

**INNOVATING ENERGY**  
ARENA'S INVESTMENT PLAN

2017



Australian Government  
Australian Renewable  
Energy Agency

**ARENA**






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Great ideas will fast-track Australia's shift to a low emission economy and make energy services more secure, reliable and affordable for Australian families and businesses.

## Investing in Australia's renewable energy future

At the Australian Renewable Energy Agency (ARENA), we understand that great ideas, successfully applied, will transform Australia's renewable energy future.

Great ideas will fast-track Australia's shift to a low emissions economy and make energy services more secure, reliable and affordable for Australian families and businesses.

Great ideas will spark collaboration, new technologies and ground-breaking research to grow Australia's renewable energy industry.

ARENA's job is to bring the best ideas to life and share knowledge to unlock the potential of Australia's vast renewable resources.

Our funding, knowledge and networks can help bridge the gap between innovation and commercialisation, accelerating Australia's renewable energy future.

### Our Investment Plan

This plan sets out our four investment priorities and explains how to apply for funding. ARENA is looking for the best funding proposals that align with our objectives and investment priorities – this forms part of the merit assessment for our funding programs.

Our Investment Plan builds on the work, achievements and knowledge we have gained to date. It is reviewed and updated as required.

Further funding announcements will be published on our website.

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The 'investment priorities' in this Investment Plan replace the 'investment focus areas' in the 2015-16 to 2017-18 General Funding Strategy

## About ARENA

ARENA aims to accelerate Australia's shift to secure, affordable and reliable renewable energy.

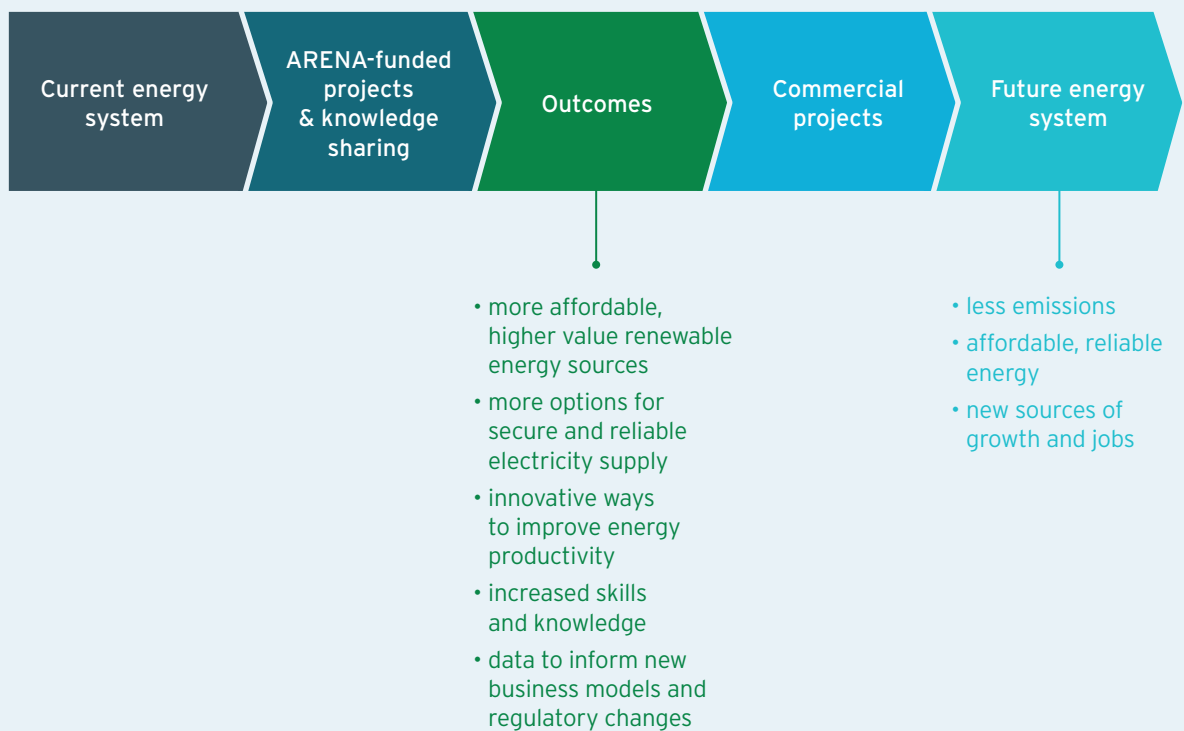
On behalf of the Australian Government, it is our job to find Australia's best renewable energy ideas and connect them with the resources they need to help power the nation's future.

Established on 1 July 2012 by the Australian Renewable Energy Agency Act 2011, ARENA is funded to 2022.

Our Corporate Plan provides context for our overall operations. Our Annual Report sets out our achievements and results.

To find out more about ARENA, go to [www.arena.gov.au](http://www.arena.gov.au)

Figure 1 – Accelerating Australia's shift to an affordable and reliable renewable energy future



## Our investment approach

ARENA is committed to achieving maximum impact and value from the projects it funds, with minimal capital investment.

We fund projects across the innovation chain – from research to pre-commercial deployment. This funding is focused on finding and demonstrating first-of-a-kind renewable energy solutions, which reduce technical and commercial risks and grow Australia's renewable energy knowledge and expertise. Renewable energy solutions include hybrid, related or enabling technologies. This means ARENA may fund solutions, such as storage, demand response, energy efficiency, electrification and fuel switching, where they could help grow the supply of renewable energy in Australia.

We work with project proponents to set the size and nature of funding and scope a project's value – this includes collaborating with industry, researchers and government to achieve specific outcomes that can be replicated for future projects.

By sharing knowledge, we amplify the effect of the projects we fund, driving improvement and adoption of promising renewable energy technologies and business models and, ultimately, putting Australia on a fast-track to a secure, affordable and reliable renewable energy future.

When making funding decisions, we ask:

- **Is the project innovative or novel?**
- **Is there a pathway to commercialisation?**
- **Will the project help unlock future investment?**

### Our funding programs and initiatives

Our Advancing Renewables Program funds renewable energy projects, from desktop studies (including data-focussed projects) through to later-stage innovation and commercialisation projects, led by Australian businesses. This program is always open for applications. We also announce targeted funding rounds under the program as required.

Research support is available through our Research and Development (R&D) Program funding rounds and strategic research initiatives.

Funding rounds will be announced on our website after May 2017, broadening the scope of our work – initially to include energy productivity – and extending our support of promising renewable energy research and commercialisation activities.

These funding mechanisms will enable ARENA to deliver on government priorities such as feasibility studies and demonstration projects for energy storage and funding rounds for advancing concentrating solar thermal and demand response technologies.

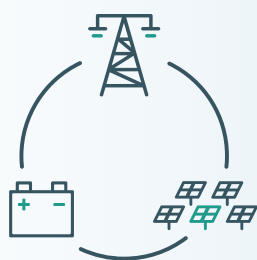
Go to [www.arena.gov.au](http://www.arena.gov.au) for program funding guidelines and to stay informed of funding announcements.

## Our investment priorities

1

### DELIVERING SECURE & RELIABLE ELECTRICITY

Delivering affordable low emission electricity solutions that keep the lights on.



2

### ACCELERATING SOLAR PV INNOVATION

Making solar PV more efficient and affordable through research and development.

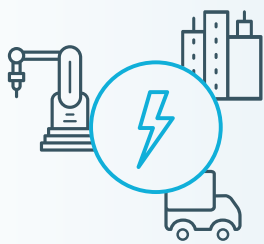




# 3

## IMPROVING ENERGY PRODUCTIVITY

Helping reduce energy cost and emissions in the transport, building and industry sectors.

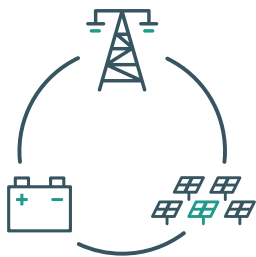


# 4

## EXPORTING RENEWABLE ENERGY

Creating new, scalable export value chains in renewable energy.





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# 1 DELIVERING SECURE AND RELIABLE ELECTRICITY

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By investing in innovative ways to use, store, manage and share renewable energy, ARENA can help provide affordable, secure and reliable electricity for Australians into the future.

Australia's electricity system is changing as ageing fossil fuel generation is retired and more Australians choose to install rooftop solar and other distributed energy technologies such as battery storage. Already, around 1.5 million Australian households have installed rooftop solar to help manage their electricity costs and lower emissions. Renewable energy sources, such as large-scale solar photovoltaic (PV) and wind, have also experienced strong growth, driven largely by the Renewable Energy Target, and have great potential to provide low cost, low emissions electricity for Australia.

Innovation in enabling technologies and new ways of managing the electricity system will allow Australia to shift smoothly to a higher share of renewable energy sources. This will protect the security and reliability of our electricity system, help manage costs and increase the potential for further investment in renewable energy by Australian families and businesses.

## What we want to achieve

ARENA aims to show how integration costs can be reduced and where renewable energy can add value to the electricity system. This will transition the electricity sector to meet or exceed a proportional share of Australia's emissions reduction targets, while minimising costs and maintaining security and reliability.

## What we are looking for

- **New flexible capacity and grid stability technologies (and associated business models) that could balance the electricity system with higher shares of renewable energy, ensuring electricity is available where and when it is needed.**
- **New ways to evolve electricity grids to integrate more distributed energy resources, including solar PV, energy storage and demand management.**
- **Projects that provide knowledge and information relevant to deliberations on energy policy, market rules, regulation or network practices and procedures.**

## Long-term impact

Australia could be using cost-competitive low emissions options to balance and operate the grid from 2020, with a growing contribution to 2030. With better integrated distributed energy, individual energy users may be using distributed renewable energy and

other technologies (such as storage, energy efficiency and demand management) to meet up to half of Australia's electricity needs by 2050, reducing spend on grid infrastructure by as much as \$16B.<sup>1</sup>

## Examples

### Flexible capacity and grid stability

Area of innovation	Example proposals
Technical and commercial pathways for technologies that can provide flexible capacity.	<ul style="list-style-type: none"><li>• Demonstration of lower cost or increased performance of low emissions flexible capacity technologies – such as demand response, pumped hydro, batteries, concentrating solar thermal (CST) with storage, power-to-gas and innovative bioenergy.<sup>2</sup></li><li>• First-of-a-kind commercial arrangements to make technology financeable.</li><li>• Research and development of improved CST components and systems.</li></ul>
Low-cost, more efficient or effective grid services that use low emissions technologies to adapt to new types of generation.	<ul style="list-style-type: none"><li>• First-in-Australia frequency control or synthetic inertia services from wind, solar PV or batteries.</li><li>• New software and novel algorithms for detecting and responding to power system contingencies.</li><li>• New ways to control grid voltage.</li></ul>
Better planning for high-share renewable energy scenarios.	<ul style="list-style-type: none"><li>• Grid modelling, analytics or tools to improve grid planning and inform investment decisions.</li><li>• Knowledge-sharing and consensus-building to identify, inform and resolve broader industry or regulatory issues.</li></ul>

<sup>1</sup> CSIRO and Energy Networks Australia 2016, *Electricity Network Transformation Roadmap: Key Concepts Report*

<sup>2</sup> ARENA requires a life cycle assessment for successful funding applications that involve bioenergy or biofuel projects. Go to [www.arena.gov.au/lca](http://www.arena.gov.au/lca) for further information.

## Integrated distributed energy

Area of innovation	Example proposals
Delivering benefits from distributed renewable energy.	<ul style="list-style-type: none"><li>• New business models or approaches to realise the potential value of distributed energy to reduce grid costs or manage grid stability.</li></ul>
Successful high-share renewable systems.	<ul style="list-style-type: none"><li>• Demonstration of how micro-grids could meet local energy needs, including greenfield housing needs in new suburban areas.</li><li>• Demonstration of improved grid configurations or management techniques to allow more renewable energy to be used where integration issues emerge early.</li></ul>
Improved knowledge and understanding to support integration of distributed renewable energy and grids.	<ul style="list-style-type: none"><li>• Studies that evaluate different types of battery control models (such as DNSP-controlled or user-controlled) and commercial models.</li></ul>

## 2 ACCELERATING SOLAR PV INNOVATION

By supporting ongoing research, development and demonstration, ARENA will help to further drive innovation in solar PV in Australia and internationally.

Australian R&D has helped realise the potential of solar PV as an affordable and competitive source of renewable energy, cascading through global manufacturing supply chains and contributing to the dramatic decline in solar PV costs. It has also created opportunities for export revenue through licensing intellectual property, researcher-industry collaboration, and education.

National large-scale solar PV is on track to achieve price parity with wind power, at least five years earlier than expected. As more solar PV is installed, further cost reductions will make a low emissions electricity system even more affordable in the future.

### What we want to achieve

ARENA aims to make solar PV more affordable and competitive. We want to find further innovations in solar PV and help fulfil the Australian Government's commitment to double clean energy R&D spending by 2020.

### What we are looking for

- **New technologies and tools to reduce installed costs of PV systems, improve system reliability and longevity, and develop materials for new markets or applications.**
- **Opportunities to help Australian businesses translate these ideas into PV manufacturing supply chains.**

### Long-term impact

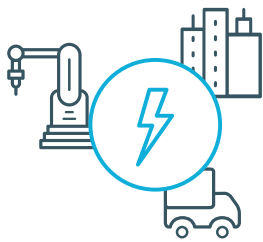
Reducing the cost of solar PV to less than 6c/kWh and appropriate market conditions could see solar PV produce more than 30 per cent of Australia's electricity within 15 years.

Reducing solar PV costs would also make it cheaper to build 'excess' PV capacity, which could be used to charge storage, provide electricity during extended periods of cloudy weather or deliver services to improve grid stability. This would allow solar PV to contribute to the overall reliability and security of electricity supply as the share of variable renewable energy grows.

## Examples

Area of innovation	Example proposals
Increased efficiency and reliability of solar PV cells in converting sunlight to electricity.	<ul style="list-style-type: none"> <li>Improved cell and module efficiency, including in silicon cells, perovskite cells and tandem cells with silicon as a base material.</li> </ul>
More reliable and durable solar PV modules.	<ul style="list-style-type: none"> <li>Low cost and robust module design.</li> <li>Improved encapsulation techniques for emerging PV technologies to address degradation issues.</li> <li>New tools and processes to identify and address defects.</li> </ul>
Reduced balance-of-system costs and improved solar PV operations.	<ul style="list-style-type: none"> <li>Low cost and robust mounting designs and improved manufacturing processes.</li> <li>Reduced lifetime cost in wiring, switches, and inverters.</li> <li>Improved operational and maintenance tools and software.</li> <li>Improved solar forecasting.</li> <li>Solar PV end-of-life management and lifecycle assessment.</li> </ul>
New solar PV materials with potential to unlock new applications of solar PV and/or integration of solar PV with other processes and uses.	<ul style="list-style-type: none"> <li>Development of solar PV into new products for flexible, transparent or other specialised applications.</li> <li>Integration of solar PV into new market areas.</li> </ul>
Translation and commercialisation of Australian R&D into manufacturing supply chains.	<ul style="list-style-type: none"> <li>Researcher-manufacturer collaboration to integrate new ideas, processes and tools into manufacturing operations.</li> </ul>







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## 3 IMPROVING ENERGY PRODUCTIVITY

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ARENA will help improve energy productivity in Australia by supporting replicable, innovative and efficient energy use and adoption of renewable energy across the industry, built environment and transport sectors.

Historically cheap energy prices and ageing industrial infrastructure have hampered energy productivity and adoption of low emissions energy solutions by Australian businesses and families.

To accelerate action in these two areas, the National Energy Productivity Plan (NEPP) set a goal to improve Australia's energy productivity by 40 per cent from 2015-2030. To contribute to the Government's policy in this area, ARENA intends to invest in innovation to improve energy productivity across Australia's industry, built environment and transport sectors.

### What we want to achieve

ARENA aims to help meet – and show the potential to exceed – the NEPP goal by showing how different technologies and approaches (including energy efficiency, electrification and fuel switching to renewable energy sources) could reduce energy use and associated emissions while improving productivity.

### What we are looking for

To the extent proposals relate to ARENA's objectives, we are looking for:

- Accelerated improvements in energy productivity and adoption of renewable energy by industry, particularly applications with a significant share of emissions.
- Innovative building technology and designs to increase energy productivity of the built environment.
- Improved energy productivity in the transport sector, including electrification and fuel switching.
- Opportunities to improve energy productivity and integrate renewable energy by optimising value chains across sectors.

### Long-term impact

New ways to improve energy productivity and address barriers to adoption of associated technologies could increase Australia's energy productivity beyond the NEPP target. Substantially more productive energy use would also help Australia to meet its international emissions reduction targets and grow the economy.

## Examples

Area of innovation	Example proposals <sup>3</sup>
Industry	<ul style="list-style-type: none"><li>• Feasibility studies, demonstrations and pre-commercial deployments integrating energy productivity and renewable energy into manufacturing or other processes, with renewable energy supplied through process electrification or direct thermal input (bioenergy or solar thermal).</li><li>• Information and knowledge-sharing to help decision-making and encourage energy productivity improvements and adoption of renewable energy.</li><li>• Demonstration of how energy productivity and renewable energy solutions could be incorporated into greenfield developments.</li><li>• Application of energy productivity and renewables to displace diesel in mining.</li><li>• Innovative technologies or business models to increase the potential for energy productivity, demand response or electrification (where this could increase renewable energy use).</li></ul>

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<sup>3</sup> ARENA can fund proposals contributing to ARENA's renewable energy objectives. Funding for some aspects of energy productivity is contingent on the expansion of ARENA's technology remit, announced by the Government in March 2016.

Area of innovation	Example proposals <sup>3</sup>
Built environment	<ul style="list-style-type: none"> <li>• Development of building technology and designs with potential to materially improve energy productivity and/or renewables integration.</li> <li>• Demonstration of ways to materially increase building performance above current minimum standards.</li> <li>• Development of techniques to deliver deep energy productivity improvements in the existing built environment.</li> <li>• Demonstration of how energy productivity solutions can be incorporated into urban transformation areas or large parcels of industrial land.</li> <li>• Demonstration of how innovative energy productivity solutions can be incorporated into suburbs, cities or towns.</li> <li>• New ways to control heating, cooling and associated thermal storage to balance variable renewable energy.</li> <li>• Innovative business models for increasing the uptake of renewable energy in buildings.</li> </ul>
Transport	<ul style="list-style-type: none"> <li>• Studies into enablers of electrified transportation, covering areas such as planning, infrastructure requirements, technical, market and commercial issues.</li> <li>• Research, development and demonstration of supply chains, reduced costs and long-term, large-scale production of net zero emission jet, marine and heavy vehicle fuel (whether bio-based or synthetic).</li> </ul>
Value chain optimisation	<ul style="list-style-type: none"> <li>• Feasibility studies and demonstrations of projects to optimise energy productivity across value chains.</li> </ul>

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## 4 EXPORTING RENEWABLE ENERGY

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ARENA will help drive innovation in Australia's renewable export industry and position the industry for long-term growth.

Australia has vast renewable energy resources, good export capabilities and strong relationships with key international markets. As the global economy transitions to low emissions energy, Australia will be well positioned to export renewable energy as primary energy (for example as hydrogen or ammonia) or embodied in processed raw materials.

With the right investment and innovation, Australia will be able to satisfy demand for low emissions energy in countries with limited renewable resources of their own.

### What we want to achieve

ARENA aims to explore opportunities for Australian renewable energy to supply energy-intensive, large-scale export value chains.

### What we are looking for

- Australian innovation in future renewable energy export industries.
- Innovation in technologies to improve cost and efficiency of using renewable energy to supply export value chains.
- Feasibility studies for first-of-a-kind projects that use renewable energy to supply export value chains.

### Long-term impact

A strong renewable energy export industry would create new renewable energy supply jobs in Australia and contribute to the global transition to a low emissions economy, at minimal cost.

Using renewable energy to power the extraction, refining and export of minerals (such as iron and aluminium) and ores (such as lithium and other precious metals) could also help grow the Australian economy. ClimateWorks estimates the value of iron ore mining could grow by 138 per cent by 2050, non-ferrous metal ore mining by 150 per cent and other mineral exports could quadruple.<sup>4</sup>

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<sup>4</sup> ClimateWorks Australia (2014), Pathways to Deep Decarbonisation in 2050: How Australia can prosper in a low carbon world

## Examples

Area of innovation	Example proposals
Improved cost, efficiency and technical or commercial readiness of technologies with renewable energy export potential.	<ul style="list-style-type: none"> <li>• First-of-a-kind projects to incorporate renewable energy at key points in the export process.</li> <li>• Demonstration of renewable production methods for transportable energy storage options (such as hydrogen or ammonia).</li> <li>• Development and demonstration of ways to use renewable energy to process raw materials and resources for export.</li> <li>• Demonstration of on-site production, storage and power generation using renewable hydrogen.</li> </ul>
New business models to integrate renewable energy into export value chains.	<ul style="list-style-type: none"> <li>• Feasibility studies, roadmaps and supply chain analyses that identify opportunities and remove barriers for renewable energy exports.</li> <li>• New networks and platforms that enable rapid sharing of ideas, knowledge and expertise and improve data transparency.</li> <li>• Small-scale, low-cost trials and pilots that are designed to quickly test new processes and products as well as regulatory, commercial or policy approaches.</li> </ul>
Breakthroughs in technologies to produce energy carriers from renewable energy.	<ul style="list-style-type: none"> <li>• Research and development of hydrogen production technologies that show potential in the lab.</li> </ul>



## Before applying for ARENA funding

Our funding is usually provided as a grant. Where a proposal has the potential for significant commercial success, a grant could be recouped or converted to equity or debt if allowed by a Ministerial determination.

### Before applying, applicants should:

1. Consider how the proposal aligns with the investment priorities in this Investment Plan or relevant funding announcements.
2. Consider if the proposal is eligible for a funding program. The eligibility and merit criteria for funding programs are summarised on our website.
3. Review the guidelines for the relevant funding program in full.
4. Consider the potential value of knowledge-sharing from the project.
5. Contact ARENA at an early stage to discuss the proposal and its potential to attract funding from other related sources.

Figure 2 – Supporting innovation and commercialisation



## Related funding sources

### Clean Energy Innovation Fund

ARENA and the CEFC are jointly responsible for operating the Clean Energy Innovation Fund. The Innovation Fund is a \$200 million program available to provide debt and/or equity finance for innovative clean energy projects and businesses which support renewables, energy efficiency and low emissions technologies. Investments from the Innovation Fund will help eligible projects and businesses get to the next stage of commercialisation. The Innovation Fund does not make grants.

Information on the Innovation Fund is available at:

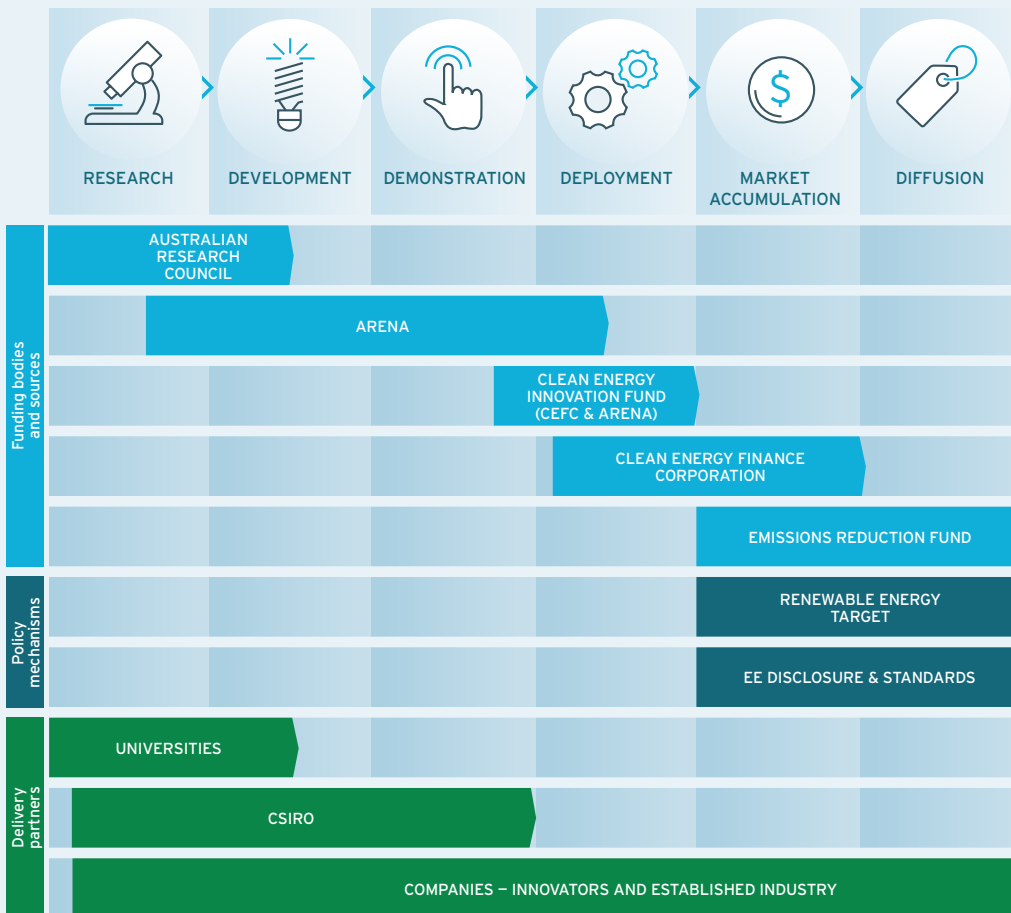
[www.cefc.com.au/innovationfund](http://www.cefc.com.au/innovationfund)

### Southern Cross Renewable Energy Fund

The Southern Cross Renewable Energy Fund is a co-investment between ARENA and Softbank China Venture Capital, managed by Southern Cross Venture Partners Pty Ltd.

[www.sxvp.com](http://www.sxvp.com)

Figure 3 – A partnership across the innovation chain



Further information is available at  
**arena.gov.au**

**Australian Renewable Energy Agency**

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