



An Australian Government Initiative  
Australian Centre for Renewable Energy

**STRATEGIC DIRECTIONS** FOR  
THE AUSTRALIAN CENTRE  
FOR RENEWABLE ENERGY





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**An Australian Government Initiative**  
**Australian Centre for Renewable Energy**

**OFFICE OF THE CHAIR**

ACRE Secretariat  
GPO Box 1564  
Canberra ACT 2601

March 2011

The Hon Martin Ferguson AM MP  
Minister for Resources and Energy  
PO Box 6022  
Parliament House  
CANBERRA ACT 2600

Dear Minister

I am pleased to present to you Strategic Directions for the *Australian Centre for Renewable Energy (ACRE)*. The Strategic Directions provides the design outline of a funding strategy to support the development, commercialisation and deployment of renewable energy and enabling technologies.

A draft version of the ACRE Strategic Directions was released for consultation on 7 December 2010, along with a key issues document posing questions to facilitate focused responses. ACRE received 71 submissions from a range of renewable energy technology stakeholders, including companies, entrepreneurs, industry associations, government agencies and investors. Submissions not provided in confidence are available on the ACRE website at [www.acre.gov.au](http://www.acre.gov.au).

Submissions were generally supportive of the priorities outlined in the consultation draft. Several emphasised the importance ACRE being mindful of the broader policy context for renewable energy in order to encourage an optimal environment for technology development across the innovation continuum.

The ACRE Board was impressed with the high quality of the submissions and wishes to express its gratitude to those who provided such valuable input to the process of developing the Strategic Directions. Working with such a committed group of stakeholders, the Board is confident ACRE will play a key role in the development of renewable energy and enabling technologies in Australia.

Yours sincerely

A handwritten signature in black ink, appearing to read 'Mary O'Kane', with a long horizontal flourish extending to the right.

**Mary O'Kane**

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For further information on the Australian Centre for Renewable Energy and the ACRE Board visit [www.acre.gov.au](http://www.acre.gov.au)

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# THE ACRE BOARD VISION AND MISSION

## **Vision**

National energy markets delivering competitively priced renewable energy sourced from a diverse range of technologies.

## **Mission**

To deliver programs and provide relevant policy advice to move promising renewable energy technologies, products and services through their innovation cycles to commercial competitiveness nationally and internationally for the benefit of Australia.



# THE RENEWABLE ENERGY CHALLENGE

Renewable energy has a vital role to play into the future in Australia's transition to a low-carbon economy. Australia has abundant, diverse natural energy resources and other advantages supporting our potential to generate large volumes of renewable energy at competitive prices, such as extensive and modern energy distribution systems, sophisticated energy markets, and an advanced capacity to finance and build large infrastructure projects.

In addition to this, Australia has some excellent research facilities, strong capability, a highly skilled workforce, and an established record of innovation and technological advancement.

Australia has the potential to capitalise on these advantages and create significant opportunities – jobs and investment flowing from regional economic growth and export potential from a growing global clean energy marketplace.

Even with these advantages, the task of meeting the Government's renewable energy target of 20 per cent by 2020 remains significant given the capital costs of current renewable technologies, the high rate of investment in generation and transmission that is required, and the operational challenges of integrating intermittent sources into our power systems. This target is demanding.

A longer term challenge lies in meeting the Government's goal to reduce carbon emissions by 60 per cent below 2000 levels by 2050. Renewable energy will need to supply a much larger share of total energy use, at substantially lower costs and higher reliability to help meet this target without compromising our prosperity. This will be in the context of significantly higher global and national total energy requirements by 2050.

The task – and opportunity – of delivering decades of future investment in renewable energy will fall to the private sector. However, governments have a critical and enabling role to play in helping to lower barriers to that investment, progress new technologies along the innovation chain, and increase their competitiveness and compatibility with future low-emission fossil fuel sources. Supportive policies and programs developed collaboratively by all Australian governments are essential if we are to attract the required investment in the research, development, demonstration and commercial deployment of renewable energy to establish successful renewable energy ventures that return benefits to Australia.



# ACRE CHALLENGES AND OPPORTUNITIES

The Australian Government has established the Australian Centre for Renewable Energy (ACRE) as a key component of its \$5 billion Clean Energy Initiative to 'promote the development, commercialisation and deployment of renewable energy and enabling technologies and to improve their competitiveness in Australia'.<sup>1</sup>

ACRE has three components:

- an independent, statutory advisory board – the ACRE Board
- a statutory Chief Executive Officer who is an ex-officio member of the ACRE Board
- staff of the Department of Resources, Energy and Tourism

The three components function together to deliver programs and advice for the Australian Government on renewable energy technology development.

ACRE will focus on moving technologies through the innovation chain, illustrated in Figure 1 and Figure 2 below, with the aim of ultimately lowering the cost of energy produced by renewable energy technologies to a point where they are better able to compete with traditional fossil-fuel technologies.



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<sup>1</sup> Second reading speech, 18 November 2009, for the Australian Centre for Renewable Energy Bill 2009.

Figure 1

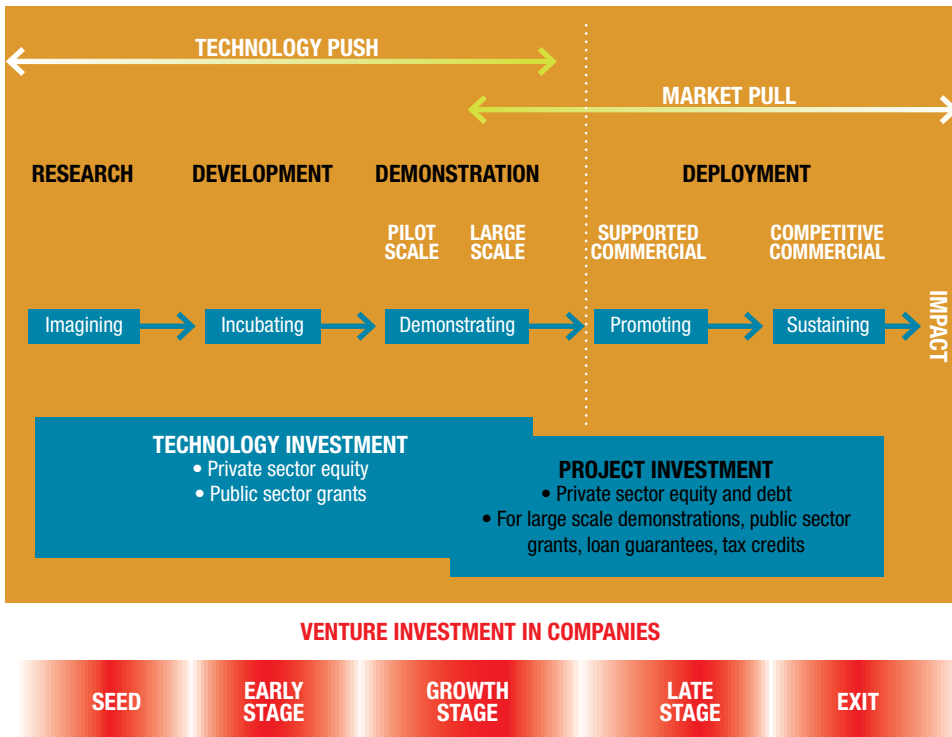


Figure 1: ACRE is focused on supporting renewable energy technology development at the development, demonstration and supported commercial stages of the innovation chain, as government support during these stages can play a crucial role in countering market failures that inhibit the commercialisation of promising technologies.

Figure 2

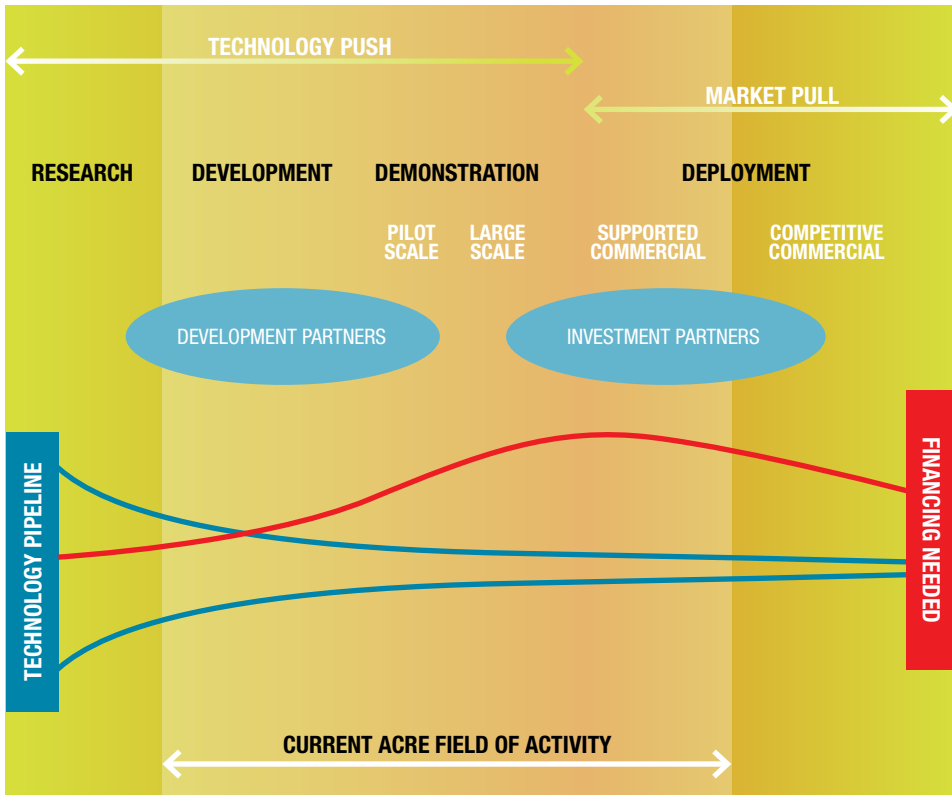


Figure 2: Renewable energy technology pipeline and financing needed along the innovation chain. At the development, demonstration and early deployment stages, there is typically a consolidation of the number of technologies but the financing needed for them to demonstrate their viability through large-scale demonstration projects increases substantially. ACRE proposes to concentrate its funding support at these stages, but in order to identify and effectively support promising technologies it must also form partnerships at the research and commercial deployment ends of the chain. For example, ACRE might consider work undertaken at the development stage through bodies like the Australian Solar Institute, universities and CSIRO as well as in the private sector. At the commercial deployment end, ACRE will engage stakeholders, including strategic investors and generators, to gain broader market awareness of pull-through factors that are likely to contribute to achieving commercial success. These pull-through factors are likely to differ across renewable energy sectors.



ACRE's fundamental challenge is to allocate its limited funding to projects and measures in an emerging industry which is characterised by:

- diverse technologies and processes
- high capital costs
- long timeframes for project development
- rapid and sometimes disruptive movements in the costs of competing technologies
- markets for inputs and outputs that can move substantially and greatly alter the viability of projects and measures
- the potential need for companies to undergo major transformations in capability and financial structure from the time that funding is agreed to the completion of the support period.

### Narrow focus or support a wide range of projects?

With limited funds, ACRE faces the choice of either supporting all renewable energy technologies, or focusing its support on a narrower range of technologies that may produce higher benefits. The ACRE Board recommends that funds be allocated to **'best value'** investments, with value measured primarily by the potential economic benefits from lowering the cost and increasing the supply of renewable energy in Australia over the long term. This will require a **targeted** approach to realise opportunities and overcome barriers of particular importance to Australia.

### The challenge of program design

Public funding and support of renewable energy technology development has grown in recent years in Australia and globally, and this experience has revealed key challenges that face the successful design and administration of these programs.

Maximising value (and minimising failure) will require ACRE to subject all proposals to rigorous **expert review** of technology potential, commercial prospects and management capacity. Such reviews might be undertaken at key events to ensure the project is on track.

Periodic reviews will allow the project or delivery model to be adjusted if required or for agreements to be renegotiated or ended if the project is failing. ACRE can build into the design and administration of support agreements a prudent level of **flexibility** to deal with changing circumstances, while maintaining probity and due process.

Thus a specific challenge is for ACRE to implement a suitable **'toolkit'** of support measures, and to select those that are best suited to each technology project or venture, taking into account the resultant incentives and risk allocations. ACRE's toolkit currently contains venture capital funding through the Renewable Energy Venture Capital Fund, and grants funding through a suite of existing grant programs. The toolkit could be expanded to allow ACRE to invest flexibly in a range of technologies, recognising that different projects at different points along the innovation chain will require different types of funding support, which could include, for example, loan guarantees and concessional loans. Program guidelines will provide further information on the toolkit. The ACRE Board will consider the merits of other support mechanisms and advise Government on their suitability.



ACRE proposes to use its evolving toolkit in an integrated and flexible manner so as to optimise key outcomes such as public and private sector leverage, capacity building and collaboration with other relevant organisations. Successful funded projects should have the opportunity to apply for further funding to take them to the next innovation stage.

ACRE recognises the key role the market will play in selecting technologies for use based on their commercial appeal. Currently, there is substantial uncertainty as to which technologies, processes and systems will progress to competitiveness and commercialisation, which has two important implications:

- it will be critical for ACRE to have access to high quality and current **market intelligence** and **modelling**, to help it make informed decisions on the technologies to prioritise for support, taking into account competing and future prospects, and to advise the Minister on support options
- the conventional approach of initiating funding rounds focused narrowly on a particular technology and/or innovation stage may leave projects without an opportunity to apply for funding for long periods, at a substantial cost to Australia's innovation effort. Within its funding envelope, ACRE can seek to match the supply of support to market demand, by not placing unnecessary constraints of renewable energy resource, technology or innovation stage.

### Opportunities through collaboration

The Australian and global renewable energy development effort is characterised by high levels of program diversity and low levels of coordination across different funding bodies. There can be benefit in diversity, in allowing different technologies and support measures to be trialled in the most conducive environment. There can also be costs, for example inefficient duplication of, or gaps in, support for particular technologies or projects.

The ACRE Board believes there are considerable opportunities for enhanced **collaboration in program design and administration**, particularly involving state and territory governments, industry representative bodies, other renewable energy technology funding bodies, such as the Australian Solar Institute (ASI), and possibly other funding agencies internationally. The Board recommends prioritising such program collaboration.

The Board also recommends ACRE implement its activities in a manner that builds on and complements the work of other organisations. For instance, the ASI Strategic Plan, released on 17 November 2010, will be an important reference for ACRE in considering its support for solar energy technologies.



**Effective collaboration with research institutions and other funding bodies** will assist with marshalling the expertise (from Australia and overseas) required to break through those technology barriers that appear insurmountable. Key sources of research and development expertise that ACRE can draw on in Australia will be CSIRO, Geoscience Australia, ANSTO, universities, Australian Research Council (ARC) Centres of Excellence, Cooperative Research Centres (CRCs), and state and private sector laboratories. Key research funding alliances and complementary support strategies could be established in Australia with the ASI, the ARC, the CRC Program, the Rural Industries Research and Development Corporation (RIRDC) and the National Research Infrastructure Council (NRIC) to maximise the value of commonwealth investment and minimise risk of duplication. Overseas bodies for collaboration include the Advanced Research Projects Agency-Energy (ARPA-E), the UK and Australian Carbon Trusts, the National Renewable Energy Laboratories in the USA, the New Energy and Industrial Technology Development Organization (NEDO) in Japan, the Energy Research Institute in India and the Energy Research Institute of the National Reform and Development Commission in China.

Sharing ideas and information with bodies around the world with a similar remit will also be important. Such bodies include the International Energy Agency (IEA) and the Energy Efficiency and Renewable Energy Advisory Committee (ERAC), recently established in the USA.

### **The challenge of maximising benefits to Australia**

It is important to distinguish ACRE's two complementary roles in helping develop an Australian renewable energy sector, which are:

- to develop **Australian technology and ventures** with prospects of realising benefits to Australia by exploiting identified opportunities in national or global markets (through venture capital and funding of strategic R&D). In this case, the Australian resources being developed are intellectual capital and management, so to restrict support to those proposals that will lead directly to commercialisation in Australia would reduce the prospects for success. In practical terms, most renewable energy sources will have ultimate commercial prospects in Australia, but this may in some cases be satisfactorily achieved if later stages of the innovation chain occur overseas first; and
- to develop **Australian renewable energy resources** by leveraging the best available technology, finance and management capacity to lower the costs of commercial deployment of renewable energy in Australia (through support for piloting, demonstration and early stage commercialisation). The source of technology, finance and management will be the global market, including Australia; to restrict this activity to Australian technologies and companies alone would compromise the goal of maximising the supply and competitiveness of renewable energy.



# THE ACRE APPROACH

To meet its challenges and achieve its vision and mission, there are a number of key approaches the ACRE Board recommends the Government support in the delivery of ACRE's objective. Specifically the Board recommends Government support:

**a. Establishing early and ongoing engagement with proponents of prospective projects and measures**

ACRE should maintain an 'open door' for promising projects and measures, to guide them towards a point at which ACRE support can be considered, and to ensure that ACRE's decisions are informed as far as possible by an understanding of competing options.

**b. Adopting an outcome-oriented strategy which is proactive, expert, flexible, transparent, merit based, targeted and patient**

Active management by governments of funding agreements is essential to minimise the risks arising from the challenges that companies and technologies encounter through the innovation chain. ACRE proposes to take a proactive, expert and flexible approach to addressing the risks encountered by funded technologies and companies, and to target its support to best value investment, and to consider expanding its toolkit of appropriate support options in a transparent and merit based way.

Development of renewable energy technologies is capital intensive and likely to take time. ACRE will identify funding mechanisms which help provide certainty for co-investors over the longer term.

**c. Prioritising maximising public value above breadth of coverage of technologies and innovation stages while encouraging sufficient diversity of technologies in development**

While ACRE's portfolio of technologies is, and is likely to continue to be, diverse, different technologies will warrant different levels and modes of support to maximise the projected economic benefits of ACRE's funds. Support will therefore be provided on a 'best value' basis as the prime criterion, but encouraging the development of a diversity of technologies will be another important criterion.

**d. Supporting the early stage development of Australian renewable energy technologies and ventures**

This will entail investment of venture capital into Australian ventures and provision of strategic grants and other suitable public finance mechanisms to progress Australian technologies, including encouraging commercialisation through global markets.

#### **e. Supporting the piloting, demonstration and early-stage commercial deployment of renewable energy in Australia**

Reducing the delivered cost of renewable energy will necessitate a focus on moving technologies down their respective energy cost curves. The technologies, and the companies and finance which support their deployment, may be sourced from the global market.

#### **f. Supporting critical enabling technologies and systems**

Maximising the benefits of renewable energy sources requires a complementary focus on enabling technologies and systems. These may include resource assessments, new materials, integration systems, information and communication technologies, forecasting systems, control systems, fuel supply logistics, energy storage and smart grids. Improving supply reliability and grid integration of electricity from intermittent renewable resources is a key objective of this support.

#### **g. Synthesising, disseminating and utilising knowledge**

ACRE proposes to establish a 'one-stop shop' for high quality and current national and international information on developments in renewable energy technologies, systems and policies. ACRE also proposes to assist the renewable energy industry with the production of some of this knowledge, for example through industry roadmaps and feasibility studies.

This resource is proposed for the benefit of Australia's private and public sectors, and will be developed in collaboration with expected users. Building capacity and skills across the innovation chain through the ongoing dissemination of knowledge and lessons learnt is critical.

To enable a smooth transition from technology push to market pull, ACRE will develop and gather market intelligence so it can advise Government on market pull mechanisms that may be effective in the Australian market, complementing its current role in supporting innovation in renewable energy technologies.

Gathering and disseminating knowledge will also play a significant role in increasing community awareness of renewable energy technologies and their role in Australia's energy future.

#### **h. Supporting growth in skills and capacity in renewable technologies**

ACRE proposes to support industry to build its capacity to develop renewable energy and enabling technologies. Key areas of focus include information on lessons learnt, best-practice guidelines, standards development and ensuring skills needs are met.



**i. Increasing collaboration and thereby leveraging funds and knowledge**

ACRE proposes to take a leadership role in improving coordination and collaboration among other agencies, governments, industries, and the finance community to increase renewable energy technology innovation and deployment in Australia, and thereby increase industry competitiveness. Governments can play an important role in facilitating private sector investment. Private capital market participants, including venture capitalists, project financiers, corporate financiers, institutional investors and social investment enterprises all have a role in the growth of the renewable energy sector, as do local, state, national and international agencies.

Similarly close coordination with research organisations and research funding bodies is vital to ACRE maximising the speed of technological innovation for renewable energy exploitation. Even though a project may be at the demonstration stage, for example, hard, seemingly intractable problems may be encountered that require a refocussing of effort to solve those issues before proceeding on with the demonstration project. Research expertise would need to be drawn together quickly to characterise and solve these problems. There will be times when the research expertise required will not be available in Australia, but Australia's research organisations have worldwide contacts and collaborations and, through these, appropriate expertise can be sought.

**j. Reviewing broader renewable energy issues and policy settings**

ACRE proposes to annually review broader renewable energy issues and policy settings. This will help inform its funding decisions and management. It will also enable an analysis of gaps to providing an optimal policy framework for renewable energy and enabling technologies across the innovation continuum.

# THE ACRE TECHNOLOGY FOCUS

ACRE must liaise closely with industry to target its support to technologies and stages in the innovation chain where that support can have maximum impact. A preliminary overview of renewable energy subsectors and ACRE's proposed focus within each subsector is provided below, which should be read with the caveat that ACRE will remain open to supporting 'disruptive' technologies<sup>2</sup> in any sub-sector.

## Solar

Australia's solar resources are abundant and predictable.

Developments in solar energy cover technologies ranging from solar heating to concentrating solar thermal (CST) systems to photovoltaics (PV and concentrating photovoltaics (CPV)). While the state of development and deployment for each technology is varied, all are currently characterised by high installed cost per unit of energy delivered and low efficiencies. Significant research, development, demonstration and deployment are required to achieve cost effective systems at scale.

As with other technologies characterised by variability in generation output, connection to the grid requires an ability to safely and reliably integrate these systems into the Australian network. This includes development of short and medium-term storage options and other load management strategies.

CST includes parabolic trough, linear Fresnel, parabolic dish and solar tower technologies. Although some reasonable scale demonstrations of the various technologies have taken place, these are not at commercial scale and not significant in number. Development focussed on lowering the cost of solar field components, increasing reliability, and increasing efficiency through higher temperatures and improved receiver design are essential. Proving up alternatives to steam would be of value in water-constrained areas.

In contrast, first-generation PV technology (mono or polycrystalline silicon wafers) is well established and being increasingly deployed around the world. However, despite reductions in cost due to increased scale of manufacture, it may not offer the cost breakthroughs ultimately required to compete at utility scale in wholesale electricity markets. Second-generation (thin-film based) and third-generation (e.g. multi junction materials based and organic PV, quantum effect technologies) potentially offer lower production cost and/or higher efficiency solutions in the future, although durability and ability to produce at scale need to be resolved. Further R&D into improving the properties and cost of materials and manufacturing processes is critical, noting that the R&D required for small-scale and large-scale technologies differs.

In summary, solar energy technologies are still costly and will take some years to become viable even under a carbon price. The intermittent nature of solar energy, and the high cost and limited capacity of electricity storage systems, makes use of power generated by solar energy technologies challenging – although developments in storage and demand side control are occurring which may change that outlook.

<sup>2</sup> A **disruptive technology** is one that disrupts an existing market, typically by substantially improving the price competitiveness of a product in that market in ways not anticipated.

Cost reductions will come from both global developments in the design, conversion efficiency and manufacture of solar technology systems together with a more established Australian solar industry. Australia has opportunities to benefit from both, and existing Government support is designed to increase deployment and reduce solar energy costs in the Australian energy market.

Based on current knowledge, industrial-scale solar generation located in Australia's best insolation zones provides the greatest prospect for lowest cost and abundant solar energy. Micro-generation through rooftop systems using current technologies is less prospective, because such systems are below economic scale. Strategic and applied R&D in low-cost solar conversion may allow growth in new sectors such as consumer electronics.

The dominant form of energy produced from solar resources is likely to be electricity, complemented by small-scale direct heating of water and building space. Australia's electricity transmission system will require considerable investment to accommodate a substantial growth in remote, utility scale solar power.

Current programs and initiatives, particularly Solar Flagships, the ASI and ACRE Solar demonstration projects, will provide valuable lessons on the deployment of utility scale solar energy.

Given the range of existing **solar** technology programs provided by government, ACRE's priority for solar is on compelling enabling technologies, including storage, grid connection technologies, and hybrid systems.

## Geothermal

Australia's geothermal resources are extensive but not yet fully known or realised.

Geothermal energy has potential as a source of base load power supply, but will also have application as a direct source of space and water heating for domestic and industrial purposes.

Once Australia's geothermal resources have been proven to reliably supply heat at adequate temperatures and at competitive cost, the levelised cost of electricity from geothermal energy in future years may be competitive with traditional fossil-fuel sources.

Technology challenges in the geothermal field include resource exploration, characterisation, mapping and proving; reservoir characterisation and stimulation; improved drilling systems; well stimulation and fluids chemistry; the development of new high-temperature materials, electronics and tools; monitoring technologies; development of advanced remote sensing to help reduce drilling risk; and improved electricity conversion and connection to the grid and changes to the rules governing the construction of transmission infrastructure.

For direct heating/cooling systems, demonstrating the commercial use of geothermal technologies remains a challenge for a variety of reasons including cost and information failures. Other relevant aspects include the need for collaboration among researchers, industry and government, increased social awareness and acceptance, environmental considerations, and development of close-to-grid and off-grid applications.

The range of geothermal resources currently under active development in Australia includes hot rocks and hot sedimentary aquifers for power generation and direct use. In order for the Australian geothermal energy sector to attract greater funding from the private sector, it needs to demonstrate that the technologies work with Australian geothermal resources and at power-plant scale safely. Significant ACRE funding has been invested in drilling to prove up reserves and in geothermal projects, but as yet no demonstration plants are in operation.

Many of the current ACRE-supported projects are remote from the grid. Enhancements to the transmission system will be needed if the technology is proven commercially to realise these remote geothermal resources.

The challenges of making geothermal energy economically viable in Australia are thus both technical and financial. ACRE is currently undertaking a scoping study to understand more clearly the challenges facing the sector and to assist with developing options for support in the future.

One area where ACRE could play an important role is to facilitate resource discovery and recovery (in collaboration with geoscience bodies, universities, industry, CSIRO and state and territory governments). Greater R&D can help support reductions in conversion costs.

ACRE's priority for **geothermal** energy is: to facilitate national coordination; facilitate resource discovery and proving; and/or support pilot demonstration projects to enable learning by doing and information gathering and dissemination.

## Wind

Wind resources for Australia are reasonably well understood.

Wind power is a relatively mature technology with single units now reaching scales of 5MW and strong and widespread deployment around the globe. Additional innovation in materials science would enable the design of larger lightweight rotor blades to overcome the load on turbines; however, turbine development has almost exclusively been conducted outside of Australia and this is likely to continue to be the case. Incremental development to improve efficiency and reliability will also continue.

The Australian challenge is to manage the issues associated with the uptake of the technology. This requires addressing the technical objective of how best to integrate wind energy into the grid and the social and environmental challenge of increasing public acceptance of wind farms. As with several other renewable energy sources, managing intermittency and variability is the key to effective grid integration. This requires further improvements in wind forecasting techniques, grid design tools, whole-of-system control strategies, and design and application of appropriate short-term energy storage.

Off-shore wind energy is currently not competitive under Australia's renewable energy target and large scale demonstration is premature, but this may change in the medium term. There may be value in ACRE supporting low-cost studies into the potential for off-shore wind generation.

In light of its widespread deployment, ACRE does not propose to focus its activities on wind technologies. However, ACRE may consider supporting those enabling technologies that may significantly improve grid connection issues, or measures to broaden understanding of wind development issues.

## Hydro

Hydroelectric generation is a mature technology with limited opportunities in Australia for new large-scale projects. It is currently Australia's major source of renewable electricity, comprising nearly 75 per cent of all installed renewable capacity. This percentage contribution will decline as wind and other sources of renewable energy expand. Australia has around 108 hydroelectric power stations with total installed capacity of 7.8 GW. Australia's technically feasible hydroenergy potential is estimated to be around 60 TWh per year. The share of hydro in Australia's total electricity generation is projected to fall from 4.5 per cent currently to around 3.5 per cent in 2029-30.<sup>3</sup>

Water availability and environmental challenges are key constraints on the future growth of hydroelectricity. Australia is unlikely to see new large-scale generators. Future growth in Australia's hydroelectricity generation will be underpinned by the development of small-scale facilities and the refurbishment of current large-scale hydro plants.

In light of its widespread deployment, ACRE does not propose to focus its activities on hydro technologies.

## Wave/Ocean/Tidal

Australia has excellent wave, ocean and tidal energy resources.

Wave and ocean technologies include tidal barrage (lagoon), tidal stream (currents), waves (swell) and ocean current and ocean thermal energy. Ocean energy systems are pre-commercial so improvements are highly dependent on engineering and demonstration activities, with grid integration also being a barrier. A large number of different ocean technologies are being trialled internationally, with most projects at the prototype or testing phase. Engineering design solutions are being developed to address specific technology barriers for each system. The major barriers to uptake appear to be demonstrating the feasibility of technologies at scale, regulatory complexities, environmental considerations, and a lack of internationally recognised performance data and standards.

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<sup>3</sup> Australian Energy Resource Assessment, Geoscience Australia, 2010

ACRE's priority is to monitor developments internationally in ocean technologies and assist the development of nationally consistent regulatory regimes around state and commonwealth ocean jurisdictions. ACRE may consider supporting selected pilot-scale ocean energy technology projects.

## Bioenergy

Bioenergy refers to the conversion of biomass to heat, electricity or fuels. Biomass energy technologies include bagasse (sugar cane residues), wood waste and biogas from landfill and sewage facilities. The USA, Europe and elsewhere are now using biomass to generate significant quantities of power. Although bioenergy has provided just under a quarter of total Renewable Energy Certificates (RECs) surrendered, Australia is yet to develop this resource to significant levels.

The market for biofuels is less certain than the market for renewable power from biomass. First generation biofuels, such as ethanol from sugar cane, grains and cereals, face the challenge of becoming economic without subsidies. Second-generation biofuels, such as lignocellulosic ethanol and algae-derived oils, have challenges of feedstock supply, producing sufficient volumes at competitive costs, conversion technologies and accessing supply chains. Technologies being developed overseas could speed up this process, but will require adaptation to Australian conditions. A shift to integrated biorefineries producing heat, power, biofuels and replacements other biobased products may improve the economic feasibility of bioenergy options.

The Government has announced it will establish the Australian Biofuels Research Institute. This initiative could help increase understanding of the prospects for a sustainable biofuels industry in Australia, encourage a more commercial focus, fund individual or collaborative projects (for example, proof of concept projects, small-scale pilot projects), and support collaboration, feasibility studies and other projects. One challenge is to assess the potential for economic and environmentally sustainable pathways (on a whole-of-lifecycle basis) for second-generation biofuels in Australia, by feedstock, process and product.

ACRE's support for bioenergy technologies will prioritise the assessment of sustainable and economic pathways, R&D and pilot projects for second-generation biofuels projects (including algae), and biopower and bioheat projects.

## Hybrid systems

Hybrid systems integrate renewable energy technologies with fossil-fuel energy generation to allow the benefits of one technology to compensate for the limitations of another. Renewable energy sources in combination with non-renewable sources have the capacity to produce reliable supply, and can extend the life of existing infrastructure. For example, gas is seen as an important transition technology to integrate with renewable technologies to address load variation. The key technology barriers are integration with existing technology, retrofit challenges, and matching the ratio of renewable to conventional energy.

ACRE currently supports two significant hybrid projects – a solar-coal hybrid project at the Kogan Creek power station in Queensland and an integrated renewable energy and storage project at King Island in Tasmania.

ACRE's priority is to support key hybrid projects that facilitate early commercial deployment of renewable energy technologies.

### Enabling technologies and systems

Enabling technologies are those that allow renewable energy technologies to function more effectively within an electricity grid or independently of the grid. They include energy storage; transformation or control technologies used in conjunction with energy generation; renewable energy resource mapping; materials science; forecasting and modelling capability software and systems; and sustainability and greenhouse gas life cycle analyses. ACRE supports modelling approaches which integrate forecasts and scenario analysis across the entire physical economy – including energy, water, carbon emission and sequestration, land use, urban systems and infrastructure, and transport in and between urban centres – and suggests that these could play an important role in informing policy development and decision making.

ACRE's priority is to support critical enabling technologies for Australian conditions and selected technology concepts with breakthrough potential.

# ACRE INITIATIVES

## New initiatives

The ACRE Board recommends that Government support the implementation of the following new initiatives<sup>4</sup>:

### a. Developing a knowledge bank for global policy, technical, commercial and investment-related information

Using a relatively small proportion of its existing funding, ACRE will build up detailed intelligence on renewable energy technologies, including supporting an industry-focused, regularly updated, accessible, open-source, on-line platform of knowledge and information for the key stakeholders in the renewable energy industry and investment community. This could involve building databases, aggregating existing information and creating alliances. The types of information that would be valuable to industry include policy developments, investment opportunities, recent research results, and new project developments.

This knowledge bank also will drive ACRE's role in examining market mechanisms to pull through the technologies that are currently being supported by it and other organisations.

### b. Establishing a flexible and integrated funding program – Emerging Renewables

Through the addition of the \$40 million Emerging Renewables program and ACRE's existing funds, ACRE will establish a single new funding program that offers a flexible, integrated approach to technology funding and program delivery. This new program, to be called the Emerging Renewables Program, would seek to use a range of public financing mechanisms from ACRE's toolkit to support 'best value' renewable energy and enabling technology projects and measures to progress technologies to the next stage along the innovation chain and to lower the cost of renewable energy in Australia. The program will also support measures that may involve industry skills development, capacity building, knowledge sharing and collaboration, and seed funds to leverage research funds from other bodies to deal with targeted 'barrier' research problems.

A key outcome of the Emerging Renewables Program will be to increase the potential for leverage and collaboration from the private sector. ACRE will work with other government agencies and state and territory governments to refer applicants, as appropriate, to complementary support mechanisms and will consider proposals for co-funding promising projects. Consistent with the Australian Government's announcement, at least \$40 million of funding would be available for less-developed technologies such as geothermal and wave.

The ACRE Board recommends that the Emerging Renewables Program should feature a two-stage application process, commencing with a call for Expressions of Interest (EOI) to establish credentials, followed by invitations for shortlisted applicants to submit a full proposal. Consistent with probity and due processes, ACRE will work with applicants to provide guidance on the suitability of their application against the selection

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<sup>4</sup> ACRE currently has up to \$120 million to invest in promising renewable energy and enabling technologies and other measures targeted at industry growth.

criteria. Participants in existing ACRE programs will be able to apply to the Emerging Renewables Program and companies who have received Emerging Renewables funding support may be able to apply again to ACRE for support to progress to the next stage along the innovation chain. Compelling proposals may also be considered on an ongoing basis.

Using ACRE's approach as a guide, all proposals will be rigorously assessed and subject to expert review against a multi-criteria decision-making framework which ACRE will develop. Assessment criteria will include the technology potential, stage along the innovation chain, commercial prospects, management capacity, project/research plan and project/investment risk.

ACRE will target renewable energy technologies and projects of particular benefit to Australia with potential to achieve the greatest energy cost reductions. Ongoing reviews of a project's performance – technical and commercial – will be undertaken on a regular basis.

Importantly, through its review process, ACRE would be able to identify quickly those projects which are not performing well against established key performance indicators, and will have the capacity to withdraw support so funds can be redirected to more promising areas.

In summary, the proposed key operating principles of the Emerging Renewables Program are:

1. Lowering the cost of renewable energy supply in Australia is a key consideration in determining suitability for funding.
2. A two-stage process will be followed, i.e. EOI followed by invitations to submit full proposals.
3. ACRE will be open for business on a semi-continuous basis.
4. Applicants will nominate the stage in the innovation chain to which they wish ACRE funding be applied (e.g. engineering design/development, pilot-scale demonstration, research to tackle a major technical problem encountered).
5. Progress from an EOI to an invitation to apply for funding is not guaranteed and any such invitation, if issued, may take considerable time if project development costs are large and/or ACRE's available funds are limited.
6. Evidence of global competitiveness of technologies proposed for ACRE funding will be required.
7. Budgeting and funding rules for proposals will be developed, including proposing the option of non-grant funding mechanisms.
8. Applicants must provide evidence that they have a plan including funding sources to progress their technologies to the next stage in the innovation chain and/or to commercialisation (ACRE reserves the right to undertake due diligence with technology providers and financial backers).
9. Risk assessments for each project will be required.

10. Successful projects will be subject to ongoing review to ensure they continue to meet ACRE's objective.

The further development of the decision-making framework will be undertaken in the context of the development over the coming months of program guidelines for the Emerging Renewables Program. These program guidelines are a key element in implementing ACRE's Strategic Directions, and will include further information on the toolkit to support renewable energy and enabling technologies. Once this Program is approved by Government, ACRE expects to announce an EOI call in mid 2011.

## ACRE initiatives already announced

### a. The Renewable Energy Venture Capital Fund

The Australian Government has announced the establishment of a new \$100 million Renewable Energy Venture Capital (REVC) Fund to make critical early-stage equity investments that leverage private funds to help commercialise emerging renewable technologies. The REVC Fund will be a key component in the ACRE toolkit providing opportunities for renewable energy technology proponents to access private capital, particularly important as their financing requirements change along the venture chain.

The REVC Fund will provide capital and active management to help promising companies achieve commercial success in Australian and overseas markets. The REVC Fund will be part of ACRE's integrated strategy to support the development of renewable energy technologies and the growth of the companies behind them.

ACRE has consulted on the design of the REVC Fund and is developing program guidelines for the initiative. Once the Fund is operating, the fund manager or managers will be responsible for all investment decisions, which will be made on a commercial basis in accordance with the fund manager's investment practices and program guidelines. This venture capital mechanism provides both capital and active management to help promising companies achieve commercial success in Australian and overseas markets.

### b. The Australian Biofuels Research Institute

The Australian Government has announced funding of \$20 million for a new Australian Biofuels Research Institute. ACRE is responsible for coordinating the creation of the Institute and ensuring its focus is on commercialising research into second-generation biofuels. ACRE will work with relevant research and educational institutions and the biofuels industry to develop a model that draws on the expertise of a wide range of organisations.

While there is considerable work being done on various aspects of biofuels internationally and domestically, there is no one body of work that addresses issues associated with commercialising second-generation biofuels in Australia.

### c. Renewable energy studies related to the Mt Isa to Townsville transmission line

The Australian Government has committed \$2 million from ACRE funding for it to undertake renewable energy studies along the proposed Mt Isa to Townsville transmission line. This initiative will complement the Australian Government's Connecting Renewables Initiative.

#### **d. Off-Grid Renewable Energy Studies**

The Australian Government has also tasked ACRE with conducting regional studies to identify opportunities for greater deployment of renewable energy in off-grid and remote grid locations. The regions identified for initial consideration are the Pilbara and Mid-West Western Australia. This work will assist ACRE to identify off-grid or remote energy market opportunities for renewable energy technologies.

### **Existing ACRE initiatives**

#### **a. Manage existing renewable energy programs and improve existing program delivery**

ACRE will continue to manage existing programs that are providing support at particular points along the innovation chain. Much can be learnt from the current suite of programs that ACRE is already managing. As the projects move to the end of their current funding period, ACRE will undertake rigorous evaluation of projects to identify the best support it can offer to optimise the success of the projects and, if appropriate, guide proponents to funding sources for the next stage in the innovation chain, including, where appropriate, applying to new ACRE programs.

ACRE currently manages the following programs and measures that are helping to progress renewable energy technologies:

- Renewable Energy Demonstration Program
- ACRE solar projects
- Second Generation Biofuels Research and Development Program
- Geothermal Drilling Program
- Wind Energy Forecasting Capability Program
- Renewable Energy Equity Fund
- Advanced Electricity Storage Technologies Program.



# ACRE MEASURES OF SUCCESS

The ACRE Board recommends that ACRE establish key performance indicators to gauge the success of its strategic activities. It also recommends ACRE monitor renewable energy uptake measures and developments, including ones where it does not have control of outcomes but which give a sense of the context in which ACRE operates.

ACRE will develop a set of portfolio reports that cover each technology type to record progress. The measures below will feed into these reports.

## Short-term measures of success

- **Quality of projects and other measures supported**

The Government, through ACRE, will be investing over \$690 million to support a range of technologies through different funding mechanisms and measures so that developers can access support that is tailored closely to their needs. Funding support ranges from high-value demonstration projects to relatively inexpensive industry studies. This means there should be a greater number of projects and measures supported than is currently the case. ACRE will subject proposals to rigorous testing and assessment, to ensure only the best receive Government support. ACRE will look for opportunities for early wins.

- **ACRE stakeholder satisfaction**

ACRE recognises that stakeholder engagement will be key over the coming years. ACRE aims to provide a seamless stakeholder service that is timely, responsive and considered.

- **International partnerships developed**

Developing strong international partnerships is an effective way for ACRE to support certain renewable energy technologies where the majority of the development will be undertaken overseas. International partnerships can provide valuable information to industry on technology development and financing opportunities, and inform policy makers on appropriate policy tools. Initially, ACRE is likely to be limited to participating in existing international partnerships and working through established contacts, but over time should play an increasing role in leading partnerships and setting up new networks.

- **Proportion of contracts managed within timeframes established**

Grant funding deeds typically set a timeframe with milestones that must be achieved before payments are made. ACRE should improve the Government's ability to manage projects within the timeframes established through introducing a more flexible, responsive approach to support, and drawing on experience managing its existing programs.

- **Number of collaborative projects building on the work of state/territory governments or researchers supported**

ACRE will maximise the value of the Government's investment through collaboration. This could involve working with other government agencies at both the national and state/territory level to support projects and measures through referral services or co-investment models, or building on the work undertaken by other support bodies including the Australian Solar Institute, universities and CSIRO.

## Medium-term measures of success

- **ACRE as a leading partner in a range of collaborations**

ACRE will work to develop a reputation as a lead partner in the renewable energy technology space. Where ACRE is not able to fund promising projects or measures, it may refer them elsewhere. ACRE may act as a catalyst in forming key collaborations across technologies or on particular research efforts.

- **Cost of energy produced by ACRE funded projects**

Reducing the cost of renewable energy is ACRE's primary focus. While this outcome will be impacted by many factors outside its control, ACRE can help reduce renewable energy costs in the projects and measures it directly supports.

- **Value of commonwealth, state and territory government investment in renewable energy technologies leveraged**

As ACRE successfully develops partnerships with state and territory governments, the total value of matching government and private sector support for renewable energy technology development and deployment should increase.

- **Number of private investors in renewable energy technology, and value of investments.**

Encouraging private sector contributions is a key focus for ACRE. If ACRE is able to offer the types of funding mechanisms and information that leverage the highest ratios of private sector investment, over time the number of private sector investors, and the volume of their investment, should increase.

## Long-term measures of success

- **Share of renewable energy technologies in total generation mix**

ACRE will help to contribute to increasing the proportion of renewable energy in Australia's total energy mix.

- **Cost of energy generated from renewable sources**

In the long-term, it is hoped that the support ACRE provides to particular projects and measures will reduce energy costs, not only for projects where it has provided support, but generally across a number of renewable energy resources and technologies. Clearly other factors will be significant in contributing to, or detracting from, this outcome. Nevertheless, it is important that ACRE closely monitors energy costs from various technologies.

# APPENDIX 1

## SUBMISSIONS RECEIVED

A total of 71 written submissions were received on the draft ACRE Strategic Directions paper. Public submissions can be accessed via ACRE's website at [www.acre.gov.au](http://www.acre.gov.au).

### Industry Associations (12)

Australian Geothermal Energy Association (AGEA)  
Australian Geothermal Energy Group (AGEG)  
Australian Pipeline Industry  
Australian Solar Cooling Interest Group  
AusBiotech  
Bioenergy Australia  
Clean Energy Council  
Copper Development Centre  
Oil Mallee Association of Australia  
Standards Australia  
Sustainable Energy Association of Australia\*  
World Bioenergy Association (Andrew Lang)

\* Formerly Western Australian Sustainable Energy Association (WA SEA)

### Companies (31)

#### Bioenergy/Biofuel

Bioenergy Plantations Australia

#### Energy/Fuel

Horizon Power  
Origin Energy

#### Finance/Consultancy/Advisory

ARUP  
California Clean Energy Fund (CalCEF) (Angel fund)  
ERS Group of Companies (risk management)  
KTM Capital (financial advisory)  
Peak Corporation  
Winwick Business Solutions

#### Hydro

Hydro Tasmania

## **Geothermal**

Geodynamics  
Hot Dry Rocks  
KUTh Energy  
Panax Geothermal  
Petratherm

## **Ocean**

Ocean Power Technologies (Australasia)  
Pty Ltd  
Oceanlinx

## **Solar**

Clean Energy Australasia (also geothermal)  
Earth Solar Power (also geothermal)  
VastSolar  
Brightsource Energy Australia

## **Wind**

Vestas  
In-Confidence (9)

## **Research Institutions – including CSIRO/universities (8)**

Australian ITER forum (Fusion energy)  
Centre for Energy Technology (University of Adelaide)  
CSIRO  
Curtin Centre for Advanced Energy Science and Engineering (Curtin University of Technology)  
Geothermal Research Initiative (GRI)  
Global Change Institute (University of Queensland)  
Murdoch University (Algae R&D)  
Oz Energy Analysis (University of Adelaide)

## **Government (12)**

Australian Nuclear Science and Technology Organisation (ANSTO)  
Department of Transport, Energy and Infrastructure (South Australia)  
Geoscience Australia  
Queensland Government  
Renewables South Australia  
Rural Research and Development Council  
Warringah Council  
Department of Innovation, Industry, Science and Research (DIISR)  
Industry and Investment, New South Wales  
Victorian Department of Primary Industries  
In-Confidence (2)

## **Individual (6)**

Tim Bateman  
Steven Langley  
Peter Mitchell  
Professor Peter Seligman  
Robin van Spaandonk (2 submissions)

## **Other (2)**

Australian Conservation Foundation  
In-Confidence (1)

# APPENDIX 2

## GLOSSARY

### **Base load**

The minimum level of demand (load) on an electricity supply system that exists 24 hours a day.

### **Biofuels**

Liquid fuels (e.g. ethanol, biodiesel) produced directly or indirectly from biomass.

### **Bioenergy**

The use of organic material (biomass) as a source of energy for power (or electricity) generation and direct source heat applications in all energy sectors including domestic, commercial and industrial purposes as well as the production of liquid fuels for transport

### **Biomass**

Vegetable and animal derived organic materials, such as forestry residues, wood waste, bagasse (sugar cane residue), oilseed crops and animal waste.

### **Conversion**

The process of transforming one form of energy into another before use. Conversion itself consumes energy, calculated as the difference between the energy content of the fuels consumed and that of the fuels produced.

### **Demonstration**

Shows that the technology is viable in real world applications with market potential. Established or newly created firms adopt the concept or product marking the transition from public to private institutional funding.

### **Deployment**

The expansion in the use of the technology, possibly through supported markets. The concept or product then becomes widely available and adopted in the broader market. Technologies at this stage are able to compete with other mature products in the marketplace, with successful instances being associated with falling costs as market share expands.

### **Development**

The synthesising of new knowledge into an idea and subsequent development to an end use concept with commercial potential.

### **Enabling technologies**

Those technologies that enable renewable energy technologies to function more effectively within an electricity grid.

### **Non-renewable resources**

Resources, such as fossil fuels (crude oil, natural gas, coal) and uranium that are depleted by extraction.

### **Ocean energy**

Mechanical energy from the tides and waves, and thermal energy from the sun's heat. Ocean energy is classified as tidal energy, wave energy and ocean thermal energy.

**Photovoltaic (PV)**

Those technologies that generate a current or voltage when exposed to visible light or other electromagnetic radiation from the sun.

**Renewable energy technologies**

These are technologies where the energy is generated from natural resources and which can be constantly replenished.

**Renewable resources**

Resources that can be replenished at a rate equal to or greater than the rate of depletion, such as biomass, hydro, solar, wind, ocean and geothermal.

**Solar thermal**

Those technologies that use heat derived from the sun's radiation to generate electricity.



