round process, suggesting strong participant interest and engagement in the process.▶ One participant identified some communication and collaboration breakdown during negotiations (see section 5.1.4.4), however, this was an exception and the relationship has been rebuilt subsequently which reflects ARENA's ability to establish and manage relationships.
ARENA communication	<ul style="list-style-type: none">▶ Participants regarded ARENA personnel involved in the Competitive Round process as responsive and competent.▶ Participants said that ARENA personnel were available to answer questions and fostered open communication with participants. This supported a strong understanding of Competitive Round requirements and is likely to have ensured few low-quality applications were received.

Findings

ARENA's communication of the funding process to participants was clear, active and responsive. ARENA consulted with participants prior to program launch, and engaged with participants throughout the application process and during project delivery. Relationships established were generally collaborative. Where relationships deteriorated, these have been rebuilt over time.

Recommendations

- ▶ Continue to resource programs with similar calibre personnel
- ▶ Share the positive feedback with ARENA personnel (within the program and beyond) to encourage continued strong performance and build similar performance in other teams

5.2.2.3 Assurance, governance and contract management

The following questions were considered in this section:

- ▶ How effective are the assurance and governance structure arrangements throughout the LSS lifecycle?
- ▶ Are the contract management, monitoring and reporting arrangements effective?

Stakeholder consultations revealed that:

- ▶ ARENA's assurance and governance processes were consistently applied
- ▶ Some logistical challenges were encountered in meeting withdrawal request requirements
- ▶ Monitoring and reporting requirements were adequate and not overly burdensome
- ▶ ARENA was confident that funds had been spent for Project Purposes

These findings are explored further in the tables below.

ARENA assurance and governance processes were effective and consistently applied.

<p>Objective approach to withdrawals</p>	<ul style="list-style-type: none"> ▶ The Competitive Round design objective aimed to remove the perception that the provision of ARENA grant funding was discretionary as this would have had impacted adversely debt financing appetite and financing cost. ▶ Accordingly, the process adopted for funding withdrawals was objective (through being based on IC certification) and did not allow for funding be clawed back unless funding recipients failed to comply with their knowledge sharing obligations. Financiers viewed this as an easy obligation for funding recipients to meet, and it was an important metric for ARENA to retain to support achievement of the program objectives.
<p>Consistent reporting across projects</p>	<ul style="list-style-type: none"> ▶ Funding recipients submitted Monthly Project Review Reports (Monthly Reports) to ARENA. Shortly thereafter, ARENA would hold a monthly meeting to discuss project progress and any issues that appeared in the Monthly Reports. ▶ Through this process, ARENA noted that it had identified some issues that could be raised with other participants to help other participants navigate challenges or avoid technical issues. ▶ Some participants were surprised at the high-level nature of the discussions and thought that ARENA would have shown more direct interest in project progress, through site visits or greater interrogation of financial reports. ▶ This observation is particularly relevant in respect of projects that did not receive debt finance. Where debt finance was provided, ARENA could achieve more comfort that the financiers were performing adequate due diligence on project costs and the recipient's financial stability. Where only grant funding and equity contributions were covering project costs, the need ARENA to undertake more detailed review of financial information provided would be greater.
<p>Staff turnover was managed well</p>	<ul style="list-style-type: none"> ▶ Participants noted a few occasions where contract managers assigned to their projects were redeployed with ARENA or resigned from ARENA. Participants observed that transition from the outgoing ARENA contract manager to the incoming contract manager was smooth. ▶ Arrangements implemented to ensure smooth transition and minimal loss of project knowledge were that the new contract manager attended some project review meetings prior to becoming fully responsible for the project. This allowed project knowledge to be transferred over time.

Some logistical challenges were encountered in meeting withdrawal request requirements.

<p>Logistical challenges</p>	<ul style="list-style-type: none"> ▶ All participants observed that there were logistical challenges involved in meeting the requirements for funding withdrawal requests though suggestions for improvements varied across participants. Changes to delegations, engaging with participants on appropriate timeframes and having single withdrawals for project-financed transactions were common suggestions. ▶ Once EPC providers submitted invoices, these had tight timeframes for payment. (One participant indicated that payment had to be made within 5 business days.) The funding agreements typically gave ARENA 5 days to review and sign-off on a funding Withdrawal Request submitted by a participant to pay EPC provider claims. ▶ While the internal approval documentation required was easy to prepare, because the bank account signatory authorisations were personal to the ARENA CEO and CFO, ARENA personnel found it challenging to obtain sign-offs within the 5-day timeframe, particularly when the CEO and/or CFO were on leave or travelling.
<p>Delegations and downstream contracting requirements</p>	<ul style="list-style-type: none"> ▶ Though ARENA said there were few instances where sign-offs could not be obtained within the specified timeframes, personnel considered that a risk-based approach to delegations could be adopted in future so that lower-level personnel could be approved as bank account signatories. This feedback echoes comments made in Jan Harris' <i>Future Needs of the Australian Renewable Energy Agency: Final Report</i>⁶¹ which suggests that the CEO's Delegation and senior APS staff delegations are set at quite low monetary thresholds and may present "a challenge to ARENA's ability to meet its objectives". (Since approximately 2017, ARENA has adopted a risk-based approach to delegations.) ▶ Potentially, understanding participants' downstream contracting and payment arrangements could help to ensure that timeframes specified under those documents can be met. If possible, EPC providers could be asked to offer longer payment terms to allow for internal ARENA sign-offs to be procured. ▶ However, given ARENA met most of the challenging timeframes imposed upon it, any solution adopted to ease the challenges associated with meeting withdrawal request timeframes would

⁶¹ Jan Harris, *Future Needs of the Australian Renewable Energy Agency: Final Report*, 28 April 2017, p.17 [Confidential].

Some logistical challenges were encountered in meeting withdrawal request requirements.

need to be tempered with the need for ARENA to retain its responsiveness and ability to provide rapid approvals.

Monitoring and reporting was adequate and not overly burdensome.

Frequency and type of reporting

- ▶ Participants considered the frequency of monthly reporting and meetings was appropriate to keep abreast of project progress.
- ▶ In respect of financial reporting requirements, some participants considered that quarterly financial reporting was too onerous. They suggested that a risk-based approach to reporting could be adopted that would consider the quantum of funding provided and the riskiness of the projects.
- ▶ While this observation may have merit, most participants considered that the monitoring and reporting requirements (including the requirement to provide quarterly, half-yearly and annual accounts financial reports) were appropriate and not too onerous. Save for knowledge sharing reports, similar reports are required by their internal governance protocols as well as by their financiers at similar intervals. As such, ARENA reporting requirements imposed minimal additional administrative burden upon funding recipients.
- ▶ Participants acknowledged that a potential improvement would be to better align reporting requirements with the financiers' reporting requirements to avoid some duplication.

Template reports

- ▶ Views varied regarding whether the requirements for specific monthly reports or knowledge sharing reports was well understood. Typically, funding recipients developed their own reporting formats. Depending on whether ARENA accepted the recipient's approach, the recipient would retain the format or make modifications.
- ▶ Some participants considered that providing template report formats with indicative requirements would have helped participants meet their reporting requirements more accurately.

ARENA was confident that funds had been spent for Project Purposes.

Funds expended for Project Purposes

- ▶ The Independent Certifier (IC) certified project invoices and reviewed EPC obligations to ensure that project funds were being spent appropriately. IC certifications were a necessary condition precedent to withdrawing grant funds.
- ▶ However, participants noted that ARENA's requirements added an additional layer of administration when a financier already required such documentation to ensure appropriate withdrawal and expenditure of funds. It may be beneficial in future to better align debt and grant funding requirements to reduce duplicative administration.

Findings

ARENA established similar governance and funding agreement management protocols for each project to ensure a consistent approach to program delivery. Processes relating to withdrawing funds were objective and supported bankability. Meeting withdrawal request timeframes was sometimes challenging due to ARENA's internal delegations and bank authorisations being personal to the ARENA CEO and CFO. Staff turnover was managed well to ensure smooth transition and minimal knowledge loss. Monitoring and reporting was generally considered to be reasonable and appropriate, particularly where projects were wholly funded by grant and equity funding.

Recommendations

- ▶ Retain ARENA's current risk-based approach to delegations so that lower-level personnel can be approved as bank account signatories to facilitate prudent but expeditious withdrawal request approvals
- ▶ Where participants secure debt financing, ARENA should align its reporting requirements more closely with the debt financier's requirements to minimise the administrative burden for participants
- ▶ Subject to the recommendation above, consider developing monthly reporting and knowledge sharing templates to provide guidance to participants and enhance reporting consistency

5.2.2.4 Application and selection process

The following questions were considered in this section:

Application and selection process

- ▶ Was the application process (two-step process) suitable for this type of funding program?
- ▶ Was the selection process suitable and transparent for this type of funding program?
- ▶ Were the objectives of the program and selection criteria well understood by funding applicants and selectors?
- ▶ Is the application and selection process sufficiently flexible to account for a broad range of funding applications?

Stakeholder consultations revealed that:

- ▶ The two-stage EOI and Full Application process was suitable and worked well
- ▶ Participants understood the program's objectives and requirements well
- ▶ Involving ARENA in a project financing process added complexity due to due diligence requirements, and interactions with multiple parties

These findings are explored further in the tables below.

The EOI / Full Application process worked well for the projects.

<p>Suitability of the two-stage process</p>	<ul style="list-style-type: none"> ▶ The Competitive Round process was considered appropriate given the objectives of the Competitive Round and the types of projects that ARENA was seeking. This meant that the program likely achieved greater value for money than if applicants had individually submitted their projects. ▶ There was a clear group of similar technologies to facilitate competition and comparison between projects. There were clear milestones included in the requirements, which meant that funding applicants had to compete on timing and deliverability, not only for grant funding. ▶ Having a two-stage process meant that early stage projects could submit funding applications and continue project development work to meet more rigorous requirements at Full Application stage. This kept the process open to a wider market, piquing market appetite and encouraging investment.
<p>Transparency and understanding of objectives</p>	<ul style="list-style-type: none"> ▶ ARENA's expectations of participants were made clear upfront, particularly with respect to aspects such as the amount of funding available, the program objectives and quantity of MW required to be eligible for funding. ▶ Feedback from stakeholder consultations indicated that the objectives of the Competitive Round were well understood. During consultations, participants repeated objectives such as cost reduction, development of knowledge and expertise in the large-sale solar market and reduction of barriers to renewable energy uptake. They also understood the importance of knowledge sharing as part of ARENA's mandate. ▶ Participants also considered that the requirements of the Competitive Round process were clear and well communicated to the market, and that the assessment criteria and application requirements were well understood. ▶ Documentation ARENA issued was concise and clear. One participant recalled that ARENA issued a short (less than 10 page) document which comprehensively described what was required of successful projects. This enabled the participant to structure its proposal to directly respond to ARENA's requirements. ▶ Stakeholders considered that there was a standard spread in the quality of the responses received. This suggested that requirements were well understood and resulted in reasonable to high-quality responses, and few low-quality responses.
<p>Flexibility to accommodate projects</p>	<ul style="list-style-type: none"> ▶ Participants generally found that the application requirements accommodated their projects well. However, one observation was that the grant funding ended up primarily funding projects in Queensland and New South Wales. Victoria was under-represented in the list of successful projects. ▶ That appears to have been a function of the methodology ARENA adopted, prejudicing southern NEM states, potentially as a result of focussing on the LCOE benchmark rather than impact on the grid more broadly. ▶ Potentially, this issue could have been mitigated through adopting additional assessment metrics (see section 5.1.3.1).
<p>Rigour of assessment process</p>	<ul style="list-style-type: none"> ▶ Participants considered that the Competitive Round process was rigorous. ARENA engaged leading consultants across technical and financial workstreams to support the assessment. Participants observed that they were asked detailed questions in relation to, for example, tax structuring and technologies used. This gave participants confidence that the assessment process was well run, and undertaken carefully and rigorously. ▶ The projects that were selected all successfully reached Financial Close by May 2017 indicating high-quality projects were ultimately selected. ▶ There was some confusion on ARENA's part in relation to how other government programs interacted with projects submitted in the Competitive Round process. For example, some participants submitted their projects in the Queensland Solar 150 reverse auction process. Some feedback suggested that during the Competitive Round assessment, ARENA unnecessarily focussed on risks relevant under the Solar 150 program which were irrelevant to the project economics under the Competitive Round, and should not have been taken into account.
<p>Negotiations process</p>	<ul style="list-style-type: none"> ▶ Participants considered that the negotiations process could be improved and streamlined for future funding processes. ▶ Participants considered that ARENA resourcing for the negotiations process was sufficiently skilled and experienced. The funding agreement was also designed to remove ARENA's discretion to withhold grant funding and reduce ARENA's rights to claw back grant funds save for where recipients did not meet their knowledge sharing obligations. Participants acknowledged this to be an appropriate commercial position to support bankability. ▶ However, while CEFC reviewed the funding agreement prior to its release to bidders, participants recalled that negotiations regarding the tripartite deed were highly contested.

The EOJ / Full Application process worked well for the projects.

	<p>Knowledge sharing obligations were also contested to such an extent that ARENA issued a revised funding agreement with updated requirements more palatable to funding recipients.</p> <ul style="list-style-type: none"> ▶ Further, while monitoring and reporting obligations were generally considered appropriate, participants felt that these obligations could be better aligned with the requirement of financiers to avoid duplication. ▶ Participants suggested that greater upfront vetting of documentation with CEFC and the market prior to the commencement of the process would have been beneficial. Participants considered that upfront market engagement would likely have ensured the commercial position ultimately presented to the market was acceptable, streamlined negotiations and increased process efficiency.
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Involving ARENA in a project financing process adds complexity.

<p>Complex due diligence</p>	<ul style="list-style-type: none"> ▶ Participants understood the need for ARENA to undertake rigorous due diligence to ensure the proper expenditure of grant funds. ▶ However, participants considered that this added complexity to project finance transactions as due diligence requirements differed between CEFC, ARENA and commercial banks. ▶ Elements of this process could potentially be streamlined in future by ARENA aligning: <ul style="list-style-type: none"> ▶ Its own due diligence processes with financiers' due diligence processes ▶ Its reporting and funding withdrawal requirements with financiers' requirements. ▶ Where projects are funded solely off a funding recipient's balance, ARENA would need to have more rigorous due diligence and reporting requirements.
<p>Interactions with financiers</p>	<ul style="list-style-type: none"> ▶ Negotiations in relation to some project financing areas were challenging and protracted. The tripartite deed was the most contested aspect of project documentation. ARENA and debt financiers sought to agree the order in which equity, debt and grant funds were withdrawn and expended. Negotiations were particularly difficult if CEFC, ARENA and a commercial bank were seeking to agree priorities. ▶ These arrangements could potentially be streamlined in future through CEFC and ARENA better aligning themselves on arrangements prior to the documents being released to participants.
<p>Downstream contracting</p>	<ul style="list-style-type: none"> ▶ There were a range of ARENA requirements that needed to be passed through to downstream contractors such as the Independent Certifier and the EPC contractor. This added complexity to IC and EPC arrangements and created some complex practical arrangements.
<p>Tax structuring</p>	<ul style="list-style-type: none"> ▶ One participant noted that ARENA grant funds are taxable, and this creates a tax structuring challenge for parties which creates additional cost in determining how to minimise their tax liability. ▶ A better approach would be to have an intergovernmental arrangement under which the grant funds are deemed not taxable. The participant considered this would minimise the need for project expenditure on tax advice.

Findings

The Competitive Round process was considered appropriate given the objectives of the LSS Funding Round and the types of projects ARENA was seeking. There was clear group of similar technologies to facilitate competition and comparison between projects. The program's objectives and requirements were clearly communicated to participants, so they could prepare well-conceived responses. The process was perceived as being rigorous and well-run given the involvement of third party advisers and the detailed nature of questions asked.

However, the evaluation metrics seemed to favour projects based in Queensland and NSW (possibly due to the focus on the LCOE benchmark), which disadvantaged projects in other jurisdictions. The negotiations process was protracted as project documentation presented to participants and financiers was not initially commercially acceptable.

Recommendations

- ▶ Consider additional evaluation criteria that support broader grid stability and reliability objectives
- ▶ Undertake greater upfront engagement with CEFC and the market on commercial terms to ensure that project documentation is more likely to meet market risk appetite
- ▶ Better align ARENA's due diligence processes and reporting requirements with those of financiers to streamline administrative requirements

6. Conclusions

ARENA funding for the LSS Funding Round has contributed to the development of depth and expertise in the Australian large-scale solar industry and reduced large-scale solar technology costs, though it is one of several contributing factors. Government initiatives supporting the development of renewables such as Commonwealth and State renewable energy targets, state government programs and CEFC funding have also supported growth in large-scale solar investment.

ARENA's LSS Funding Round has contributed to the advancement of local skills, capacity and knowledge in the broader market through knowledge sharing and accelerated project pipeline development. The program has also boosted confidence in the commercial bank sector, and has improved the ability of large-scale solar projects to obtain debt finance. Partly through the influx of projects following a similar time trajectory, the Competitive Round has exposed broader system issues such as grid connection delays and MLF reductions that may have occurred at some point due to the higher penetration of renewable generation in the system.

The analysis conducted in respect of the Competitive Round process demonstrates that the intended outcomes of the process were achieved. The Competitive Round process was an effective funding mechanism given the economic climate at the time and the readiness of large-scale solar technology. The Competitive Round also allowed ARENA to adopt a common framework across projects, which achieved a common risk allocation across projects and some contract management efficiencies. Given these factors, a competitive process was a more effective mechanism than an individual application process would have been.

The Competitive Round projects have demonstrated price discovery and transparency through publication of project cost information, and projects were able to improve upon the targeted LCOE benchmark of \$135/MWh. Through the Competitive Round process, market players gained confidence in the large-scale solar' commercial viability and in its ability to compete with wind. Projects prior to the Competitive Round have also played a significant role in developing the industry by achieving their intended outcomes, with those projects often establishing a "blueprint" for those to follow.

The Competitive Round process was effectively managed throughout the application and assessment phases. The negotiations phase was adequately resourced but there were some contested elements of project documentation and challenging timeframes for achieving Financial Close. This indicated that there are opportunities to improve how these processes proceed in future.

6.1 Key findings

The following table provides a summary of the key findings from the program analysis performed.

ARENA's Competitive Round - Findings

Market characteristics pre-Competitive Round versus post-Competitive Round

- ▶ Analysis of the market characteristics of large-scale solar in Australia reveals the rapid growth of the LSS PV industry since the Competitive Round on both a state and national level, in terms of expansion of accredited and installed capacity, increase in number of projects, and widening of market supply.
- ▶ Total forecasted capacity in the NEM, which encompasses existing, committed or proposed projects, has increased from 1,373MW prior to the Competitive Round in May 2015 to 7,922MW in December 2017, around the timing of Financial Close achieved by LSS Competitive Round projects. By May 2019, the forecast increased to 27,463MW, including 22,530MW of capacity either committed or proposed.
- ▶ Queensland is now Australia's leading state with 63% of accredited solar PV capacity in 2018.

ARENA's Competitive Round - Findings

<p>Cost reduction and competitiveness with other technologies</p>	<ul style="list-style-type: none"> ▶ Declining values for large-scale solar LCOE and implied WACC assumptions demonstrate the technology has become competitive with other commercially viable forms of power generation in Australia, such as wind and pumped hydro. ▶ Globally, costs of utility-scale solar PV were on the decline, but the magnitude of this change between Australia and China (from 111% in 2015 to 20% in 2016) is greater than for all other countries in the analysis, and implies there were country specific factors in Australia contributing to this total cost reduction. ▶ Declining balance of system cost in Australia has driven the narrowing cost differential over China in recent years, and we can expect ARENA funding to have the greatest impact on balance of system costs as they are country specific, as opposed to modules which are priced at an international level. ▶ A major component of the balance of system cost is soft costs (i.e. administration costs), but determining the net impact of ARENA funding on soft costs is difficult given the context of recent issues reported by stakeholders around time delays resulting from the grid connection process. While the Competitive Round may have precipitated this issue earlier than it would otherwise have materialised by accelerating investment in renewables, the program has been instrumental in enabling market participants to resolve these issues, through knowledge sharing materials and workshops.
<p>LCOE, price discovery and transparency of Competitive Round projects</p>	<ul style="list-style-type: none"> ▶ All 12 LSS projects in the Competitive Round bid below the LCOE benchmark of \$135/MWh. This represented a significant discount to the \$186/MWh LCOE benchmark set in 2014 at the ACT Renewables Auction. ▶ The LCOE benchmark focussed attention of the market on risk management and decreasing costs across the whole value chain. ▶ Price discovery is evident through the reduction in overall projected project cost and min-max spread of bids between EOJ and Financial Close. ▶ The Competitive Round has provided transparency and price discovery through publishing project cost data, but its usefulness for proponents and impact on forecast costs has been limited by the rapidly decreasing cost climate of large-scale solar and the broad nature of published cost categories.
<p>Impacts for projects prior to the Competitive Round</p>	<ul style="list-style-type: none"> ▶ Combined, the ARENA funded projects outside of the Competitive Round achieved the intended outcomes. ▶ The ARENA funded projects prompted industry development and cost reduction through knowledge and skills transfer from proponents to the local labour market, and development of a solar industry supply chain. ▶ The AGL project provided academic research infrastructure and developed intellectual property in solar generation through its partnership with the University of Queensland and the University of New South Wales. ▶ The ARENA funded projects also shared key project learnings and implications for future projects, focused on technical elements of project delivery, through the knowledge sharing reports published on the ARENA website.
<p>Broader impacts and unintended consequences for the LSS projects</p>	<ul style="list-style-type: none"> ▶ The advancement of local skills, capacity and knowledge of broader market participants, including EPC contractors, NSPs and AEMO has been key to the development of the large-scale solar industry in Australia. This has developed experience and capacity across the supply chain to develop and provide technology suited to Australian requirements. ▶ Project sponsors' abilities to obtain finance has improved as commercial bank confidence in the commercial viability of large-scale solar technology has strengthened. The LSS projects and Competitive Round have encouraged the global flow of capital to Australia and helped reduce the strike price of synthetic PPAs, supporting the development of the corporate PPA market. ▶ Unintended consequences have arisen partly from the influx of projects following a similar time trajectory, although some of the issues that have arisen may have occurred at some point due to the higher penetration of renewable generation in the system. The analysis suggests that the co-ordinated nature of the Competitive Round helped the market identify solutions and better navigate process challenges through ARENA's knowledge sharing materials and workshops.
<p>Competitive Round as a funding mechanism</p>	<ul style="list-style-type: none"> ▶ The Competitive Round was an effective funding mechanism given the economic climate and the readiness of solar PV technology at the time. Through offering grant funding, ARENA stimulated investment appetite and attracted global developers, EPC and O&M providers to the Australia market. The influx of investors contributed to further reducing solar technology costs (which were already trending down), created market competition and accelerated development of the large-scale solar PV pipeline. The Competitive Round process also allowed ARENA to adopt a common framework across projects, which achieved

ARENA's Competitive Round - Findings

	<p>a common risk allocation across projects and some contract management efficiencies. Given this context, a competitive process was a more effective mechanism than an individual application process would have been.</p> <ul style="list-style-type: none"> ▶ ARENA engaged with the market and CEFC to some extent prior to program launch to test concepts such as process timing and commercial principles for the funding agreement. Requiring bid bonds and engaging third party advisers to support the assessment process facilitated robust assessment and the selection of high-quality projects. ▶ Aspects of a funding round which could be enhanced in future include greater collaboration with CEFC, other agencies and the market to ensure the acceptability of commercial principles and identify alternative methods of deploying remaining ARENA grant funding. Consideration of additional assessment metrics such as the impact of a project on grid stability and reliability could support greater geographical diversity and potentially less grid congestion.
Management of the Competitive Round	<ul style="list-style-type: none"> ▶ ARENA has competently managed the LSS Funding Round throughout the application process and project delivery phases. It has employed adequate systems to ensure the appropriate expenditure of public funds, and capable personnel to manage the process while creating collaborative relationships with funding recipients. ▶ There is room to improve some processes under funding agreements. Adopting a risk-based approach to delegations may have eased the logistical challenges associated with approving grant funding withdrawal requests. While ARENA consulted with CEFC to some extent on the funding agreement's development, intercreditor priorities and knowledge sharing obligations were contentious during negotiations. Greater market-testing of documentation prior to the program's launch may have supported greater acceptability of project documentation. Further, a more strategic approach to developing knowledge sharing requirements and publishing formal knowledge sharing may be beneficial to ensure funding recipients know and comply with their obligations, and that topical information is shared in a timely manner.

6.2 Recommendations

The following table sets out recommendations to consider when designing and implementing future grant funding programs. Not all recommendations will be relevant and applicable to every future funding program, but they may provide a foundation for improving collaboration, processes, and program outcomes depending on the parameters of future ARENA grant funding programs.

ARENA's Competitive Round - Recommendations

Effective achievement of objectives	<ul style="list-style-type: none"> ▶ Increased focus on assessment criteria other than a project's LCOE or funding gap is desirable to achieve greater geographical diversity and support grid stability and reliability in the NEM. ▶ The value to the market of capex and opex data could be improved through increased data granularity and categorisation. ▶ Liaising more with AEMO prior to program launch, and potentially considering a staged approach to offering grant funding, may have alleviated some of the delays encountered in projects achieving grid connection.
Leveraging lessons learned	<ul style="list-style-type: none"> ▶ This report provides recommendations which ARENA can leverage to support the success of future funding programs (also presented in this table).
Competitive Round versus alternative funding mechanisms	<ul style="list-style-type: none"> ▶ When designing a funding program, ARENA should retain its existing procedures which assess market and technology readiness to determine whether a Competitive Round or individual application process is suitable.
Timing	<ul style="list-style-type: none"> ▶ Ensure sufficient time and resourcing is allocated to ensure extensions of time for assessment or reaching Financial Close are not required. ▶ To streamline negotiations, undertake greater consultation with the market and CEFC to ensure that project documentation is commercially palatable.

ARENA's Competitive Round - Recommendations

Bid bonds and bid cost reimbursement	<ul style="list-style-type: none"> ▶ Assess whether bid bonds or bid cost reimbursement is worthwhile on a case by case basis. (Factors to consider include (inexhaustively) the quantum of the grant, the sophistication and financial capacity of the likely and desired applicants, and technology readiness). ▶ Use a similar approach to what was used in the Competitive Round to determine the quantum of bid bonds or bid cost reimbursement in future funding processes.
Other feedback	<ul style="list-style-type: none"> ▶ Consult with CEFC to a greater extent during the program design process. ▶ Consider partnering with CEFC to approach the market as a combined ARENA/CEFC team. ▶ As there is no new funding for ARENA, consider opportunities to formally partner with other agencies to use what remains of ARENA's \$2 billion investment mandate more effectively through greater and more open collaboration. ▶ Application submission methods should be able to support the types of formats that market participants typically use when preparing submissions.
Knowledge sharing	<ul style="list-style-type: none"> ▶ Adopt a more strategic approach to developing knowledge sharing requirements so they are aimed at eliciting information relevant to program outcomes. ▶ Leverage lessons learned from other ARENA programs that are exemplars in setting knowledge sharing requirements (such as ARENA's battery storage program). ▶ Ensure that knowledge sharing requirements are targeted, practical and practicable. ▶ Hold more informal knowledge sharing workshops, implement a structured timeline and agenda process for these workshops, and include involvement from parties such as AEMO, CEFC or NSPs. ▶ Consider introducing anonymous surveys or Chatham House Rules interviews to encourage participants to share important insights to which they may not want to be attributed. ▶ Consider alternative and more efficient methods of publishing knowledge sharing information, for example developing summary reports, slide-packs or video tutorials that highlight the key insights from a number of projects at similar stages and attach detailed knowledge sharing reports, similar to how ARENA reports on outcomes to knowledge sharing workshops. ▶ Consider how insights could be better located, promoted and communicated on ARENA's website, for example modify the knowledge bank website so that the information provided can be sorted in additional ways, including by funding program, media type, and key issues.
Communication with participants	<ul style="list-style-type: none"> ▶ Continue to resource programs with similar calibre personnel to those deployed for the Competitive Round. ▶ Share the positive feedback with ARENA personnel (within the program and beyond) to encourage continued strong performance and build similar performance in other teams.
Assurance, governance and contract management	<ul style="list-style-type: none"> ▶ Adopt a risk-based approach to delegations so that lower-level personnel can be approved as bank account signatories to facilitate prudent but expeditious withdrawal request approvals. ▶ Where participants secure debt financing, ARENA should align its reporting requirements more closely with the debt financier's requirements to minimise the administrative burden for participants. ▶ Subject to the recommendation above, consider developing monthly reporting and knowledge sharing templates to provide guidance to participants and enhance reporting consistency.
Application and selection process	<ul style="list-style-type: none"> ▶ Consider additional assessment criteria that support broader grid stability and reliability objectives. ▶ Undertake greater upfront engagement with CEFC and the market on commercial terms to ensure that project documentation is more likely to meet market risk appetite. ▶ Better align ARENA's due diligence processes and reporting requirements with those of financiers to streamline administrative requirements.

Appendix A Evaluation plan: evaluation questions and analytical framework

The evaluation applied a mixed-methods approach designed to address 26 evaluation questions and to analyse the various sources of data available. A mixed methods approach is a methodology for conducting research and evaluation that involves collecting, analysing and integrating quantitative and qualitative data and information in a single study.

The purpose of this approach is that both qualitative and quantitative research, in combination, provide an opportunity to address evaluation questions from a number of perspectives and minimises the presence of 'gaps' in the information and data collected.

The evaluation focused on the following key elements:

- ▶ Impact of the LLS portfolio (i.e. the effectiveness of the funding of ARENA's LSS portfolio of projects)
- ▶ Process evaluation of:
 - ▶ Competitive round as a funding mechanism (i.e. the efficiency and effectiveness of the funding mechanism)
 - ▶ ARENA's management of the LSS portfolio (i.e. the appropriateness and efficiency of ARENA's management)

Impact of ARENA's LSS portfolio of projects

The impact evaluation approach focused on determining whether the intended outcomes of the funding program were achieved. The following questions were used to evaluate the impact of the Competitive Round and projects that were not part of the Competitive Round:

Table 6 - Impact evaluation questions for the Competitive Round

Effectiveness	<ul style="list-style-type: none"> ▶ Has the Competitive Round demonstrated the ability to deliver a large-scale solar PV project at a cost below the Competitive Round levelised cost of electricity (LCOE) benchmark of A\$135/MWh? What was the impact/flow-on effect? ▶ Has the Competitive Round further reduced the cost of large-scale solar PV and successfully provided a clear path for the technology to become competitive with other commercially viable forms of power generation in Australia (including wind power)? <ul style="list-style-type: none"> ▶ To what extent can the cost reductions that have been achieved in the sector be attributed to ARENA's LSS Competitive Round? ▶ To what extent has ARENA's LSS Competitive Round accelerated reductions in LCOE? ▶ Has the Competitive Round provided transparency and price discovery in relation to current and projected costs of large-scale solar PV through the sharing of forecast and actual costs of both successful and unsuccessful projects on an anonymous basis? <ul style="list-style-type: none"> ▶ Has there been an impact on forecast costs? ▶ What are the characteristics of the large-scale solar PV sector in Australia now compared with the characteristics of the large-scale solar PV sector in Australia prior to the Competitive Round?
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Table 7 - Impact evaluation questions for projects not part of the Competitive Round

Effectiveness	<ul style="list-style-type: none"> ▶ Were the ARENA-funded large-scale solar projects that were not part of the Competitive Round successfully deployed? <ul style="list-style-type: none"> ▶ Were their intended outcomes achieved? Intended outcomes were: <ul style="list-style-type: none"> ▶ Develop a large-scale solar industry in Australia ▶ Provide research infrastructure (AGL-only) ▶ Develop and share technical and economic knowledge from the program
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	<ul style="list-style-type: none"> ▶ What flow-on effect or impact did they have? ▶ What other broader benefits, impacts (e.g. learnings to the market, industry, system operator) and unintended consequences have been realised as a result of ARENA funded projects?
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Analytical framework

The following analytical approach was undertaken to answer the evaluation questions outlined above:

- ▶ Undertook financial analysis of the cost of large-scale solar projects (LCOE), and disaggregated cost analysis to address first two impact evaluation questions for the Competitive Round. Different cost categories are likely to have been affected in different ways by the program. For example, we understood that it is unlikely that ARENA funding at a utility scale would influence manufacturing costs for PV modules and inverters, as much of the capital equipment is generally imported. We used a disaggregated approach to assess whether the Competitive Round further reduced the cost of large-scale solar PV:
 - ▶ Identified cost categories with likely highest impact from ARENA's funding program - we expected these were construction (or EPC) costs, and potentially system and other project costs
 - ▶ Undertook analysis of these cost categories of both ARENA-funded and non-ARENA funded projects to determine how they have changed over time, specifically from prior to ARENA's funding of large-scale solar, to now, as well as trend over this time period
 - ▶ Undertook comparative analysis of these cost categories in Australia and overseas jurisdictions with no (or little) government support to estimate the impact of ARENA's funding. This was informed by secondary data analysis of cost curves for LSS. This was supplemented by comparative analysis of other indicators, including size, and speed of growth of the LSS market in Australia and overseas
- ▶ Undertook analysis of historical costs trends and forecasts of LCOE in Australia to estimate the impact of the Competitive Round on forecast costs. Analysis considered both comparison of forecasts of LCOE included in funding proposals to ARENA with actual realised costs, as well as cost trends over time
- ▶ Undertook desktop research and analysis of the LSS market to compare characteristics of the market prior to the LSS Competitive Round and other ARENA funded LSS projects to now. This was used to estimate broader impacts of the LSS portfolio on the market and whether the intended outcomes of the LSS Competitive Round were achieved. Key measures included:
 - ▶ Number of market participants
 - ▶ Number and installed capacity of LSS PV
- ▶ Identified the flow-on effects, broader benefits and impacts of the Competitive Round and other ARENA-funded LSS projects to the market through the sharing of technical and economic knowledge. Undertook qualitative analysis of the flow-on effects, through stakeholder consultation with project proponents and key industry stakeholders. These involved learnings around connection process, GPS requirements and broader industry knowledge and understanding of solar integration with other energy sources

Process Evaluation

The process evaluation focused on evaluating:

- ▶ The effectiveness and appropriateness of the Competitive Round as a funding mechanism, and
- ▶ The effectiveness and appropriateness of ARENA's management of the LSS portfolio.

The following process evaluation questions were used to evaluate these:

Table 3 - Process evaluation questions to evaluate the Competitive Round as a funding mechanism

Effectiveness	<ul style="list-style-type: none"> ▶ Has the Competitive Round been an effective and efficient way of maximising achievement of outcomes? This includes the process for awarding funds, approvals and contract management. ▶ To what extent did the Competitive Round leverage lessons learnt from ARENA's large-scale solar projects that preceded the Competitive Round?
Appropriateness	<ul style="list-style-type: none"> ▶ Was the use of a Competitive Round compared with other potential procurement mechanisms appropriate as a means to generate competitive tension? ▶ Was the LSS Competitive Round administration costs appropriate? ▶ Was the Competitive Round process timing appropriate? ▶ Was the LSS Competitive Round implemented on time and on budget? ▶ Was the application process and selection process implemented on time? ▶ Is the use of bid bonds or bid cost reimbursement for final stage applicants be appropriate in further driving reduction in cost of solar PV? <ul style="list-style-type: none"> ▶ Should these mechanisms continue to be used in future funding programs? ▶ If so, would it be value for money ARENA? ▶ Do you have any other feedback regarding the appropriateness of the Competitive Round funding process?

Table 4 - Process evaluation questions to evaluate ARENA's management of the LSS

Effectiveness	<ul style="list-style-type: none"> ▶ Is the Knowledge Sharing element an effective way to gather knowledge, insights and data for the advancement of the broader solar industry in Australia? <ul style="list-style-type: none"> ▶ is it achieving its objectives of sharing knowledge and lessons learnt with the broader market? ▶ How can it be improved? ▶ How effective was the communication of the funding process by ARENA to participants? ▶ How effective are the assurance and governance structure arrangements throughout the LSS lifecycle? ▶ Are the contract management, monitoring and reporting arrangements effective?
Appropriateness	<ul style="list-style-type: none"> ▶ Application and selection process <ul style="list-style-type: none"> ▶ Was the application process (two-step process) suitable for this type of funding program? ▶ Was the selection process suitable and transparent for this type of funding program? ▶ Were the objectives of the program and selection criteria well understood by funding applicants and selectors? ▶ Is the application and selection process sufficiently flexible to account for a broad range of funding applications?

Analytical framework

The following analytical approach was undertaken to answer the evaluation questions outlined above:

- ▶ Process evaluation of the Competitive Round as a funding mechanism:
 - ▶ Reviewed outcomes of the Competitive Round in terms of financial outcomes, and feedback from funding applicants on the process

- ▶ Desktop comparison of the Competitive Round against other funding mechanisms in terms of likely ability to achieve value for money and other objectives of the ARENA LSS Funding Round
- ▶ Reviewed the Competitive Round process to identify to what extent lessons learnt from funding of LSS projects that preceded the Competitive Round were addressed
- ▶ Process evaluation of ARENA's management of the LSS
 - ▶ Reviewed the application process, including consideration of time to complete, resource requirements and cost for applicants to respond
 - ▶ Reviewed the selection process, including selection criteria, time, and communication with applicants
 - ▶ Reviewed the grant process, including the approval process, contract management, process for awarding funds
 - ▶ Reviewed the assurance and governance structure in place throughout the LSS lifecycle to assess the effectiveness of the reporting and governance arrangements
 - ▶ Assessed the effectiveness of reporting arrangements for monitoring program performance and ongoing contract management, including reviewing frequency of reporting, information captured in reporting templates
 - ▶ Reviewed Knowledge Sharing element of the LSS, including both at the project and portfolio level. This entailed:
 - ▶ Information and data captured by ARENA via a combination of knowledge sharing reports and alternative methods of communication between ARENA and funding recipients (e.g. inhouse forums)
 - ▶ Timing and frequency of information and data provided by funding recipients
 - ▶ Use of information and data by industry

Appendix B Consultations and interview guides

Interviews

Interviews formed a large part of the data gathering required for the process evaluation. The purpose of the interviews was to gather in depth information and supplement desktop research, particularly relating to the process evaluation questions with a range of stakeholders.

EY undertook a total of 10 interviews of 1 hour each. The stakeholder interviews were with a range of:

- ▶ Key ARENA project managers
- ▶ Successful and unsuccessful project proponents - Manildra Solar Farm Pty Ltd, APT Pipelines Limited, Genex Power Limited, NEOEN Australia and Gannawarra Solar Farm Pty Ltd
- ▶ Key industry stakeholders - AEMO, CEC, NAB and Allens

Survey

Further to the interviews, a survey was used to supplement feedback received and confirm any views uncovered in the interviews and to capture a broader range of respondents.

Interview guides

The following interview guide questions relate to the stakeholder interview with ARENA project managers.

The Competitive Round - issue of EOI through to negotiation
<p>We understand the objectives of the Large-scale Solar Program are to: reduce the cost of renewable energy, increase the value delivered by renewable energy, improve technology readiness, reduce barriers to renewable energy uptake and increase relevant skills, capacity and knowledge.</p> <ul style="list-style-type: none">▶ In comparison to other procurement approaches (e.g. project participants approaching ARENA for funding on an individual basis), how effective was the Competitive Round at achieving these objectives?▶ Are there other ways that ARENA could support the achievement of these aims?▶ What are the broader benefits of the ARENA funded projects, aside from industry cost reduction? <p>The Competitive Round was a two-stage EOI / Full applications process.</p> <ul style="list-style-type: none">▶ What elements of the process worked well in your view?▶ What could be improved for subsequent processes?▶ Do you think information released after EOI stage regarding opex and capex costs supported increased competition between applicants and / or improved de-risking of projects?▶ Did you work on any of ARENA's previous large-scale solar projects and, if so, are you aware of any lessons from those previous projects that were adopted for the Competitive Round? <p>There were a couple of long gaps in the Competitive Round timetable: 6 months between the opening of Full Applications to their closing; up to 3 months between Full Applications closing and Offers to Negotiate being issued.</p> <ul style="list-style-type: none">▶ Was it beneficial to afford applicants 6 months to prepare their applications?▶ Could these timeframes be shortened in future? <p>We are keen to hear your views on how the evaluation governance structures (including the involvement of advisers) supported or hindered the evaluation process.</p> <ul style="list-style-type: none">▶ Were there elements of the funding process, eligibility or merit criteria that applicants did not understand well, did not respond to well, or that you think could be improved for subsequent processes?▶ Was the information requested from applicants sufficient and relevant to enable assessment of the applicants?▶ Did the internal materials (e.g. presentations and evaluation plan) adequately help you prepare for, and perform the evaluations?▶ Was there sufficient experience, and the right mix of skills and experience on the evaluation panel to make the most appropriate decisions? In your response, please also consider how external advisors were involved throughout the process. <p>Moving to approvals:</p> <ul style="list-style-type: none">▶ Did you encounter any challenges or delays in obtaining internal approvals to shortlist projects, announce successful projects or issue Offers to Negotiate?

- ▶ Was the timing for achieving internal approvals reasonable in your view?
Let's discuss negotiations regarding the funding agreement.
- ▶ How did you find the negotiations process with ARENA? (Consider timeframe for completion, who drove negotiations, level of expertise, collaboration between recipients, debt provider etc.)
- ▶ Were there particularly contentious areas under the funding agreement?
- ▶ In your view, did ARENA demonstrate sufficient experience and resourcing to support negotiations?
- ▶ How effective was collaboration between ARENA, debt providers, the funding recipient and legal advisers during negotiations through to Contract Close and Financial Close?
- ▶ Was there any part of the negotiations process that you believe could have been improved?

Delivery and management of projects

We understand bid bonds were used to incentivise project participants to reach Financial Close, and bid cost reimbursement was provided to unsuccessful parties.

- ▶ Were any concerns raised by applicants in relation to providing bid bonds or the amount of the bid bonds?
Under the Funding Agreements, Project Review Groups are established, ARENA must ensure Withdrawal CPs are satisfied and sign funding Withdrawal Requests, review monthly Project Review Reports, ensure recipients provide appropriate Compliance Certificates each quarter, among other responsibilities.
- ▶ How would you describe the level of compliance by the project counterparties with the agreement's processes and requirements?
- ▶ In your view, are the obligations imposed under the funding agreements sufficient and adequate, too onerous, or are there areas for improvement?
- ▶ In your view, has ARENA allocated sufficient and adequately experienced resources to carry out its responsibilities effectively and within timeframes specified in the funding agreement? (Consider processes associated with Withdrawal Requests, satisfaction of Withdrawal CPs.)
- ▶ Would enabling lower-ranking ARENA personnel to act as signatories to the bank account have supported a more efficient drawdown process? What monetary thresholds would be appropriate in your view for a GM level person to authorise?

We understand there were robust financial reporting requirements. Monthly reports, quarterly, half-yearly and annual reports as well as submission of audited financial statements, and certifications from the IC as to the appropriate expenditure of funds.

- ▶ Was this a reasonable level of reporting or do you think that this created unnecessary administration?
- ▶ Can you suggest areas for improving monitoring and reporting of financial and project milestones?

Knowledge Sharing is an important element of the LSS Funding Round.

- ▶ Was the knowledge sharing associated with these projects an effective way to gather knowledge, insights and data for the advancement of the broader solar industry in Australia?
- ▶ Did it inform forecasts costs?
- ▶ Did it have any impact on projected timing to reach key milestones?
- ▶ To what degree have learnings from the market, industry and system operators been critical in stimulating the solar PV market in Australia? This may involve learnings around connection process, GPS requirements and general solar integration with other energy sources.
- ▶ In your opinion, have there been any unintended consequences as a result of the ARENA funding? For example, creation of backlog of approvals, grid congestion and/or other impacts.
- ▶ If so, could anything be done differently in future funding rounds to mitigate this?
- ▶ Were there any other benefits and/or limitations of the knowledge shared, or improvements you can suggest?

Internal ARENA funding

Funding and resources required to run competitive processes are important.

- ▶ Are there areas (not already mentioned) that you consider would contribute to reduced internal program administration costs?

The following interview guide questions relate to the stakeholder interview with project proponents.

The Competitive Round - issue of EOI through to negotiation

We understand the objectives of the Large-scale Solar Program are to: reduce the cost of renewable energy, increase the value delivered by renewable energy, improve technology readiness, reduce barriers to renewable energy uptake and increase relevant skills, capacity and knowledge.

- ▶ In comparison to other procurement approaches (e.g. project participants approaching ARENA for funding on an individual basis), how effective was the Competitive Round at achieving these objectives?
- ▶ Are there other ways that ARENA could support the achievement of these aims?
- ▶ What are the broader benefits of the ARENA funded projects, aside from industry cost reduction?

The Competitive Round was a two-stage EOI / Full applications process.

- ▶ What elements of the process worked well in your view?
- ▶ What could be improved for subsequent processes?

During the Competitive Round, ARENA published capex and opex data from the projects. Was the information published useful? Do you think the published information provided price transparency to applicants and drove further competition?

- ▶ Did the published information influence your project cost forecasts?
- ▶ Did it lead to a further reduction in project costs?
- ▶ Could the sharing of information on costs be improved in future? (i.e. Is there a preference for more/less/other information?)
- ▶ Do you think information released after EOI stage regarding opex and capex costs supported increased competition between applicants and / or improved de-risking of projects?

There were a couple of long gaps in the Competitive Round timetable: 6 months between the opening of Full Applications to their closing; up to 3 months between Full Applications closing and Offers to Negotiate being issued.

- ▶ Was it beneficial to afford you 6 months to prepare your application?
- ▶ Was this sufficient time to prepare your application? Could these timeframes be shortened in future?

We are keen to hear your views on how the funding process was run.

- ▶ Did you find that the funding process, the eligibility and merit criteria were clearly communicated to you and that you understood the requirements well? Were there elements that were unclear or could be improved in subsequent processes?
- ▶ Did the process easily support your project, or did you have to modify your project so that it met Competitive Round requirements?
- ▶ To what extent do you think information released after EOI stage regarding opex and capex costs supported increased competition and / or improved de-risking of projects?
- ▶ How did you find the level of interaction with ARENA during the competitive process?
- ▶ Do you have any comments to provide regarding how the evaluation process was performed?

Let's discuss negotiations regarding the funding agreement.

- ▶ How did you find the negotiations process with ARENA? (Consider timeframe for completion, who drove negotiations, level of expertise, collaboration between recipients, debt provider etc.)
- ▶ Were there particularly contentious areas under the funding agreement?
- ▶ In your view, did ARENA demonstrate sufficient experience and resourcing to support negotiations?
- ▶ How effective was collaboration between ARENA, debt providers, the funding recipient and legal advisers during negotiations through to Contract Close and Financial Close?
- ▶ Was there any part of the process that you believe could have been improved?

Delivery and management of projects

We understand bid bonds were used to incentivise project participants to reach Financial Close, and bid cost reimbursement was provided to unsuccessful parties.

- ▶ Did you have any concerns about providing bid bonds or the amount of the bid bonds?
- ▶ Did it increase the amount of grant funding you requested?
- ▶ Did the offer of bid cost reimbursement influence your decision to bid?
- ▶ How did you perceive the value of bid cost reimbursement offered?

Under the Funding Agreements, Project Review Groups are established, ARENA must ensure Withdrawal CPs are satisfied and sign funding Withdrawal Requests, review monthly Project Review Reports, ensure recipients provide appropriate Compliance Certificates each quarter, among other responsibilities.

- ▶ How would you describe the funding agreement's processes and requirements?
- ▶ In your view, are the obligations imposed sufficient and adequate, too onerous, or are there areas for improvement?
- ▶ Was the time required to follow the processes and requirements reasonable? (e.g. did it take too long to get relevant approvals for withdrawals?)
- ▶ In your view, has ARENA allocated sufficient and adequately experienced resources to carry out its responsibilities effectively and within timeframes specified in the funding agreement? (Consider processes associated with Withdrawal Requests, satisfaction of Withdrawal CPs.)

We understand there were robust financial reporting requirements. Monthly reports, quarterly, half-yearly and annual reports as well as submission of audited financial statements, and certifications from the IC as to the appropriate expenditure of funds.

- ▶ Was this a reasonable level of reporting or do you think that this created unnecessary administration?
- ▶ Can you suggest areas for improving monitoring and reporting of financial and project milestones?

Knowledge Sharing is an important element of the LSS Funding Round.

- ▶ Do you think the knowledge sharing regime associated with these projects is an effective way for ARENA to gather and share knowledge, insights and data for the advancement of the broader solar industry in Australia?
- ▶ Do you think it informs projects' planning and forecast costs?

- ▶ Do you think information shared had any impact on your projected timing to reach key milestones?
- ▶ In your view, to what extent have learnings from the market, industry and system operators been critical in stimulating the solar PV market in Australia? This may involve learnings relating to the connection process, GPS requirements and general solar integration with other energy sources, for example.
- ▶ Have there been any unintended consequences as a result of the ARENA funding? For example, creation of backlog of approvals, grid congestion and/or other impacts.
- ▶ If so, could anything be done differently in future funding rounds to mitigate this?
- ▶ Are there any other benefits and/or limitations of the knowledge shared, or improvements you can suggest?
- ▶ How resource intensive was the Knowledge Sharing Plan process?

The following interview guide questions relate to the stakeholder interview with broader market participants.

Broader Program Objectives
<ul style="list-style-type: none"> ▶ In your view, has the Competitive Round contributed to reducing the cost of large-scale solar PV and supported it becoming more commercially viable? ▶ Can you identify any broader benefits of the ARENA funded projects, aside from industry cost reduction? ▶ To what degree have the learnings ARENA provided to the market, industry and system operators been critical in stimulating the solar PV market in Australia? This may involve learnings around connection process, GPS requirements and general solar integration with other energy sources. ▶ Have there been any unintended consequences as a result of the ARENA funding? For example, creation of backlog of approvals, grid congestion and/or other impacts. ▶ If so, could anything be done differently in future funding rounds to mitigate this? ▶ Information provided to us indicates that LSS projects took, on average, 19 months to reach commercial operation from Financial Close and were, on average, 8.5 months behind schedule. Data suggests that grid connection was the largest contributor to delays, in particular, demonstrating the ability to meet Registered Performance Standards. <ul style="list-style-type: none"> ▶ In your view, what contributed to participants' inability to achieve proposed timeframes, and were there things they could have done to address this? (Consider stage of development, knowledge and expertise, resourcing, engagement with AEMO etc) ▶ To what extent do you grid connection delays could be attributed to matters within the recipients' control vis a vis simply being part of the current ▶ Did any project participants approach you to debt finance their Competitive Round projects? ▶ What were the key issues or risks that prevented you from providing debt to the projects? ▶ What were the factors that enabled you to provide debt to the projects? ▶ Did having ARENA as part of the capital structure have a positive, negative or neutral impact on your decision to finance projects? ▶ What specific development thresholds were required to pique your interest? Were there projects which you ruled out specifically because of their development status? If so, why? Could you provide us with some anonymised examples? ▶ In your opinion and having the benefit of hindsight, do you believe the projects that received ARENA funding would have been good candidates for bank finance without ARENA's participation? ▶ Would changes to specific project characteristics have improved your appetite to finance the Competitive Round projects? ▶ Do you think that the Competitive Round has contributed to increased deal flow? How has the Competitive Round contributed to the market's establishment of risk allocation principles, if at all? ▶ Noting ARENA's role in supporting the development of innovative renewable technologies, what strategies could be implemented to help financiers de-risk or become more comfortable with the risks associated with innovative projects or emerging technologies such as battery storage, pumped hydro or solar thermal? Are there particular projects you would / would not finance, and why? ▶ How do you think ARENA can help to develop these emerging technologies? ▶ Knowledge Sharing is an important element of the Competitive Round. In 2016, ARENA published aggregated and anonymised information on opex and capex costs. In your view, has this information and/or subsequent releases of cost information aided price transparency and price discovery relating to current and project costs of large-scale solar PV? ▶ Do you think knowledge sharing associated with the funded projects is an effective way to gather knowledge, insights and data for the advancement of the broader solar industry in Australia?
Delivery and management of projects
<p>Let's discuss negotiations regarding the funding agreement.</p> <ul style="list-style-type: none"> ▶ How did you find the negotiations process with ARENA? (Consider timeframe for completion, who drove negotiations, level of expertise, collaboration between recipients, debt provider etc.)

- ▶ Were there particularly contentious areas under the funding agreement?
- ▶ In your view, did ARENA demonstrate sufficient experience and resourcing to support negotiations?
- ▶ How effective was collaboration between ARENA, debt providers, the funding recipient and legal advisers during negotiations through to Contract Close and Financial Close?
- ▶ Was there any part of the process that you believe could have been improved?

Under the Funding Agreements, Project Review Groups are established, ARENA must ensure Withdrawal CPs are satisfied and sign funding Withdrawal Requests, review monthly Project Review Reports, ensure recipients provide appropriate Compliance Certificates each quarter, among other responsibilities.

- ▶ What were the key requirements to achieve Financial Close? How many of the projects in which you were involved required an executed Offtake Agreement to achieve Financial Close?
- ▶ How would you describe the level of compliance by the project counterparties with the agreement's processes and requirements?
- ▶ In your view, are the obligations imposed sufficient and adequate, too onerous, or are there areas for improvement?
- ▶ In your view, has ARENA allocated sufficient and adequately experienced resources to carry out its responsibilities effectively and within timeframes specified in the funding agreement? (Consider processes associated with Withdrawal Requests, satisfaction of Withdrawal CPs.)
- ▶ Was the time required to follow the processes and requirements reasonable? (e.g. did it take too long to get relevant approvals for withdrawals?)

We understand there were robust financial reporting requirements. Monthly reports, quarterly, half-yearly and annual reports as well as submission of audited financial statements, and certifications from the IC as to the appropriate expenditure of funds.

- ▶ Was this a reasonable level of reporting or do you think that this created unnecessary administration?
- ▶ Can you suggest areas for improving monitoring and reporting of financial and project milestones?

Knowledge Sharing is an important element of the Competitive Round.

- ▶ Do you think the knowledge sharing regime associated with these projects is an effective way for ARENA to gather knowledge, insights and data for the advancement of the broader solar industry in Australia?
- ▶ Do you think it informs projects' forecast costs?
- ▶ Do you think information shared had any impact on your projected timing to reach key milestones?
- ▶ In your view, to what extent have learnings from the market, industry and system operators been critical in stimulating the solar PV market in Australia? This may involve learnings relating to the connection process, GPS requirements and general solar integration with other energy sources, for example.
- ▶ Have there been any unintended consequences as a result of the ARENA funding? For example, creation of backlog of approvals, grid congestion and/or other impacts.
- ▶ If so, could anything be done differently in future funding rounds to mitigate this?
- ▶ Are there any other benefits and/or limitations of the knowledge shared, or improvements you can suggest?
- ▶ How resource intensive was the Knowledge Sharing Plan process?

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