UPPER SPENCER GULF COMMON PURPOSE GROUP

Opportunities for Growth

Renewable Energy and CleanTech Sectors

Upper Spencer Gulf, South Australia

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Executive Summary

The Upper Spencer Gulf is a region in transition.

With strong heritage and capability in industrial manufacturing, the three cities that form the nucleus of the region – Whyalla, Port Augusta and Port Pirie - are also ideally located in close proximity to some of the best and most diverse renewable and low carbon energy resources in the world[1].

The three cities are now seeking to utilise their existing capabilities to support transition into a major economic growth and research hub for renewable energy, low carbon and clean technologies.

This report explores the opportunities and challenges to achieving this goal.

The analysis in this report highlights that while there are some immediate challenges, the stage is set for a renewable energy and clean technology revolution in the region. Whilst much of this will be delivered through market forces, the region has significant opportunity to leverage private investment and growth potential that will help diversify the local economy, create jobs and increase prosperity and long term sustainability of the Upper Spencer Gulf.

The region has world class solar resources and, due to significant cost reductions in the price of solar panels, the business case for small scale solar remains compelling despite the loss of direct incentives such as feed in tariffs. There is also continuing development and research in large scale solar, opening up considerable opportunities for the Upper Spencer Gulf. Solar thermal capacity has the great advantage of incorporating storage and is currently receiving strong community, research and commercial interest in the region.

The region has excellent wind resources and large areas of open landscape, outside protection zones, for the installation of wind farms. As wind is a mature and cost-effective renewable technology, the potential for further deployment in the region remains.

Residents of the Upper Spencer Gulf have demonstrated that they are keen to progress a clean energy future for the region. The community has consistently indicated support for renewables and there is growing interest and activity from local businesses seeking energy efficiency improvements. Coupled with co-generation and tri-generation facilities, businesses and households can be at the forefront of energy savings and supporting renewable and clean technology growth.

A number of local businesses already support the renewable industry in the region and will form an important base for the growth of this sector into the future. The three large town centres, coupled with heavy industry and a range of complementary specialisations, will provide the critical mass for renewable growth. Over time, growth and cost competitiveness of local renewable energy generation may also mean the Upper Spencer Gulf becomes increasingly attractive for energy intensive industries.

Whilst the national policy context still promotes the uptake of renewable energy and other enabling policies, a substantial review of this policy environment over the past year has created considerable uncertainty and risk in the renewable energy investment market. At a state level however, the Government of South Australia continues to be strongly supportive of significant renewable energy investment, and in policies that support the Upper Spencer Gulf.

Within the Upper Spencer Gulf itself challenges exist in relation to skills and infrastructure capacity that will need to be addressed if the region is able to take full advantage of opportunities in the renewable energy, low carbon and cleantech sectors.

The three cities are all below the state average in the share of technical, scientific and professional services. Improving the capacity of the region to support the necessary research, technical skills and workforce training related to these emerging sectors will be imperative if it is to maximize growth potential.

There are also infrastructure and some regulatory constraints in the electricity and gas grids that limit the immediate uptake of large scale renewable energy generation.

Ultimately however, the Upper Spencer Gulf provides an ideal location to trial and test renewable energy technology, research and innovation, development and commercialisation. It combines excellent renewable resources with proximity to existing infrastructure and high energy use facilities.

The strategic advantages of the Upper Spencer Gulf provide a compelling opportunity for growth in the renewable energy, low carbon and cleantech sectors. It is imperative that the region undertakes the necessary actions to take advantage of this potential.

Summary of Recommendations

This report identifies a number of actions that will help diversify the local economy, create jobs and support the transition of the Upper Spencer Gulf to a cleaner and more sustainable future:

1. Develop regional technical and research capacity to support opportunities to trial renewable energy and clean technologies in the Upper Spencer Gulf through partnerships with industry and leading research institutions including Adelaide University.

2. Work with the South Australian Premier's Climate Change Council to implement the state's Climate Change Vision – Pathways to 2050 priority action 8.3 to trial a partnership to develop integrated solutions for industry development based on a low carbon economy in the Upper Spencer Gulf.

3. Work with South Australian and Australian Governments to support development of cleantech industry clusters in the Upper Spencer Gulf and promote opportunities for Industrial symbiosis.

4. Prepare an energy demand and emissions profile for the Upper Spencer Gulf.

5. Continue to support the implementation of initiatives such as the 'Repower Port Augusta' and 'Green Grid' projects and increase the ability of the region to provide renewable generation into the grid.

6. Work with the South Australian and Local Governments to ensure land-use, zoning and development plan provisions support renewable energy and innovative clean technologies in appropriate locations to maximize synergies and avoid sensitive or high-value environmental or community locations.

7. Work with Local, South Australian and Australian Governments to improve coordination across agencies to support innovative development and deployment of renewable energy, low carbon and clean technologies in the USG.

8. Develop a marketing strategy promoting the capabilities and resources in the region and the opportunities for growth in renewable energy and complementary industries.

9. Work with the South Australian and Australian Governments to develop an industry exchange program so that core industries in the region can learn the skills and technologies to support the renewable energy, low carbon and clean-tech sectors.

10. Work with Regional Development Australia and the South Australian Government to undertake a skills audit to identify training requirements in the region and funding mechanisms to support reskilling for the renewable and clean-tech sectors.

11. Work with Australian and South Australian Governments to access support through initiatives such as the Next Generation Manufacturing Investment Program, Regional Infrastructure program, Innovation Voucher program and Business Transformation Voucher program to assist growth in the renewable energy and clean-tech sectors in the Upper Spencer Gulf.

12. Work with the Australian Government, South Australian and Local Governments to promote programs that support the uptake of renewables and energy efficiency across Upper Spencer Gulf communities.

13. Develop a partnership with the State Government to target energy intensive industries and actively seek investment in the Upper Spencer Gulf.

Introduction

Australia's domestic energy mix is changing. Renewable energy produces approximately fourteen per cent of Australia's electricity supply[2] with wind and solar photovoltaic growing rapidly to become significant sources of power. The costs of these renewable technologies have fallen considerably. Other renewable technologies, including solar thermal, marine and geothermal are also being developed and may enter the Australian market over time[3].

Non-renewable resources have traditionally provided the bulk of South Australia's energy use, with 61% of electricity generation sourced from natural gas and coal in 2013–14. However, this is down from 82% in 2009–10, highlighting the transformation currently underway towards an increasing share for renewable generation and a greater reliance on imports[4].

The Upper Spencer Gulf regional cities of Port Augusta, Port Pirie and Whyalla are ideally located in close proximity to some of the best and most diverse renewable and low carbon energy resources in the developed world. As the role of renewable energy expands in the world as a whole and the cost of renewable energy continues to fall, the advantages of the Upper Spencer Gulf and surrounding areas in a low-carbon economy may become a source of competitive advantage for the region, and enhance its prospects for accelerated economic development[5].

The region has exceptional endowments of wind energy, solar energy, wave energy, geothermal energy, biomass energy and high grade uranium oxide. This region also contains natural gas resources which are favoured by the world's movement towards low-carbon energy[6]. Effective utilisation of these resources has potential to make the Upper Spencer Gulf a future source of low-cost energy relative to the rest of Australia and globally.

The broader Upper Spencer Gulf region currently has the capacity to generate 5,616GWh annually through coal fired and wind generation, amounting to nearly half (47.8%) the total energy generation capacity of South Australia[7].

Over time, the expansion of renewable energy production is expected to replace and eventually surpass the established production of electricity from coal[8].The power transmission infrastructure built around the generation of electricity at Port Augusta can greatly assist the early stages of the emergence of the region as a major source of renewable energy[9].

This makes the growth in low-carbon energy production for the Upper Spencer Gulf very real and very achievable.

This report identifies opportunities for growth in the renewable and low carbon energy sector and potential for complementary clean technologies; and provides an assessment of the resources and infrastructure, along with both domestic and international market and policy environments. It also considers future local energy needs and competitive opportunities for the Upper Spencer Gulf itself in embracing and transitioning to low-carbon energy sources.

"The Upper Spencer Gulf is one of the best regions, in the best country in the world for renewables"

(Ross Garnaut, 2014)

Leading this initiative is the Upper Spencer Gulf Common Purpose Group - an alliance of local government, regional development and education representatives focused on facilitating economic and social growth across the regional centres of Port Augusta, Whyalla and Port Pirie. The Group was formed in 1998 as a forum for the three cities to share information, jointly implement initiatives, provide a united voice and work with Government, industry and other stakeholders in the interest of improving the long term sustainability of our region.

This report builds on earlier work supported through the Australian Government's "Sustainable Regional Development" program, which aimed to ensure future population change is compatible with the economic, environmental, and social wellbeing of Australia. Through this national program, the Upper Spencer Gulf Regional Sustainability Planning project specifically focussed on incorporating a stronger triple bottom line approach into regional planning across the region, including the potential role of renewables in the region. The project recognized that despite the common purpose and strong links between the cities of Whyalla, Port Augusta and Port Pirie, they fall into different State planning, natural resource management and economic development regions, hampering a more strategic approach to regional opportunities.

This report also draws heavily on the collaborative, tri-party Memorandum of Understanding (MoU) of 2012 between the three Upper Spencer Gulf cities, and both Commonwealth and State Regional Development Ministers' to provide a strategic framework for coordinating and sequencing investment and planning effort to support economic diversification, long term regional sustainability and community liveability. The report progresses several strategic objectives developed through the MoU that relate specifically to building on the region's comparative advantage in renewable energy.

Figure 1: The Upper Spencer Gulf Region and Surrounds

Figure 2: South Australian Planning Regions
Box: Upper Spencer Gulf (source South Australian Government)

Upper Spencer Gulf - Demographics and Capacity

The Upper Spencer Gulf cities have a long history and high level of experience and capacity in industrial manufacturing, resource processing, electricity generation and provision of services to their rural and remote hinterlands[10].

Collectively, the region is home to around 53,000 people, representing 3.4% of the total South Australian state population. There are nearly 22,000 workers in the Upper Spencer Gulf and over 2,000 small businesses, contributing over $2.3 billion in gross regional product and equating to just over 3%, of South Australia's gross state product. The five largest industries contributing to Gross Regional Product are mining, manufacturing, utilities (electricity generation), education and health. Resources and energy link the three cities through business trade services, labourers and contractors, with a healthy mix of cooperation and competition across business in the region.

Each city has different and complementary economic specialisations, and each city has a good representation of most of the industries which have seen growth across the State over the 2008-13 period. Whyalla is strongest in mining and has close to average shares of jobs in most other industries. Port Augusta is strong in utilities and the public sector, with close to average share of jobs in most other industries, whilst Port Pirie is strong in utilities, manufacturing, health and retail, with above average share of jobs in these industries and below average share of jobs in other sectors.

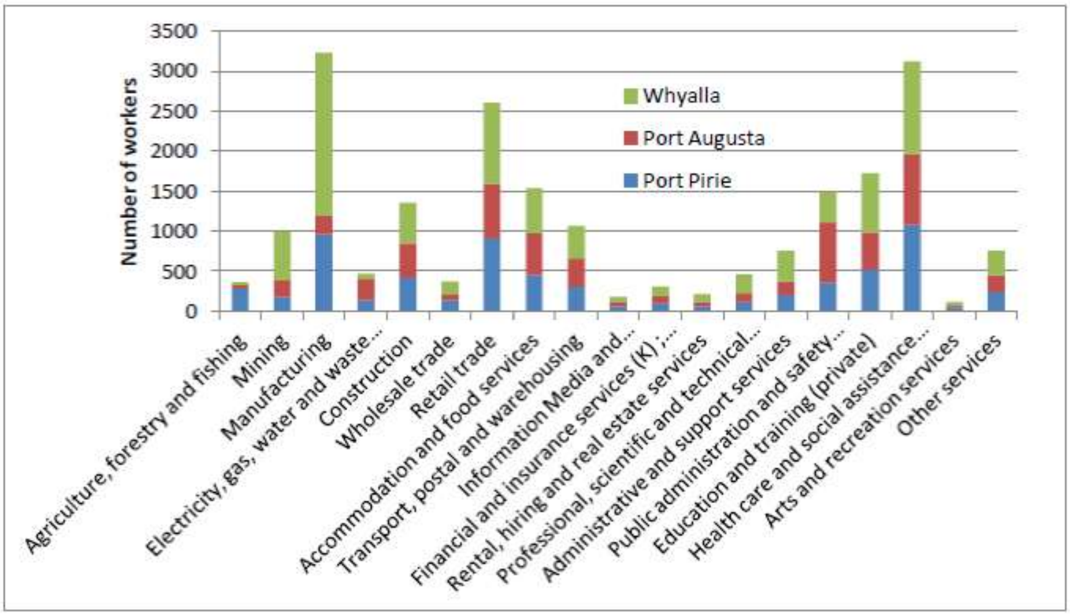
Table 1: Population, Workers and Business Snapshot - Upper Spencer Gulf Cities (source: Strategic Economic Solutions)

City	Population (LGA)	Share of State	Workers	Business Counts	Est GRP $m	Share of State
Port Pirie	17,333	1.10%	6,622	773	701	0.90%
Port Augusta	13,985	0.90%	5,740	506	637	0.80%
Whyalla	22,000	1.4%	9,158	724	1,043	1.40%
Total	53,318	3.4%	21,520	2,003	2,381	3.1%

On a cautionary note however, the three cities have only average capacity in fast growing industries, including education, health and telecommunications, suggesting economic performance over the next five years in these sectors will lag behind the rest of the state. In addition, the three cities are all below average in the share of technical, scientific and professional and business services enterprises. Building local capacity in these areas is vital if the Upper Spencer Gulf is to see more growth in a more diversified economy11 and take full advantage of its potential as a research and development testbed for renewable energy and associated technological applications.

These higher skilled job categories will be vitally important in developing and supporting renewable energy and clean technology businesses in the USG, along with labourers capable of providing the skills necessary for construction and maintenance of the technology-based equipment[12] [13] [14]. Whilst there are a significant number of construction businesses within the Upper Spencer Gulf, whether these businesses include the requisite skills to accommodate a growing renewable energy sector in construction and maintenance is unknown.

Figure 3: Employment by Industry - Upper Spencer Gulf Cities
(source: Strategic Economic Solutions)



Renewable and Low Emission Resources in the Upper Spencer Gulf

Introduction to Renewable and Low Carbon Resources

Renewable energy is energy obtained from natural resources that can be constantly replenished including: bioenergy, geothermal energy, hydro energy, ocean energy, solar energy and wind energy. Renewable energy technologies include technologies that use – or enable the use of – one or more renewable energy sources. For example, technologies that store energy generated using renewable energy or assist in the delivery of energy generated using renewable energy technologies to energy consumers[15 16].

Low-carbon or low-emissions energy comes from processes or technologies that produce energy with substantially lower amounts of greenhouse gas emissions than is emitted from conventional fossil fuel power generation. This includes electricity generation from both renewable and non-renewable sources, fuels for and modes of transportation and using, reducing, or eliminating existing fugitive greenhouse gas emissions.

Non-renewable, low carbon energy include nuclear, gas and fossil fuel based energy that employ carbon capture and storage.

Renewable and low carbon energy can be utilised for power, heat generation and transport. While power production by wind and solar energy is dependent on variable weather conditions, bioenergy, hydropower, geothermal and nuclear energy are almost always available when needed[17].

Due to their wide ranging scalability, renewable and low carbon energy can be adapted for numerous types of energy provision at domestic, commercial and industrial scales.

The Upper Spencer Gulf regional cities of Port Augusta, Port Pirie and Whyalla are ideally located in close proximity to some of the best and most diverse renewable and low carbon energy resources in the developed world[18].

Many of the renewable energy options are very good to excellent when compared to other parts of Australia and other parts of the world. The region combines high quality resources with good grid access.

This provides a regional advantage in prospective commercial scale renewable energy generation development, providing the grid capacity is not exceeded or, if the grid infrastructure is improved and upgraded to match the increase in generating capacity.

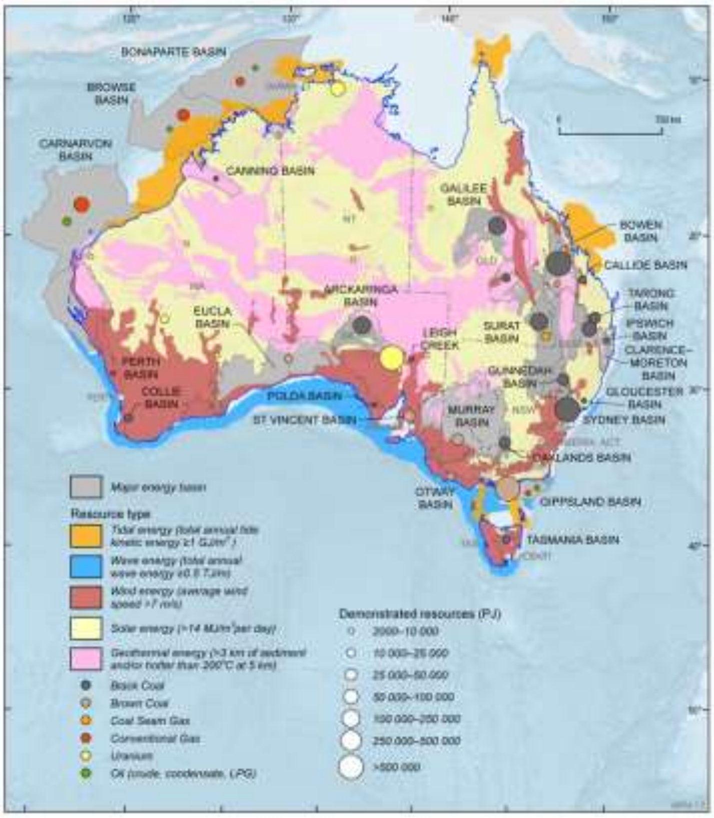


Figure 4: South Australian Energy Resources (Source: Geoscience Australia)

Solar

The quality of solar resources in the region is very high. The assessment of the solar resource is generally measured in a several ways, which are important for understanding which solar technologies best suit the region.

Global Horizontal Irradiance is the total solar radiation per unit area that is intercepted by a flat, horizontal surface. This value is of particular interest to photovoltaic installations and includes both diffuse horizontal radiation (solar radiation that has been scattered in all directions by the atmosphere) and direct normal radiation (solar radiation that comes in a direct beam from the sun). Direct Normal Irradiance is of particular interest to concentrating solar installations and installations that track the position of the sun.

The Upper Spencer Gulf receives well over 300 days of sunshine per annum, generating between 20 and 21 MJ/m2 average daily global irradiance and 23-26 MJ/m2 average daily direct normal irradiance. The long-term average global horizontal irradiance value is 5.191 kWh/m2/day (216.3 W/m2), direct normal irradiance value is 5.670 kWh/m2/day (236.3 W/m2), and the long-term average diffuse horizontal irradiance value is 1.631 kWh/m2/day (67.9 W/m2)[19].

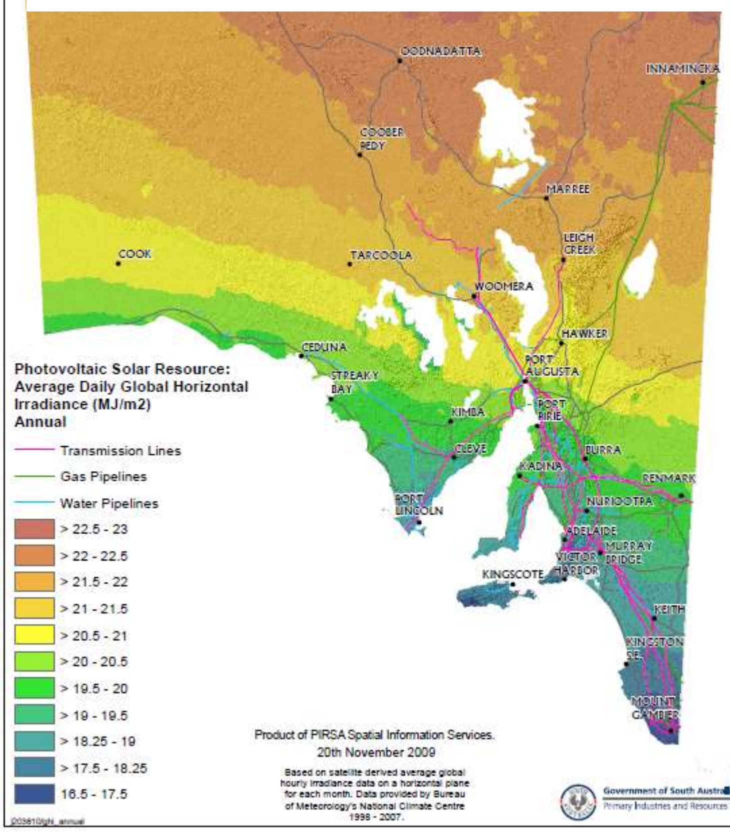
This resource provides very good opportunity for solar-based technologies including solar photovoltaic, concentrated solar thermal and large scale solar. This abundance of resource is also complemented by several solar research and development programs in the state, including shared research on solar technology between South Australia's three universities via the South Australian Renewable Energy Institute[20].

Solar Photovoltaic

Solar photovoltaic (PV) panels on the roofs of homes and businesses use energy from the sun to generate electricity. The conversion of sunlight into electricity takes place in cells of specially fabricated semiconductor crystals.

Almost 1.25 million small-scale solar power systems were installed across Australia by the end of 2013[21], generating 1.62 per cent of total electricity production. During the 2013-14 financial year 6% of South Australia's electricity was generated by domestic PV systems[22 23].

Figure5: Daily Global Horizontal Irradiance for South Australia (source: Government of South Australia)



South Australia was the first state in Australia to introduce a solar feed-in scheme to provide financial incentives for domestic installations of solar PV systems[24]. Despite closure of the feed-in scheme to new participants in 2013, investment in residential solar photovoltaic (PV) systems continues to rise, reducing overall consumption and peak demand profiles for the state[25].

In order to maximise future uptake and efficiency of solar PV, consideration to network capacity needs to be taken into account. Energy providers have raised concerns that a concentration of rooftop solar panels in some areas has the potential to undermine the quality of electricity supplies, feeding so much power back into the network that it can stress the system, create reverse flows, cause solar systems to switch off, voltage rises and power spikes that trigger shutdowns or 'tripping out or damage to household devices[26 27]. Power distribution lines and home wiring were designed for electricity to flow from power stations to appliances, but households with solar panels do the reverse of this. New inverter system products mitigate this impact as they limit power exported to the grid from solar systems and restrict the amount exported. Upgrading conductors and cables, retrofits and battery storage can also alleviate the issues.

In addition to quality solar resources, proximity to large, low cost, sparsely populated land parcels provides the Upper Spencer Gulf with additional opportunity for deployment of large-scale solar PV power generation.

Many large-scale PV farms are established worldwide with more planned or under construction. Australia has several small-scale PV farms, but none in South Australia[28]. A number of large-scale grid connected PV projects have been committed – including a 102 MW solar plant at Nyngan and a 62 MW facility near Broken Hill - but again, none in South Australia.

Large-scale solar PV uses the same technology as rooftop solar panels, but the industry is still in the early stages of development in Australia, primarily due to the relatively high levelised cost of electricity (LCOE) for this technology compared to wind[29].

Given a stable policy environment, the excellent solar resources, availability of sites and significant reductions in technology costs mean large-scale solar PV is likely to become a highly cost-competitive part of Australia's mainstream energy supply in the future[30], opening up considerable opportunities for the Upper Spencer Gulf.

Concentrated Solar Thermal

Concentrated solar thermal (CST) technology uses lenses and reflectors to concentrate sunlight, heating a fluid such as water or oil and producing steam to drive a turbine.

Research in Australia and internationally continues to highlight the benefits of solar thermal power generation in modern electricity systems[31], most notably that the technology offers stable, reliable power generation to support electricity network stability, complementing other more variable renewable energy technologies such as wind and photovoltaic power. The technology can be integrated with other thermal power sources such as biomass, geothermal or gas to provide a more reliable 24/7 hybrid power generation. This technology also offers additional industrial benefits in producing high-temperature steam that is valuable in some mining and industrial processes.

Concentrated solar thermal technologies also provides a dispatchable energy supply, with power output able to be adjusted based on grid demand. This makes the technology far more flexible than traditional solar PV plants.

There are several types of Concentrated Solar Thermal plants:

- Linear Fresnel – consists of long rows of flat or slightly curved mirrors that move independently on one axis. The mirrors reflect sun to fixed linear receivers mounted above them on towers.
- Tower – involves an array of heliostats (large mirrors with two-axis tracking) that concentrate sunlight onto a fixed receiver at the top of a tower.
- Dish – a highly efficient emerging technology in which a paraboloidal dish with two-axis tracking focuses sunlight to a point receiver.
- Trough – the most widely deployed technology. Uses parabolic mirrors to track the sun from east to west.

Solar thermal technology is being deployed to provide electricity in countries such as Spain, Germany and the United States. However, like utilities scale PV, solar thermal is still in the early stages of development in Australia, primarily due to the relatively high levelised cost of electricity (LCOE) for this technology compared to wind[32].

Australia currently has only one genuinely large-scale solar thermal plant – a 9.3 MW facility that is integrated with the Liddell coal-fired power plant in New South Wales. Covering some 18,490 square meters, the linear Fresnel array is used to pre-heat feedwater for the coal-fired power station. Construction is currently underway on the 44 MW 'Solar Boost' project at Kogan Creek in Queensland. Scheduled to come online in 2015, the plant uses linear Fresnel technology and will be Australia's largest solar thermal power station when complete.

The excellent solar resources, availability of sites, existing electricity infrastructure and reducing cost of technology means the Upper Spencer Gulf is ideally placed to take advantage of solar thermal technologies for large-scale energy generation, with growing interest in opportunities for commercialisation and deployment of new solar thermal technologies in the region.

To capitalize on this growth opportunity, local investment and capacity in skills, research and development will be required. Whilst Australian universities are leading solar thermal science and technology, producing highly qualified graduates – more will be needed to meet growing local and international demand[33].

Concentrated Solar Photovoltaic (CPV)

Another type of large-scale solar technology is concentrated solar PV (CPV), which uses lenses or curved mirrors to concentrate a large amount of sunlight onto a relatively small solar PV array. This requires less cost on PV panels; however the additional costs of lenses, mirrors and other infrastructure may outweigh these savings. Ongoing research into more efficient CPV technologies aims to bring the cost down further.

Australia's largest CPV facility is Solar Systems' 1.5 MW power station in Mildura, Victoria.

CASE STUDY

Port Augusta Solar Thermal Generation Feasibility Study[34]

Alinta Energy, the Australian Renewable Energy Agency, and the Government of South Australia have committed to jointly funding a two-year Port Augusta Solar Thermal Generation Feasibility Study.

The study involves a full feasibility and technological analysis of solar thermal power generation, including hybridised and standalone options at the Port Augusta Power Station with a view to future development of large-scale solar at site.

The initial options study considered six potential Concentrated Solar Thermal technologies for installation at or near Alinta's Augusta Power Stations: 1) Stand-alone parabolic trough; 2) Stand-alone power tower; 3) Stand-alone linear Fresnel; 4) Hybrid parabolic trough; 5) Hybrid power tower; 6) Hybrid linear Fresnel.

The options were each analysed on solar irradiance data, the most current technology performance data and capital and labour cost estimates scaled for application in Port Augusta and modelling of the predicted output of the various technology configurations. Dynamics in the National Electricity Market (NEM), potential for commercialization, third party investment, industry learnings, cost and practical obstacles were also considered, with Alinta now pursuing the full feasibility study on the basis of a stand-alone power tower plant.

The decline in the wholesale energy price due to falling demand and increasing supply, has made investment in additional generation with large capital costs difficult to rationalise. However, Alinta Energy acknowledges that solar thermal technology could have benefits beyond its generation capacity, including industry learnings and economic and community benefits.

In June 2015 Alinta Energy announced its intention to close its Port Augusta coal-fired electricity generation operation before March 2018.

The final, full feasibility study into the potential conversion of the plant to solar thermal is due in early 2016.

CASE STUDY

Vast Solar - Modular Solar Thermal[35]

Vast Solar was founded in 2008 to develop a concentrating solar thermal power system capable of competing on price with wind power in the near term.

Vast Solar has developed innovations in central receiver (power tower) design that significantly reduce the cost of the solar array – the largest element of capital cost in a solar thermal system – while maintaining the economies of scale and turbine efficiencies achieved from centralised, high temperature power block configuration, and delivering cost efficient thermal energy storage.

In mid-2014, with support from the Australian Renewable Energy Agency (ARENA), the company commenced construction of a 6 MW (1.1 MWe) CST power pilot plant at Jemalong, near Forbes in New South Wales. When complete, the project and will be the only standalone solar thermal power plant with thermal energy storage generating power to the grid in Australia. The plant is expected to be operating to supply electricity into the National Energy Market in 2015.

Opportunities exist in the Upper Spencer Gulf for deployment of this technology as a cost effective, high efficiency CST generation system that also includes thermal storage, enabling the plant to generate electricity day or night on demand.

Wind

Wind power is currently the cheapest source of large-scale renewable energy and the most widely deployed in South Australia[36]. This technology involves generating electricity from turbines that capture wind energy within the area swept by their blades. The spinning blades drive an electrical generator that produces electricity for export to the grid.

In 2013, Australia's wind farms produced over a quarter of the country's clean energy and 4 per cent of Australia's overall electricity during the year. From a global context this places South Australia as one of the leading jurisdictions in the world for wind power, second only to Denmark for market penetration[37].

South Australia has the most wind farms of any state in Australia (41 percent of installed capacity), with 33 per cent of its electricity demand being satisfied by wind power during 2013-14 financial year[38]. Over half of these installations are located in the Mid North of the state, adjacent the Upper Spencer Gulf.

The Upper Spencer Gulf and adjacent Eyre Peninsula also offers extensive opportunities for wind generation, with four wind zones identified as particularly attractive[39]. These zones experience peak wind speeds above 8 metres per second with potential for more than 10,000 MW of generation[40]. A 2010 assessment of wind speed at Port Augusta also found the long-term average wind speed conducive to wind energy.

While wind generation could be considered a mature technology, it is still an area of active research and development. There remains substantial investment in improving the efficiency, reliability and deployment of the technology[41].

The biggest gains are being achieved by focusing on the capacity factor of the turbine, which helps keeps energy cost low by maximising power. Capacity factors are improved by increasing the size of the rotors used on wind turbines. Increasing the size of the turbine rotors creates new challenges for manufacturers, however. Rotors scale poorly with size, so the cost can go up faster than the revenue generated by the increased capacity factor. Furthermore, industrial scale wind farms often cause considerable community division[42] and must be developed and operated in a socially responsible manner[43]. In the Upper Spencer Gulf, avoiding landscapes of high scenic amenity and mitigating impact on neighbours are important considerations that will require careful land use planning and zoning consideration.

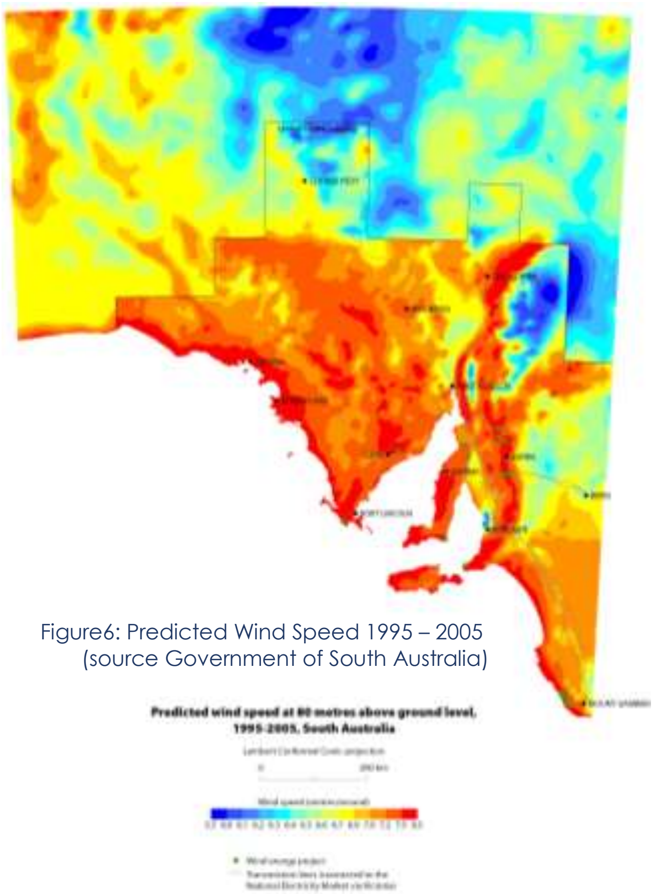


Figure6: Predicted Wind Speed 1995 – 2005 (source Government of South Australia)

Table 2: Installed wind energy in Australia by State (source: Government of South Australia)

State	Installed capacity (MW)	Number of turbines	Number of projects
South Australia	1473	649	17
Victoria	1041	518	14
Western Australia	478	~300	18
New South Wales	282	170	9
Tasmania	310	124	7
Queensland	12.5	22	2
Northern Territory	0	0	0
ACT	0	0	0

CASE STUDY
Pt Augusta Renewable Energy Park[44]
Commencing project feasibility investigations in 2010, DP Energy Australia is proposing to develop an integrated renewable energy power station, designed to exploit the complementary diurnal cycles in both the wind and solar resource of the coastal plains south of the Port Augusta city.

The location of the project, lying between the Flinders Ranges to the east and the Cultana range to the west and between the desert and ocean results in a very reliable thermally driven wind pattern driven by the temperature difference between the land and sea and directed by the adjacent ranges. Coupled with the complementary characteristic of the solar resource and close proximity to the grid, the site provides a unique combination which enables the generation profile to be optimised to the demand profile.

The project will comprise approximately 150MW wind generation capacity and approximately 150MW of solar photovoltaic (PV) generation capacity. The wind component will consist of up to 59 turbines with generation capacity of 2.5-3.0MW, with the solar component consisting of arrays of ground mounted PV modules arranged in rows, spanning an area of around 375 hectares.

The project is currently undertaking a number of detailed technical investigations ahead of formal lodgment of a development application.

CASE STUDY
Green Grid[45]
The 'Green Grid' report investigated transmission infrastructure needed to support large scale (2000MW) wind farms on the Eyre Peninsula. The study found a business case for connecting the regional wind zones to the National Electricity Market and proposed a green grid on the Eyre Peninsula supported by capacity upgrades which would allow South Australia to become a significant exporter of electricity. The proposal was, however, reliant on substantial infrastructure upgrades and extension.

Specifically the report proposed that a high voltage 500 kilovolt (kV) above ground transmission network be established from Davenport (near Port Augusta) to western Eyre Peninsula to connect new generation of up to 2000 MW at an estimated capital cost of $613m.

The report identified grid expansion and congestion issues and well-known overall transmission constraints as potential obstacles, noting previous efforts to resolve them have been unsuccessful. Additional challenges included high financing costs, low Renewable Energy Investment Certificate (REIC) price and difficulty securing sufficient value Power Purchase Agreements. In combination, these challenges encourage investment where the transmission access is strongest.

Investment in the Green Grid would enable the South Australian electricity system to support a very different fuel source from current arrangements. In times of high wind, enough power would be generated to meet the entire State's average electricity needs. In practice, a large amount of this power would flow to Victoria which operates a 500kv network.

CASE STUDY
Ottoway Engineering, Whyalla
Local Upper Spencer Gulf company Ottoway Engineering (formerly E&A Contractors) have expanded their Whyalla operations to include the fabrication and manufacturing of wind towers, in partnership with international company Siemens[46]. The company manufactured towers for the Snowtown II wind farm south of Port Pirie – one of the state's largest wind farms, generating up to 360MW of power[47]. The 80m tall and 180 tonnes towers were constructed in Whyalla in three parts and then assembled on site at Snowtown[48].

With $2 million State Government support, this new investment in the renewable energy sector has demonstrated a commitment to establishing the wind tower business in South Australia and helped reinforce the Upper Spencer Gulf's transition towards a prosperous, clean energy future, economic diversification[49].

CASE STUDY

Adelaide University Wind Turbine Efficiency Research[50]

The Institute for Mining and Energy Resources (IMER) at the University of Adelaide is leading research with two projects focused on efficiency and design of wind turbine towers and wind farms having strong application potential for new projects.

The first initiative focuses on improving wind farm design to increase efficiency. This research project has developed algorithm-based optimisation software for wind farm design, with investors saving time and money by using the software to assess wind farm design and improve efficiency of wind farms.

The second project focuses on using wakes to better design wind farms, recognizing that current clustering of wind turbines creates issues with turbine operation in the wake of surrounding towers, impacting on power output, dynamic loads and failure lifetime of the turbines as well as creates noise associated with wind farms.

Future research for the Institute includes quantifying the level of noise from wind turbines and investigating the mechanics of producing quiet turbines.

Geothermal

Geothermal energy uses the earth's natural internal heat to generate electricity and heating. Geothermal energy has the potential to sustainably provide large amounts of low-emission, base-load electricity and can also be used to power industrial processes via direct-use applications (including desalination distillation, district heating and cooling), and for ground source heat pumps.

The majority of geothermal resources are convective hydrothermal systems found in areas associated with volcanic activity. These conventional geothermal resources generate significant volumes of steam and hot water at high temperatures (between 150 – 300 degrees) and at relatively shallow depths of one to three kilometres.

Conventional geothermal resources have been used for electricity generation for around a century and provides around 0.3% of the world electricity generation across 28 countries[51]. The United States is one of the largest geothermal electricity generators, with Iceland and El Salvador both sourcing just over one quarter of their total electricity generation from geothermal sources and around 17 per cent in both the Philippines and Kenya[52].

Due to its geological stability, conventional geothermal resources are not found in Australia. Instead 'unconventional' sources of heat provide a combination of heat from naturally occurring radioactive materials such as uranium, thorium and potassium, along with conducted heat from deeper within the earth's mantle. Accessing this resource often requires deeper wells to attain the desired temperature and stimulation by hydraulic, chemical or thermal means to improve permeability. However, there are extensive areas where temperatures are estimated to reach at least 200°C at around 5 km depth[53].

Australia's unconventional geothermal resources are generally categorised as either hot sedimentary aquifers (HAS) or enhanced/engineered geothermal systems (EGS), with other technologies and extraction methods also being explored.

The geothermal sector in Australia is still in the early stages of development, accounting for only around 0.001% of national clean energy generation. Only one geothermal system is in production (Birdsville), with a pilot plant in trial and testing phase (Geodynamics Ltd Innamincka Deeps project)[54]. A number of cooler, shallower systems are also being considered for local heating applications[55] .

Ground source heat pump systems are a direct-use technology that use the ground itself as a heat source, rather than steam or water, to heat and cool buildings. Heat is extracted from the ground and delivered to the building in winter and removed from the building and stored underground in summer. Whilst ground source heat pump utilises an electric motor to circulate heat-carrying fluid, energy consumption is significantly reduced compared with conventional heating and cooling systems. China is the largest consumer of direct geothermal energy, followed by Turkey, Germany, Iceland and Switzerland[56].

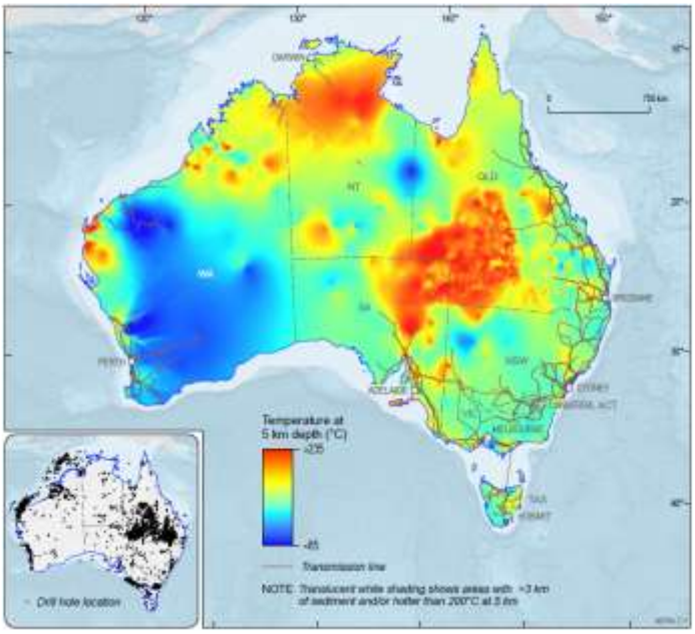


Figure 7: Predicted Temperature at 5km Depth (source: Geoscience Australia)

Figure 8: Geothermal Tenements in the Upper Spencer Gulf

South Australia was the first state in Australia to introduce a regulatory framework specifically tailored to the rapidly developing geothermal industry[57], with 55% of the nation's geothermal licences now located in the state. A number of geothermal tenements exist in, and adjacent the Upper Spencer Gulf, near Port Pirie and Port Augusta[58].

A key challenge with geothermal energy in Australia is that some of the more prospective geothermal resources are located long distances from transmission and distribution networks and load centres[59]. Demonstration of the commercial viability of geothermal energy in Australia will assist in attracting the capital investment required for geothermal energy development. The off-grid market may provide both a higher power price plus co-location making initial development of the sector more commercially feasible. Government policies, energy prices and falling investment costs and risks are projected to be the main factors underpinning future growth in world geothermal energy use[60].

CASE STUDY

Habanero Pilot Plant – Far North

The Innamincka Enhanced Geothermal Systems project is focused on the development and commercialization of geothermal energy generation in the Cooper Basin in South Australia. Enhanced Geothermal Systems or EGS is the use of heat from hot rocks, generally granite bodies, located between 3 and 5 km below the surface for power generation. EGS technologies enhance and/or create geothermal resources in the granites through 'hydraulic stimulation'.

The 1MWe Habanero Pilot Plant trial was successfully completed in 2013, supported by a grant of $90 million through the Australian Government's Renewable Energy Demonstration program. Prior to completion of the trial, the plant was operating at 19kg/s and 215°C production well-head temperature. The trial results exceeded modelled expected values, achieving the best recorded closed loop flows and highest well-head temperatures ever achieved at Habanero with availability exceeding 75% up-time since commissioning[61].

The pilot plant trial also identified a number of barriers to the success of future EGS projects in the region including high capital costs of further development of power generation and a lack of technology to remotely identify existing faults in granite rocks[62]. Despite this, the supply of direct process heat to a closely located gas plant was assessed to be viable without subsidy or assistance.

Marine Energy

Marine energy uses the movement of water to generate electricity from tides, waves or ocean currents.

Much of the southern half of the Australian continental shelf stretching from Western Australia, Victoria, South Australia and Tasmania have been identified as having world-class wave energy resources, with the Northwest Shelf, Torres Strait, Darwin and southern Great Barrier reef demonstrating potential for tidal energy[63].

Whilst wave energy potential is very low within the Upper Spencer Gulf, it does offer some medium range tidal energy potential[64].

Some opportunities for wave energy do exist to the immediate west and south of the Upper Spencer Gulf however, with demonstration plants previously being considered near Elliston on Eyre Peninsula and southern Yorke Peninsula[65].

CASE STUDY

Wave Rider Energy[66]

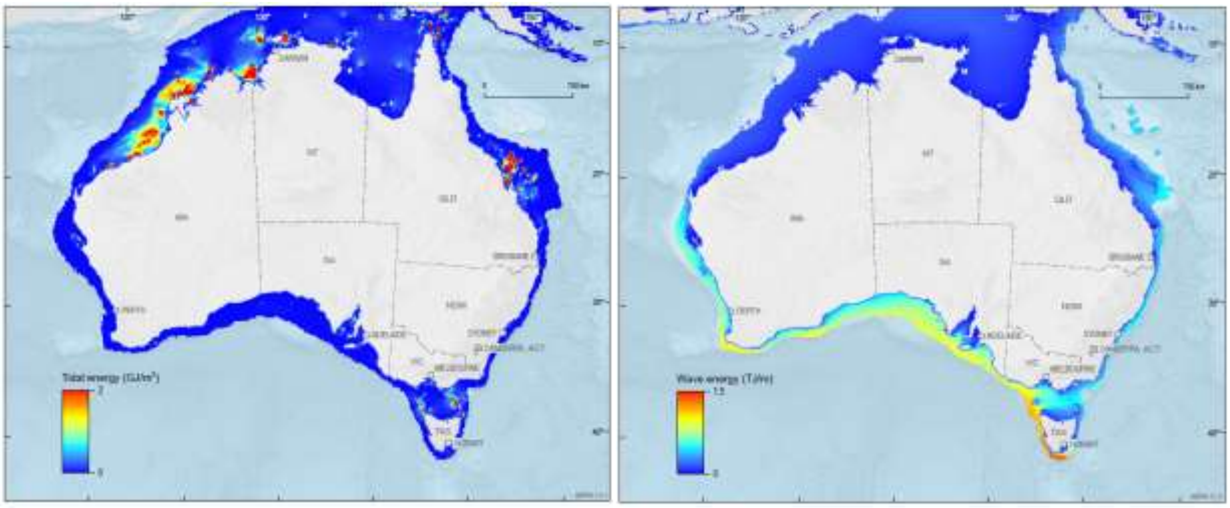
In 2013 South Australian renewable energy company 'Wave Rider Energy Pty Ltd' announced plans to develop wave energy along the South Australian coastline, based on positive results from a pilot plant near Elliston on Eyre Peninsula's west coast.

The focus of the project is to develop an efficient wave energy conversion technology, generating power by harnessing the kinetic energy of waves pushing against a series of buoys. The structure is an open steel truss, 110 metres long and 13 metres wide, with numerous buoyancy pontoons to keep it afloat. When completed will float about 800 metres off Elliston on Eyre Peninsula.

The Wave Rider pilot generated electricity from ocean waves and remained stable in high wave conditions, proving the technology concept and generating valuable data.

The construction of a pre-commercial platform now requires significant capital investment in order to reach the commercialisation phase.

Figure 9: Tidal Energy and Wave Power Potential
(source: Geoscience Australia)



Bioenergy

Bioenergy is derived from converting organic material (biomass) into forms of energy such as electricity, heat and liquid fuels.

Common sources of bioenergy include sugar cane residues (also known as bagasse), landfill gas (the methane produced by landfill), agricultural crop and livestock waste, household garbage, sewage gas, wood waste, black liquor (a by-product of the paper-making process) and energy crops such as algae.

Bioenergy currently represents 1.5 percent of total global electricity generation but provides 10 percent of the world's primary energy consumption[67], mostly in non-OECD countries where it is used for direct burning.

It is anticipated that biomass could provide the source for around 4 per cent of total global electricity generation and 6 percent of transport fuels by the end of the next decade[68].

In Australia, biomass currently provides just over one per cent of total electricity generation and represents seven per cent of total clean energy production. More than 60 per cent of this capacity currently comes from the combustion of bagasse, 20 percent from landfill gas and two percent capacity from food, forestry and agricultural waste[69].

Whilst more traditional sources of biomass are not widespread in South Australia, algae-based bioenergy (particularly for fuels) offers substantial potential for South Australia and the Upper Spencer Gulf due to the levels of solar radiation, availability of saline water (i.e. seawater), low value land and nutrient feedstocks such as waste streams[70] [71]. The Upper Spencer Gulf also offers additional benefits of access to carbon dioxide (CO2) supply and waste heat from a number of existing industrial processes located in the region that can support algae production[72].

Bioenergy has the potential for extremely strong growth over the coming decades but will require a more favourable financial environment, capacity for grid connectivity and increased research, policy certainty and support for this to be realised[73].

The South Australian Government is currently developing a Bioenergy Roadmap for the state, with potential for bioenergy in the Upper Spencer Gulf region to be considered in the first stage of this work ahead of more detailed spatial assessment in targeted locations along with identification of commercial conversion technologies and analysis on feedstock supply, logistics and demand characteristics for the prospective locations. The final stage will include community and industry engagement, feasibility and then building of projects[74].

Table 3: Bioenergy Plants Operating and Under Construction in Australia (source: Clean Energy Council, 2013)

State	Number
Australian Capital Territory	3
New South Wales	37
Northern Territory	1
Queensland	43
South Australia	8
Tasmania	4
Victoria	28
Western Australia	15
Total	139

CASE STUDY

Muradel Biofuel Demonstration Plant - Whyalla

An initiative of Murdoch and Adelaide Universities, Muradel has domesticated several highly salt tolerant strains of indigenous microalgae which can be cultivated in seawater, brine from desalination, or salty groundwater.

Propagation occurs in large, shallow ponds, with microalgae growth capturing carbon dioxide recycled from the Muradel plant and, in the future, intercepted from the emissions of neighbouring heavy industry.

Harvested microalgae and other carbonaceous materials, such as plant matter and biosolids, provide the feedstocks for conversion to green crude oil using hydrothermal liquefaction. The harvesting and conversion processes produce next to no waste as Muradel recycles water, nutrients and carbon dioxide back into the microalgae production ponds – a closed-loop recycling system [75].

Whyalla, in the Upper Spencer Gulf, is ideally suited to microalgae production and green manufacturing, offering a stable, sunny and warm climate, flat readily available non-arable land, abundant seawater and established transport infrastructure.

If successfully scaled to a commercial plant, it would produce 500,000 barrels of refinable green crude a year by 2019 which would provide enough petrol and diesel to fuel 30,000 vehicles for a year[76].

At a time when Australia imports most of its crude and refined transport fuels, Muradel's advanced biofuel technology is hoping to improve Australia's terms of trade, reduce life-cycle greenhouse gas emissions, and improve Australia's fuel security.

The planned 1000-hectare commercial plant would also create at least 100 new skilled and operational jobs in the Whyalla region.

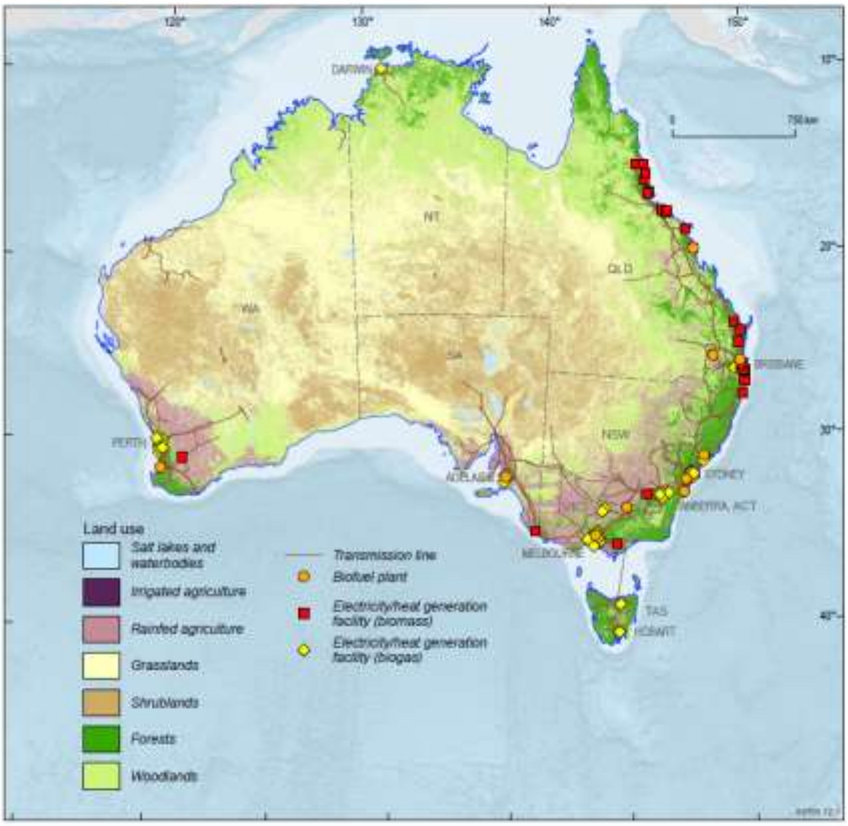


Figure 10: Australia's Bioenergy Potential (source: Geoscience Australia)

Hydroelectricity

Hydroelectricity is generated when falling water from reservoirs or flowing water from rivers, streams or waterfalls is channelled through water turbines. The pressure of the flowing water on the turbine blades causes the shaft to rotate and the rotating shaft drives an electrical generator which converts the motion into electrical energy.

Hydroelectricity is a mature renewable energy technology, providing some level of electricity generation in around 150 countries[77]. Whilst this is an important energy source in many countries, it provides only 2 percent of primary energy consumption globally and 0.8 percent in Australia, although it does account for around 58 per cent of the renewable electricity produced in Australia[78], mostly by Tasmania's 35 hydroelectric plants and the Snowy River Hydro Scheme in New South Wales.

The technology has the advantages of low greenhouse gas emissions, low operating costs, and a high ramp rate (quick response to electricity demand), enabling it to be used for either base or peak load electricity generation, or both[79]. The amount of electricity generated depends on the volume of water and the height of the water above the turbine.

Large hydroelectric power stations need dams to store the water required to produce electricity. The flow of water out of the dam to drive the turbines is controlled by the opening or closing of sluices, gates or pipes. The dams are often built to hold irrigation or drinking water, and the power station is included in the project to ensure maximum value is extracted from the water.

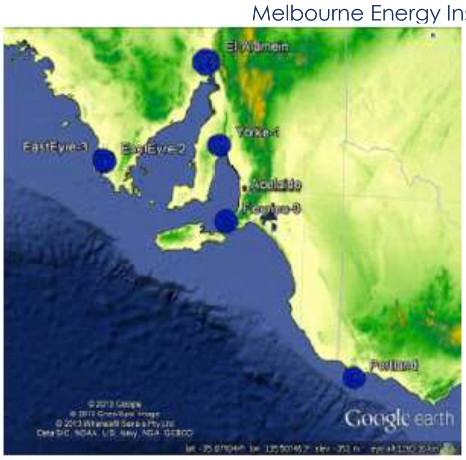
Smaller hydroelectric power stations (called mini or micro hydro) do not generally need dams but rely on naturally flowing water such as streams. These provide a good source of power and are often used as stand-alone systems not connected to the main electricity grid.

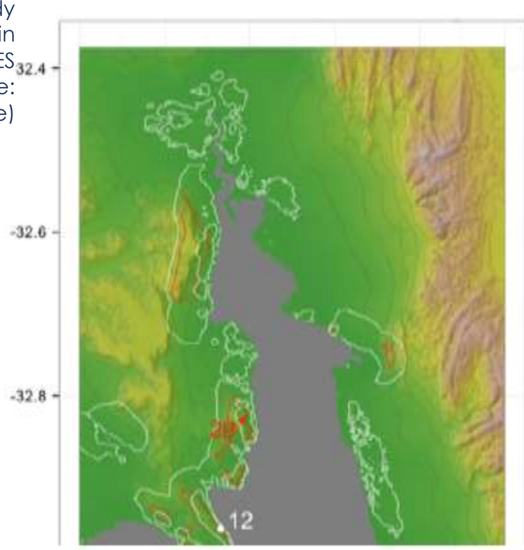
South Australia has limited water resources and only operates mini and micro hydro generation at Hope Valley Terminal Storage (2.5 MW), Seacliff Park (0.9 MW) and on-site use of water energy recovery devices at the Adelaide Desalination Plant[80].

SA Water is also installing a micro-hydro system at the Winninowie tanks in the Upper Spencer Gulf. The performance of this system will be closely monitored and it is envisaged that under the right circumstances, other remote water network sites could benefit from this technology to avoid costly electricity network extensions[81].

The main future opportunities for the Upper Spencer Gulf are for hydro systems to be used for pumped storage technology as evolving electricity supply systems place greater value on stored energy[82]. This technology can be important in managing variable renewable energy supplies such as wind or solar energy and is briefly covered in the next section dealing with enabling technologies and opportunities. Proximity and height of ranges to the gulf and existing dams and reservoirs provide solid opportunity for further investigation.

Figure11: Pumped Hydro Electricity Storage Case Study Sites across South Australia and Victoria and (right) sites in the Upper Spencer Gulf with potential for seawater PHES as indicated in red and white contours (Source: Melbourne Energy Institute)





CASE STUDY

Opportunities for Pumped Hydro Energy – Melbourne Energy Institute[83]

The Melbourne Energy Institute, in collaboration with ARUP identified opportunities for pumped hydroelectricity energy storage across Australia, finding considerable potential for the Upper Spencer Gulf.

Several case-study sites were selected based on high-level analysis of parameters such as site elevation, distance from the coast, and construction costs, wind quality and distance to the electricity transmission grid. Scope for development of seawater "turkey-nest" type PHES sites may also be used in combination with wind farms, with economic returns greater than 46% reported in some cases.

Parameters such as seawater quality, conservation values and competing land-use and ownership constraints were not considered in the study however and would be a logical next step if the opportunities for PHES were to be progressed further.

Nuclear

Electricity generation from nuclear power reactors is widely deployed internationally, currently supplying about 11 percent of the world's domestic electricity, with installed capacity to provide up to 14 percent[84 85]. Electricity generation from nuclear energy is not renewable, but is a recognised source of low carbon (ie low greenhouse gas emissions), base load electricity.

There are currently 395 nuclear power stations operating in 30 countries worldwide; 43 in Japan on shutdown awaiting possible restart; 66 under construction in 15 countries and 165 new reactors planned[86].

France generates 75% of its electricity through nuclear power, 30% or more in Belgium, Bulgaria, Czech Republic, Finland, France, Hungary, Japan, South Korea, Slovakia, Slovenia, Sweden, Switzerland and Ukraine. The USA has 100 reactors operating, supplying 20% of its electricity.

Current demand for uranium for electricity generation is mainly from the United States, the European Union, Japan, China, Russia, South Korea, Canada, Ukraine, India and Taiwan. Future demand is expected to come mainly from China, Russia, India and Korea, but is also dependent on whether the uranium is used in a 'once-through' cycle or reprocessed and efficiency improvements of nuclear energy reactors[87].

There are a number of different types of reactor design currently in operation, with the most common being the light water reactors (pressurised water reactor or boiling water reactor) and pressurised heavy water reactors. The main differences are in the techniques for cooling the reactor core and moderating the nuclear fission reaction.

Almost 200 operating reactors, mostly built during the 1960's, are due to be decommissioned in the next 25 years[88]. The design, safety and operational efficiency of modern nuclear facilities have improved significantly since the construction and operation of reactors involved in the Fukushima and Chernobyl accidents, however the risks cannot be entirely eliminated.

Research is underway into smaller capacity nuclear reactors to reduce capital costs and provide flexibility to supply smaller grids, regional communities or stand-alone industrial users. Six new types of nuclear reactor technology (Generation IV reactors) are under development with primary focus on improving reliability, safety, efficiency and cost-effective. Four of these are 'fast neutron reactors' with the other two operate with slow neutrons like current plants. The reactors are cooled by either light water, helium, lead-bismuth, sodium or fluoride salt. All operate at higher temperatures than current reactors, but three operate at lower pressure, some are using thorium (which doesn't require enrichment) and some also produce hydrogen, which has application as a transport fuel.

As there are no nuclear power stations in Australia, uranium mined in South Australia is mostly exported for power generation overseas. Other major uses for uranium include in the manufacture of radioisotopes for medical applications and in nuclear science research using neutron fluxes. Australia is the world's third largest producer of uranium[89 90], behind Kazakhstan and Canada.

Olympic Dam, to the north of the Upper Spencer Gulf, is the world's largest uranium deposit and it is estimated to contain approximately one third of the world's total reasonably assured resource[91].

Whilst there are currently no plans for Australia to have a domestic nuclear power industry[92], the Australian Government notes that nuclear technologies may present a high efficiency, low emissions option for future reliable energy that can be readily dispatched into the market[93].

Any potential change to the current involvement in South Australia with the nuclear fuel cycle is likely to impact on the Upper Spencer Gulf and the broader hinterland. Additional mining, potential for processing, electricity generation, transport of materials via road, rail or sea-port, research and development, industry workforce planning and skills development and waste disposal will provide both opportunities and risks for the region.

CASE STUDY

SA Government Royal Commission – Nuclear Fuel Cycle

In February 2015 the South Australian Premier, Jay Weatherill announced a Royal Commission into the Nuclear Fuel Cycle[94]. Established on 19 March 2015, the main purpose of the Commission is to inquire into whether there is any potential for expansion of the current level of exploration, extraction or milling of minerals containing radioactive materials in South Australia, and the feasibility of the State becoming involved in:

- Potential for the expansion of exploration and extraction of radioactive minerals
- Further processing of minerals and manufacture of materials containing radioactive substances
- Use of nuclear fuels for electricity generation
- Management, storage and disposal of radioactive and nuclear waste.

Four issues papers have been released by the Commission addressing these topics, with an expert advisory committee comprising leaders from academia, law and industry also established to support the work of the Commission.

The investigation is also likely to consider issues such as the effect on the economy and the environment, nuclear safety, renewable energy technology, impact upon communities, the effect on other sectors of the State's economy, in particular the tourism, wine and food sectors and technical feasibility issues.

The Commission will produce its final report by 6 May 2016.

'Clean' Coal
Clean coal technologies reduce emissions of several pollutants, reduce waste and increase the amount of energy gained from each tonne of coal. They include various chemical and physical treatments applied pre- or post-combustion and can be broadly divided into processes relating either to combustion efficiency or pollution control. Of Australia's approximately 30 coal-fired power plants, only four employ clean coal technology.

Designation of a technology as a 'clean coal' technology does not imply that it reduces emissions to zero or near zero. For this reason, the term has been criticised as being misleading and more appropriate to refer to 'cleaner coal'[95].

Carbon capture and storage (CCS) is a concept technology still under development that offers much higher prospects of emissions reductions than other clean coal technologies. CCS involves capture of CO2 either before or after combustion of the fuel; transport of the captured CO2 to the site of storage; and injection of the CO2 in deep underground reservoirs for long-term storage (known as geosequestration).

CCS is proposed as a means of reducing to near-zero the greenhouse gas emissions of fossil fuel burning in power generation and CO2 production from other industrial processes such as cement manufacturing and purification of natural gas.

The majority of CCS research effort is in incorporating CCS into new power generation plant designs[96].

The implementation of clean coal technologies also remains limited by the finite nature of non-renewable fossil-fuel energy resources.

CASE STUDY
Solar Hybridised Coal Gasification[97] [98]
Researchers at the University of Adelaide have been investigating the feasibility of solar hybridised coal gasification technology for producing transportable liquid fuels. This potential is being explored using the solar irradiance energy and coal present in the Ackaringa basin, to the north of the Upper Spencer Gulf.

Coal Gasification is the conversion of solid fuel (coal), water and oxygen into "syngas". Syngas can be used to generate electricity, used as synthetic natural gas or in the production of chemical feedstocks. Syngas can also be converted to a liquid fuel which can be easily transported from production site to customer. Gasification also creates Hydrogen gas which can be used to fuel hydrogen cars and make ammonia.

Traditional methods of coal gasification create high levels of emissions and harmful pollutants, however solar gasification reactors provide the potential for an alternative gasification process which utilizes the readily abundant solar energy on site at coal fields in central Australia.

Liquid fuel created from coal gasification using solar irradiance reactors has a much smaller carbon footprint and have the potential to be much more efficient.

Co-generation and Tri-generation

Co-generation both generates power and makes use of the heat that is produced during the process. Tri-generation takes this a step further by also producing cooling as part of the process. Both are extremely efficient technologies. Co-generation can be up to 80 per cent more efficient than conventional energy sources and produce around 60 per cent less carbon emissions.

Australia has approximately 3305 MW of co-generation installed, with another 18 MW of tri-generation[99].

Co-generation and tri-generation can use a variety of fuel sources, including biogas, biomass, natural gas, coal and petroleum products. There is also emerging innovation in the use of solar cogeneration[100]. The 0.6 MW Colignan Cogeneration plant in Mildura, Victoria, demonstrated an innovative use of food and agricultural waste by turning grape by-products into electricity[101].

The fundamental principle of co-generation is that systems are designed in close proximity to their place of use and are matched to the required capacity. Co-generation can be installed as a retrofit to existing buildings, with many examples of facilities supplying energy and heating in applications such as hospital and health facilities, leisure and aquatic centres, hotels, cinemas and hospitality venues, industrial, manufacturing, commercial and retail facilities, schools and universities, horticulture, airports and a variety of public utilities including NSW RailCorp and Sydney Water.

While co-generation and tri-generation are proven technologies, their broader use is being hampered by overly complex grid connection processes, often heavy regulatory burdens and the ongoing rise in natural gas prices.

CASE STUDY
Sundrop Farms

Sundrop Farms is transforming the way farming works to focus on sustainable expansion to conserve resources. Sundrop Farms' innovative technology does not rely on the previously limiting factors of fresh water, farmland and fossil fuels. Instead, concentrated solar thermal technology provides the energy to generate electricity, heat and desalination of seawater for the hydroponic greenhouse operation.

Following a successful pilot plant, Sundrop Farms is expanding its Port Augusta operation to a 20 hectare commercial site, supplying truss tomatoes for Coles supermarkets across Australia.

Sundrop is the world's first commercially and environmentally sustainable arid climate agriculture business[102].

The operation will create at least 100 new jobs during the construction phase and 200 ongoing jobs in the Upper Spencer Gulf – from greenhouse workers through to research and development.

The state Government has committed $6 million to support the expansion project. The expansion also has $150 million in support from international investor KKR[103].

Enabling Technologies and Opportunities

The renewable energy potential for the Upper Spencer Gulf can be significantly enhanced with a range of other technologies and opportunities. While these do not directly generate renewable energy, they assist in supporting its development, efficiency and overall sustainability.

Clean Tech Sector

Clean technology ("cleantech") is a general term used to describe products, processes or services that reduce waste and require as few non-renewable resources as possible[104].

Renewable energy falls within the cleantech sector, along with other technologies and services including resource efficiency, low emissions technologies, water and waste reuse and energy demand management[105].

The total value of clean technologies by the end-use sector globally is expected to rise by over 250 per cent to $525 billion in 2019[106]. This represents average annual growth of 13.5 per cent for the 10-year period from 2009.

The South Australian Government has a particular focus on developing the state's cleantech sector, engaging with local companies, industry associations, researchers and policy makers through initiatives including forums and awards, supporting the formation of industry clusters and development of the 'Cleantech Industry Capability and Opportunity Prospectus'[107].

South Australia and the Upper Spencer Gulf has particular opportunity to support and facilitate cleantech applications that are either intrinsic or highly complementary to the growth of the region's renewable energy sector, for example:

- Energy sector - electricity transmission and distribution through smart grid and micro grid technologies including demand management, load control and storage
- energy efficiency through new technologies for applications such as building cooling and heating, energy demand systems, lighting, low energy machines and devices, low-energy houses, refrigeration, industrial processes
- Waste management, processing and resource recovery at household, commercial and agricultural levels
- Water infrastructure, irrigation and control systems, water processing, desalination and filtration, water harvesting and storage options, particularly in arid environments.

The proximity of the Upper Spencer Gulf to mining, renewable and manufacturing sectors, infrastructure, existing manufacturing capabilities and opportunity for industry synergies augers well for placing this region at the fore of potential growth in these areas.

The South Australian Centre of Economic Studies reinforces these opportunities, noting the potential of the region in renewable energy and that industry-research clusters are an engine of innovation and economic growth[108].

Potential also exists for local companies with expertise in manufacturing, services and technology to capitalise on cleantech opportunities emerging as a result of wide interest in a diversity of mineral, petroleum, gas and renewable energy deposits. Potential applications include suppliers of energy efficient housing, small to medium-scale distributed energy generation, smart mini-grid technologies, energy efficient mineral processing and resource recovery systems and water processing and storage technologies.

Other complementary cleantech solutions such as distributed energy generation, electricity storage and demand management technologies and services should also be explored by the Upper Spencer Gulf alongside growth of renewable energy. As renewable energy generation capacity increases so too will the need for utility-scale smart grid technologies to support seamless integration and provide tools and techniques for electricity supply to be stable and reliable.

Another driver for the expansion of these new integration technologies, tools and techniques for electricity distribution will be its adoption in relatively small, geographically defined areas. Whilst the South Australian Government is heavily committed to expanding the Tonsley Park Sustainable Technologies precinct in Adelaide, there is opportunity for the Upper Spencer Gulf to provide an important adjunct to access land for field testing, deployment of pilot and commercial scale operations and industry synergies.

To realise this potential in a highly competitive and rapidly expanding market, it is imperative that the Upper Spencer Gulf builds its capabilities and positions itself to take advantage of these emerging high-growth industry opportunities.

CASE STUDY

Australian CleanTech[109]

Based in Adelaide and with growing links into the Upper Spencer Gulf, Australian CleanTech supports industry participants through development of policy initiatives that stimulate Cleantech jobs, investment and trade, introductions between compatible investors and project proponents, access to Chinese and Korean investors and partners and strategic advice to industry on what cleantech solutions will improve their operations.

Australian CleanTech has worked with Governments, leading Australian and Asian companies, emerging companies and investors to help deliver some of country's leading edge cleantech projects.

The Australian Technologies Competition is one such initiative that provides a profile and mentoring to Australian small to medium enterprises who have developed a technological solution in mining, food and agriculture, advanced manufacturing, energy, the built environment or global development applications.

The company also maintains a global database that tracks progress of over 2500 cleantech companies, including over 1300 Australian companies. The assessment of each company includes a review of technology, regulatory and commercial risk profiles of the companies and provides ongoing commentary on relevant developments.

The Australian CleanTech Index provides a measure of the performance of the Australian listed stocks in the Cleantech sector. With over 60 companies following under the coverage of the index and with a combined market capitalisation of over $16Bn, the index presents the only picture of the industry's growth in a single measure. Based on global best practice, the index is weighted by market capitalisation and is benchmarked against both the S&P/ASX200 and the S&P/ASX Small Ordinaries.

CASE STUDY

Upper Spencer Gulf Industrial Symbiosis[110]

A partnership project between Regional Development Australia (Whyalla & Eyre Peninsula) and the South Australian Government considered opportunities for industrial symbiosis or regional synergies, waste and by-product exchanges across the Upper Spencer Gulf.

Industrial Symbiosis is the direct practical outcome of Industrial Ecology principles. It focuses on the exchange of by-products, energy, and process wastes among closely situated firms as well as opportunities for joint development/use of infrastructure and utilities. Examples of successfully established industrial symbiosis projects are well documented in Australia, Europe, North America and China.

The Upper Spencer Gulf Industrial Symbiosis Projects aims to identify, develop and evaluate industrial symbiosis opportunities for industries located in the region. By doing so, the manufacturing efficiency, profitability and performance of the businesses can be improved whilst the environmental impacts associated with their production activities can be reduced.

The synergy opportunities considered potential to assist in improving both manufacturing efficiency in the Upper Spencer Gulf, as well as supporting long term sustainable development of the region. A wide range of potential synergies were identified by the project, including:

- Options for the re-use of accumulated waste and by-product streams such as waste heat, processing water, ash, phosphate solids, gypsum, salt, oil, pallets, sulphuric acids, aggregates, slag, lime, zinc tailings, Naphtha, LPG, sludge and garnet waste;
- Locating alternative, more cost effective and sustainable industrial water sources;
- Cost-effective access to common-user infrastructure (i.e. natural gas, water, port, and rail facilities)
- Options to reduce industrial electricity and fuel costs and environmental impact.

A key recommendation from the project is to develop a regional mechanism to support these opportunities and coordinate effort across government, industry and regional stakeholders.

CASE STUDY

Nyrstar Smelter Transformation[111]

Port Pirie in the Upper Spencer Gulf has a long history and economic base as one of the world's largest primary lead smelting facilities and silver producers. In addition to lead and silver, the facility also produces zinc, copper cathode, gold and sulphuric acid.

In May 2014, after 125 years of operation, owners of the facility, Nyrstar announced a major transformation of the Port Pirie site away from a primary lead smelter into a highly flexible, advanced polymetallic processing and recovery centre. The $514 million redevelopment of the Port Pirie smelter will deliver a fundamentally different business model for Port Pirie and the Upper Spencer Gulf including re-processing of complex waste streams, e-waste and third party concentrates and residues.

The redeveloped facility is expected to have an operating life in excess of 30 years and will feature new, state-of-the-art furnace technology and a new sulphuric acid plant.

Expected to be complete in 2017, the transformation project will result in improved environmental footprint and a step change reduction in airborne sulphur dioxide and lead dust emissions and resultant community blood lead levels.

Energy Efficiency

Energy efficiency is an effective, immediate means of managing energy needs more sustainably and offers considerable technological, research and application opportunity for the Upper Spencer Gulf, as a major energy using region.

At a domestic level there are many options for reducing electricity use and cost. These range from behavioural change (for example turning lights off when not needed) through to purchasing more efficient appliances and installing energy-saving products such as solar hot water heaters, heat pumps or insulation. The Australian Bureau of Statistics (ABS) found that in 2011-12, 89 per cent of Australians took steps to limit their personal electricity use[112]. This is reflected in the Australian Energy Market Operator (AEMO) also identifying a falling demand for power across the country over the last four years.

Across the commercial and industrial sector, an increasing number of businesses are also taking action to improve energy efficiency, with a study by the Australian Industry Group in 2012 finding three quarters of Australian businesses have now taken action or are planning actions to improve their energy efficiency[113]. Average per business energy savings of 7,535kwh were calculated for small retail enterprises neighbouring the Upper Spencer Gulf[114]. The most popular energy efficiency activities for businesses include changing staff practices and identifying major areas of high energy use. The biggest driver for action on energy efficiency was concern about energy prices.

The South Australian Department of State Development facilitates greater energy efficiency in the state through policy and program initiatives in relation to national minimum energy performance standards and development of a national strategy on energy efficiency and building construction codes. The state also supports labelling requirements for electrical and gas appliances, water heater installation requirements and Government building energy efficiency[115].

The Commonwealth Government remains committed to energy efficiency measures including labelling, minimum standards, development of energy management systems, capacity building and demonstration programs[116].

Energy Storage

Energy storage technologies are becoming more viable in Australia and are being heavily deployed into other global markets[117]. In Australia storage is used mostly in remote areas where traditional energy sources like diesel are expensive, however as technology and cost improvements are made, energy storage systems are increasingly being utilised in homes and businesses. There are six main energy storage solutions deployed around the world:

- Solid State Batteries – a range of electrochemical storage solutions, including advance chemistry batteries and capacitors
- Flow Batteries – batteries where the energy is stored directly in the electrolyte solution for longer life cycle, and quick response times
- Flywheels – mechanical devices that harness rotational energy to deliver instantaneous electricity
- Compressed Air Storage – compressed air to create a potent energy reserve
- Thermal – capturing heat and cold to create energy on depend
- Pumped Hydropower – creating large scale reservoirs of energy with water[118].

This emergence of low-cost, on-grid storage technologies will genuinely transform the electricity market and is expected to significantly bolster the business case for renewable energy. Additional renewable energy capacity can be installed and stored to offset peak demand, or used when renewable generation is low.

The social, economic and environmental implications of these changes are immense, and are now being strongly emphasised in public policy discussion about the future of energy. The full potential of energy storage is emerging rapidly, with many countries, including Germany, and large companies now investing in the technology[119].

The potential for the Upper Spencer Gulf to support pilot and demonstration projects for new energy storage technologies is highly consistent with the region's focus on transformation to a cleaner and more innovative future and complementary to the range of renewable energy opportunities on offer.

CASE STUDY

Renewable Hydrogen[120]

The University of Melbourne Energy Institute (MEI) is leading an effort to study the economics of producing hydrogen and ammonia from renewable energy in the Upper Spencer Gulf for domestic use and export.

As the world moves to decarbonise its energy supplies, some countries with limited renewable energy resources are likely to move towards imports. Australia's abundant renewable energy resources are well placed to supply such markets.

One way to transport renewable energy between countries (by ship) is via an energy carrier. Ammonia is an energy carrier that has the advantage of being more "energy dense" than some other energy carriers.

Ammonia is a commonly available chemical containing nitrogen and hydrogen (chemical formula NH3). It can be made via well-known and widely-used chemical processes combining air, water (fresh, saline, or salt), and energy. The required nitrogen comes from air while the required hydrogen comes from water. The required energy can come from renewable sources.

In addition to being an energy carrier, ammonia has other uses as a fertiliser, as a pre-cursor for other fertilisers and chemicals, as an acid-gas neutraliser, and as a fuel source in its own right (Sturman engine, fuel cells, etc.). Significant work is underway in countries such as the U.S.A, Japan, England, Scotland, the Netherlands, and Korea looking at all aspects of producing and using renewable ammonia, and its precursor hydrogen.

The Upper Spencer Gulf is proposed as a demonstration site due to excellent renewable energy resources, supportive State Government policy and track record in renewable energy deployment, existing and potential domestic markets for ammonia in agriculture (fertilisers and tractor fuel), fuel and minerals processing (e.g. flue gas scrubbing), and remote electricity generation (as substitute fuel for diesel), supporting export infrastructure such as ports, rail and heavy vehicle access, and early stakeholder support.

If successful, the Upper Spencer Gulf has opportunity to be a global leader in the production of Renewable Hydrogen and Ammonia at very large scale for domestic and export markets, targeting sustainable food production and sustainable energy supplies.

CASE STUDY

Coober Pedy Renewable Diesel Hybrid Project[121]

Like many remote communities, Coober Pedy, to the north of the Upper Spencer Gulf, relies on diesel-fired generators to provide electricity.

The Australian Government "ARENA program" has committed $18,500,000 to support the Coober Pedy community to integrate renewable energy technology with the existing diesel power station. The project aims to install 2 MW solar PV, 3 MW wind generation and a range of additional proven technologies, integrated with the existing 3.9 MW diesel power station in the town.

Coober Pedy has abundant wind and solar resources that complement each other very well. Combining the two renewable energy sources with advanced enabling technologies including short-term storage, is expected to significantly reduce diesel consumption. All power requirements are expected to be supplied by renewable energy approximately 50% of the time.

This project would provide lower and more stable levelised cost of electricity over the project life for Coober Pedy and the South Australian Government. Reliable power supply will be maintained while diesel consumption is reduced, improving the plant's environmental footprint.

If successful, the hybrid project could be replicated at other off-grid communities.

National Policy Context

Renewable Energy Target

Australia's Renewable Energy Target will generate 33,000 gigawatt hours of electricity from renewable sources by 2020[122].

The Large Scale Renewable Energy Target (LRET) creates a financial incentive for the establishment or expansion of renewable energy power stations by legislating demand for Large-scale Generation Certificates (LGCs). The certificates are created for each megawatt-hour of eligible renewable electricity produced and can be sold to entities (mainly electricity retailers) who surrender them annually to the Clean Energy Regulator to demonstrate their compliance with the RET scheme's annual targets. The revenue earned by the power station for the sale of LGCs is additional to that received for the sale of the electricity generated.

The LRET includes legislated annual targets which will require significant investment in new renewable energy generation capacity in coming years. The large-scale targets ramp up to the 33,000 gigawatt hours of renewable electricity generation to 2020.

The Small-scale Renewable Energy Scheme (SRES) creates a financial incentive for households, small businesses and community groups to install eligible small-scale renewable energy systems such as solar water heaters, heat pumps, solar photovoltaic (PV) systems, small-scale wind systems, or small-scale hydro systems. It does this by legislating demand for Small-scale Technology Certificates (STCs). STCs are created for these systems at the time of installation, according to the amount of electricity they are expected to produce or displace in the future. For example, the SRES allows eligible solar PV systems to create, at the time of installation, STCs equivalent to 15 years of expected system output.

RET-liable entities with an obligation under the LRET also have a legal requirement under the SRES to buy STCs and surrender them to the Clean Energy Regulator on a quarterly basis. While it is possible for owners of renewable energy systems to create and sell the STCs themselves, in practice, installers of these systems usually offer a discount on the price of an installation, or a cash payment, in return for the right to create the STCs.

Australian Renewable Energy Agency

The independent Australian Renewable Energy Agency (ARENA)[123] complements the RET scheme. ARENA streamlines and coordinates the administration of support for research and development, demonstration and commercialisation of renewable energy technologies.

ARENA is a commercially oriented agency established by the Australian Government in 2012 to improve the competitiveness of renewable energy technologies and to increase the supply of renewable energy in Australia. The agency has approximately $2.5 billion in funding to support renewable energy technologies and projects across the various stages of the innovation chain – from research in the laboratory to large scale technology projects.

Clean Energy Finance Corporation

The Clean Energy Finance Corporation (CEFC) operates under the Clean Energy Finance Corporation Act 2012 and receives $2 billion per year from 1 July 2013 to 2017 to mobilise capital investment in renewable energy, low-emission technology and energy efficiency in Australia.

Since its inception, the CEFC has committed over $1.4 billion to co-finance clean energy projects valued at over $3.5 billion and currently has more than 55 direct investments and 34 projects co-financed under aggregation programs. These projects help to improve energy productivity for businesses across Australia, develop local industries and generate new employment opportunities.

Whilst the current Australian Government have committed to abolishing both ARENA and the Clean Energy Finance Corporation[124], existing projects will be honoured.

Solar Towns

The Solar Towns Programme will provide Australian communities with an opportunity to engage at a local level with clean renewable energy, improve local environments, generate a sense of community ownership and self reliance, and improve local community outcomes.
The Solar Towns Programme was established as part of the Australian Government's commitment to reduce greenhouse gas emissions under its Plan for a Cleaner Environment.

Up to $2.1 million will be made available through the programme from 2014-15 to 2016-17 to support targeted communities to install a renewable energy system (solar photovoltaic panels, solar hot water system or heat pump hot water system only) on an existing building that provides support to the local community[125].

Emissions Reduction Fund

The Australian Government has committed to reducing national greenhouse gas emissions to 5 per cent below 2000 levels by 2020[126].

The Emissions Reduction Fund is the centrepiece of the Government's policy suite to reduce emissions and support economic growth. The Emissions Reduction Fund will operate alongside existing programmes such as the Renewable Energy Target and energy efficiency standards.

The Emissions Reduction Fund will provide incentives for emissions reduction activities across the Australian economy through activities such as upgrading commercial buildings, improving energy efficiency of industrial facilities and housing, reducing electricity generator emissions, capturing landfill gas, reducing coal mine waste gas, reforesting and revegetating marginal lands, improving agricultural soils, upgrading vehicles and improving transport logistics and managing fires in savanna grasslands.

Incentive methods will include crediting emissions reductions that have been certified by the Clean Energy Regulator; purchasing credited reductions by the Regulator through auctions where the lowest bids from proponents are bought first and payment under the contract is tied to delivery of reductions and setting emissions baselines for large facilities.

The fund will focus on adopting technologies that are more energy efficient can reduce the energy costs of businesses and households and projects that have multiple benefits including broader biodiversity, water quality, community and employment outcomes.

Department of Industry and Science

The Commonwealth Department of Industry and Science provides information on Australian Government policies and programs relating to energy. This covers industrial energy efficiency, clean energy, energy markets, energy security, international engagement and energy facts, statistics and publications. The Department has released an Energy White Paper[127] that sets out a strategic policy framework to address the challenges in our energy sector and position Australia for a long term transformation in the way energy is produced and used. The preferred position of the current Government is not to intervene in a way that promotes one technology over another or forces technologies that are not cost competitive into the market at a cost to consumers or taxpayers.

State Policy Context

The South Australian Government has demonstrated a consistently pro-active and supportive policy environment for growth of the renewable energy and cleantech sectors. Over the past decade initiatives have included commitment to strong renewable energy targets, addressing market failures, efficient regulation, and quality information to inform investment and moving early to take advantage of national and international trends[128].

The 2009 report by the South Australian Government[129] noted a range of support measures have been implemented to encourage the uptake of mainly small scale renewable generation, including rebates for the installation of solar water heaters, feed-in-tariff for roof top photovoltaic systems, installation of photovoltaic systems at schools and support for renewable generation for remote area power systems.

The Premier's Climate Change Council identified the energy sector as an example of how South Australia can extract economic advantage from the global and national transformations taking place and specifically identifies the Upper Spencer Gulf as a priority region to trial a partnership to develop integrated solutions for industry development based on a low carbon economy (priority action 8.3)[130]. This is consistent with several of the Government's economic priorities, but particularly growth through innovation and leveraging activity in the energy sector into new intellectual property, jobs and global business opportunities[131].

In order to realise this potential however, the 2011 Renewable Energy plan for South Australia also identified the need to strengthen the pool of graduate professionals in the state and committed to working with universities and vocational education sector to examine the technical and skills needed to support this emerging sector. The lack of research and technical capabilities was also identified at a regional level[132]. Despite industry growth in the Upper Spencer Gulf, the region is below the state average with its share of relevant technical, professional and scientific skills to support this[133].

> "The energy sector provides an example of how South Australia can extract economic advantage from the global and national transformations taking place…..the Upper Spencer Gulf has been identified as a priority region for industry development based on a low carbon economy…."
>
> (Premier's Climate Change Council, 2014)

Regional and Local Policy Context

The policy context across the Upper Spencer Gulf region is broadly supportive of the opportunities growth in the renewable energy sector provides.

Regional Land-Use Strategies

At a statutory level, three regional volumes of the South Australian Planning Strategy – created under section 22 of the Development Act 1993 - cover the Upper Spencer Gulf.

The Whyalla and the Eyre Peninsula[134] plan specifically aims to maximise the region's competitive advantages in renewable energy and support development of renewable, innovative, alternative energy supplies. The plan also notes that in order to maximise these opportunities, the region's electricity transmission network needs to be improved and expanded. The region's educational institutions, including TAFE and University of South Australia campus are also identified as significant infrastructure assets that will be critical to support these emerging industries.

The Port Pirie and the Mid North[135] plan similarly encourages renewable energy development in appropriate locations, along with the training of people in the region to undertake their operation and maintenance, with the Port Augusta and the Far North[136] plan also supporting principles around energy efficiency and fostering sustainable, alternative energy supply industries in the region.

Local Government Strategic and Development Planning

Developed under the South Australian Local Government Act 1999, the three Upper Spencer Gulf Local Government strategic plans also offer broad support around renewable energy and energy efficiency.

The Port Pirie Regional Council strategic plan 2010 - 2019 focusses on calculation and reduction of the environmental footprint, specifies reduction of energy use and fuel consumption, increasing energy efficiency of public buildings and supporting renewable energy use and deployment. The Port Augusta Community Vision 2031 has a strong focus on sustainability and developing alternative energy infrastructure, with specific mention of potential solar thermal energy opportunities in the region[137]. The Whyalla Council Strategic Plan specifically identifies potential for development of a Sustainable Energy, Research and Development Centre as a key economic objective, with energy monitoring and efficiencies also a consideration.

As provided for within the Development Act 1993, the three development plan specifications for Renewable Energy Facilities (industrial scale windfarms) were mandated through a statewide amendment in 2012 and as such, are consistent across Port Pirie, Whyalla and Port Augusta. There are no specifications for rooftop wind turbines, solar or other renewable energy source facilities, such as geothermal or biomass, except requirements to orient buildings and roofs to "maximise solar access"[138] at a scale suggestive of single structure solar PV or solar thermal installations rather than ones of a commercial scale. Ensuring consistent, specific and transparent planning and permitting requirements will be important if the Upper Spencer Gulf is to fully realise growth in this sector[139] [140] [141]

Natural Resource Management Plans

Both Port Pirie and Port Augusta lie within the Northern and Yorke Natural Resource Management region, with Whyalla in the Eyre Peninsula NRM region. The regional NRM boards have responsibility, under the Natural Resources Management Act 2004, to develop and maintain a Natural Resources Management (NRM) Plan for their region. The Plan is to guide the Board, related State Government agencies and other stakeholders in their efforts to maintain and enhance the region's natural resources

The Northern and Yorke NRM Board's strategic plan presents a 10-year strategic direction for future management of the region's natural resources and identifies wind power generation as already providing an opportunity to reduce the greenhouse footprint of the region and the State, but also noting the need to manage risks associated with this new industry, including bird-strike and noise[142]. The Eyre Peninsula NRM board's strategic plan[143] does not specifically consider opportunities in renewable energy, but does identify the need to ensure both ecosystems and economies of the region can adapt to climate change.

Regional Development Australia Roadmaps

Regional Development Australia (RDA) is a national network of 55 committees made up of local leaders who work with all levels of government, business and community groups to support the development of their regions. In South Australia, RDA is jointly funded by Local, State and Australian Governments, with overarching administration through the Federal Department of Infrastructure and Regional Development.

Each RDA committee has developed a Regional Plan which outlines priorities for the region and guides them in strengthening their communities.

The Regional plans covering Port Pirie (Regional Development Australia Yorke & Mid North)[144], Port Augusta (Regional Development Australia Far North)[145] and Whyalla (Regional Development Australia Whyalla and Eyre Peninsula)[146] all strongly support opportunities for economic growth and diversification through renewable energy and clean technologies[147]. Early deployment of industrial scale windfarms, potential wind and water desalination, syngas bioenergy are all identified, along with the barriers to such growth through capacity constraints within the current electricity and gas networks.

Upper Spencer Gulf Memorandum of Understanding

In 2012, the Commonwealth and State Ministers for Regional Development, and the Local Government Association of South Australia signed a Memorandum of Understanding to facilitate collaborative arrangements for regional development in the Upper Spencer Gulf[148], with a view to facilitating economic prosperity and sustainable communities.

The MOU symbolized a commitment by the parties to working together towards a range of outcomes and particularly considered how the Upper Spencer Gulf could build on its comparative strengths by maximising its renewable energy potential, contributing to and benefiting from the sustainable and long-term growth of the resources and energy sectors and identifying and growing primary industries and advanced manufacturing opportunities across the region.

International Trends and Context

Renewable Energy Globally[149]

Renewable energy provided just over 19% of global energy consumption in 2013 - including electricity, heating, cooling and transport - with continued growth in both capacity and generation.

Total renewable energy capacity and generation is highest in China, the United States, Brazil, Canada and Germany, with investment in renewable energy led by China, the United States, Japan, United Kingdom and Germany.

Renewables represented just under 60% of net additions to global power capacity in 2014 – more than coal and gas combined[150], and now provide around one quarter of the world's power generating capacity.

In 2013, China's new renewable power capacity surpassed new fossil fuel and nuclear capacity for the first time.

As markets have become more mature and global, renewable energy industries have responded by increasing their flexibility, diversifying their products, and developing global supply chains. An estimated 6.5 million people worldwide work directly or indirectly in the renewable energy sector.

In parallel with growth in renewable energy markets, 2014 also saw significant advances in the development and deployment of energy storage systems across all sectors.

Markets, manufacturing and investment are also expanding across the developing world, becoming increasingly evident that renewables are no longer dependent upon a small handful of countries. Aided by continuing technological advances, falling prices, and innovations in financing—all driven largely by policy support—renewables have become increasingly affordable for a broader range of consumers worldwide. In a rising number of countries, renewable energy is considered crucial for meeting current and future energy needs.

International Commitment to Renewables[151]

By early 2015, at least 164 countries had renewable energy targets and an estimated 145 countries had renewable energy support policies in place.

In addition, there are currently 17 emissions trading systems (ETS) in force across four continents, covering 35 countries, 12 states or provinces, and seven cities. Together, these jurisdictions produce about 40 % of global GDP and includes nine new systems launched in Asia over the past three years, including in the Republic of Korea. Furthermore, seven Chinese pilot programs — and the planned launch of a Chinese national system in 2016 —represent a significant step forward. Emerging economies, like Mexico and Brazil, are also looking at ETS as an option for developing their climate policy plans[152].

Policy mechanisms also continued to evolve, with some becoming more differentiated by technology. Feed-in policies in many countries evolved further towards premium payments in the power sector, and continued to be adapted for use in the heating sector. Particularly in Europe, new policies are emerging to advance or manage the integration of high shares of renewable electricity into existing power systems, including support for energy storage, demand-side management, and smart grid technologies.

A mix of regulatory policies, fiscal incentives, and public financing mechanisms to support renewable energy continue to be adopted globally. An estimated 126 countries now have some form of financial support in place for renewables. Feed-in policies and renewable portfolio standards (RPS) remained the most commonly used support mechanisms, although their pace of adoption continued to slow. In contrast, public competitive bidding, or tendering, gained further prominence, with the number of countries turning to public auctions rising from 9 in 2009 to 60 as of early 2015.

As of early 2015, an estimated 45 countries had adopted renewable heating and cooling targets. Renewable heating and cooling is also supported through fiscal incentives, as well as through building codes and other measures at the national and local levels in several countries. Fifty seven countries used regulatory policies to promote the production or consumption of biofuels for transport.

Globally, thousands of cities and towns worldwide have policies, plans, and targets to advance renewable energy, often outpacing national targets. By early 2015 several jurisdictions had 100% renewable energy targets in place, with many municipalities already achieving such targets.

To reach their goals, policymakers in cities around the world continued a growing trend of mandating the use of renewable power and heat technologies through development and building regulation, through their own expenditure and procurement decisions and by advocating and influencing national policies. Local districts and cities are also increasingly working collaboratively to share information and scale up best practices in support of renewable energy.

Local Energy and Emissions Trends

Current Energy Sources

Coal currently remains a key fuel at 34 per cent of total energy consumption nationally and around 69 per cent of electricity generation, petroleum based fuels (predominantly for transport) provide 39 per cent of consumption with gas providing for 23 per cent of Australia's total energy consumption[153].

Due largely to this high reliance on coal based electricity (rather than the high energy intensity of the economy), Australia has one of the highest per capita greenhouse gas emissions globally[154].

In South Australia, non-renewable fossil-fuels have traditionally provided the bulk of the state's energy use, with 61% of electricity generation sourced from natural gas and coal in 2013–14. However, this is down from 82% in 2009–10, highlighting the transformation currently underway towards an increasing share for renewable generation and a greater reliance on imports[155].

Coal-based electricity generation from Alinta Energy in Port Augusta has declined from 25 percent of the state's power in 2011 to 16 percent in 2013. Wind generation, on the other hand, has increased from 26 percent in 2011 to 32 percent in 2013. Embedded rooftop PV installation in South Australia generated 704 gigawatt hours (GWh) during 2013–14, amounting to 18% of Australia's total PV output that year[156].

Both average demand and peak (maximum) demand in South Australia is declining, with this trend expected to continue due to:[157][158].

- Material uptake of residential and commercial PV solar
- Increased energy efficiency measures
- Economic downturn resulting in large industrial and commercial operations reducing demand
- Increase in energy costs creating a focus on reducing peak demand load.

In June 2015 Alinta Energy announced it will close its coal-fired power station at Port Augusta and the associated Leigh Creek coal mine from March 2018, or possibly sooner. Consistent with the energy market trend across the state, continuing operation at the facility has become increasingly uneconomic due to a decline in energy demand as the number of industrial customers had fallen and households have becoming more efficient.[159]

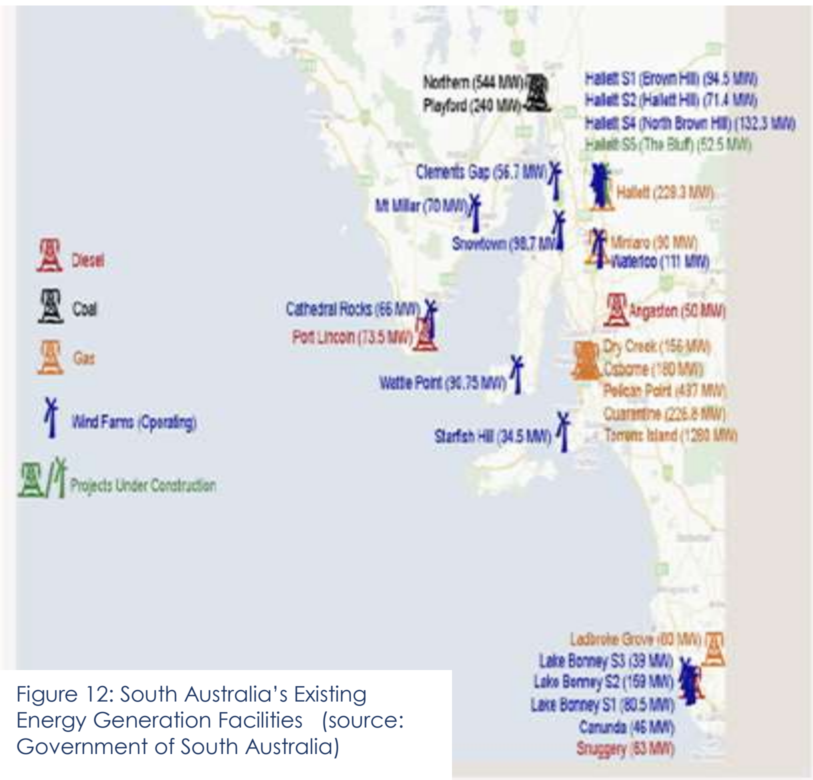


Figure 12: South Australia's Existing Energy Generation Facilities (source: Government of South Australia)

Energy Use and Emissions

In 2007 Australia introduced a national framework for corporations to report on greenhouse gas emissions, energy use and energy production under the National Greenhouse and Energy Reporting Act 2007 (NGERS). These National Greenhouse Accounts provide a solid understanding of energy use and emissions across all sectors and states and also fulfills Australia's international and domestic reporting requirements[160].

There are several corporations in the Upper Spencer Gulf and environs who are required to report their energy use and emissions and a number of power generation facilities in the region that are also required to report to the Australian Government's Clean Energy Regulator on electricity production and total emissions.

In 2013-14 nationally, there was a decline in emissions from electricity reflecting lower electricity demand and changes in the generation mix[161].

The recent repeal of the Clean Energy Act 2011 abolished the national carbon pricing mechanism from 1 July 2014, however liable entities were still required to meet their carbon price obligations for the 2013-14 financial year including reporting of emissions to the Clean Energy Regulator[162].

Table 4: South Australia's Greenhouse Gas Emissions by Sectors (source: Clean Energy Regulator)

	AUSTRALIA	SA	
	Emissions (Mt)	Emissions (Mt)	% Contribution to National Emissions
Inventory total (excluding LULUCF)	**418.0**	**30.1**	**7.2%**
SECTORS/KEY SUBSECTORS			
ENERGY SECTOR	**289.5**	**20.7**	**7.1%**
Stationary Energy	**195.0**	**11.2**	**5.8%**
Energy industries	143.3	8.1	5.7%
Electricity generation	129.6	6.5	5.0%
Other energy industries	13.8	1.6	11.6%
Manufacturing and construction	35.6	1.9	5.2%
Other sectors	16.1	1.3	7.9%
Transport	**62.0**	**5.4**	**8.7%**
Fugitive Emissions from Fuels	**32.4**	**4.0**	**12.3%**
INDUSTRIAL PROCESSES	**24.7**	**2.7**	**10.9%**
AGRICULTURE	**86.5**	**5.5**	**6.4%**
Livestock	66.0	4.4	6.7%
Other Agriculture	20.5	1.1	5.5%
WASTE	**17.4**	**1.2**	**6.8%**
OTHER	**NA**	**0.0**	**NA**
LAND USE, LAND USE CHANGE AND FORESTRY	**131.5**	**1.5**	**1.2%**
Afforestation and reforestation			
Land use change (deforestation)	131.5	1.5	1.2%
Inventory total (including LULUCF)	**549.5**	**31.6**	**5.8%**

The high proportion of trade-exposed, energy and emissions intensive industries in the Upper Spencer Gulf does make the region vulnerable to the global move towards lowering emission and energy intensity, but over time, may actually provide future opportunity as the cost of locally generated and utilized renewable energy becomes comparatively cheaper against energy sources that are also exported, such as uranium, coal and gas[163 164 165].

In addition to an energy intensive industry sector, public facilities and buildings, landfill sites, waste water treatment systems, public and street lighting also contribute significantly to the energy profile of the three Upper Spencer Gulf cities. Street and public lighting is generally the dominant source of energy use (and cost) for Local Government, accounting for between 30-60% of Council greenhouse emissions and costing the sector nationally over $125 million in direct energy costs[166]. Public lighting efficiency in South Australia has proven a difficult area to gain traction due largely to a number of financial and regulatory barriers[167]. In addition, electricity used to provide public lighting services to councils is currently unmetered[168]. A cost efficient transition will require a range of actions by Councils and service providers, including SA Power Networks and the Australian Energy Regulator.

Table 5: Greenhouse and Energy Information by Registered Corporation: 2013-14 (source: Clean Energy Regulator)

Controlling Corporation	Total Scope 1 Emission (t CO2-e)	Total Scope 2 Emission (t CO2-e)	Total Net Energy consumed (GJ)
ALINTA ENERGY FINANCE PTY LTD	3919559	18853	40670462
ARRIUM LIMITED	2850015	1100904	38641283
BHP BILLITON LIMITED	5817304	2067989	56953806
NYRSTAR AUSTRALIA PTY LTD	364810	371780	9993758
OZ MINERALS LIMITED	231389	195896	4509933
SANTOS LTD	3813163	32671	36026769

- Scope 1 greenhouse gas emissions refer to direction emissions from the operations of facilities (e.g. on site cement manufacture, electricity generation or steel manufacturing).
- Scope 2 greenhouse gas emissions refer to indirect emissions from the use of energy products (e.g. electricity, steam/heat) purchased or otherwise brought into the facility.

Energy Transition in the Upper Spencer Gulf

As global commitment to reducing emissions intensifies and eventually converges, it is anticipated there will be, as already evident, an initial adjustment from high emissions growth to greater use of well established, lower emissions technologies, such as wind, followed by new technologies that facilitate and accelerate the restructure of the energy sector ahead of a long term emergence to sustainable, low and zero emissions technologies[169].

Transforming the electricity sector will be critical to this transition, with the sector already challenged in recent years by substantial rises in capital costs of construction and increases in global coal, oil and gas prices.

A further consideration in the ultimate cost-effectiveness of renewable energy will be the efficiency of the sector and particularly the regulatory environment that separates wholesale, transmission, distribution and retail markets[170]. In this regard it will become increasingly important to consider electricity network ownership differently, and provide a regulatory system that allows for decentralization and trade in distribution capacity (i.e. integration of distribution and retail functions) and facilitate greater use and integration of storage at the point of use (ie integration of energy requirements for households and electric cars)[171] Also critical to this transformation will be a parallel investment in relevant research, education and training[172]. Underpinning a successful regional energy transition will be solid data that identifies the current profile of energy use and cost across the three Upper Spencer Gulf cities.

Table 6: Greenhouse and Energy Information for Designated Generation Facilities 2013-14 (source: Clean Energy Regulator)

Reporting Entity	Facility Name	Electricity Production (GJ)	Greenhouse Gas Emissions Scope 1 (t-CO2-e)	Greenhouse Gas Emissions Scope 2 (t-CO2-e)	Greenhouse Gas Emissions Total Emissions (t-CO2-e)
AGL ENERGY LIMITED	Hallett (Stage 1) Wind Farm	1292065	104	199	303
AGL ENERGY LIMITED	Hallett (Stage 2) Wind Farm	967209	85	156	241
AGL ENERGY LIMITED	Hallett (Stage 4) Wind Farm	1743573	134	342	476
AGL ENERGY LIMITED	Hallett (Stage 5) Wind Farm	603982	63	179	242
AGL ENERGY LIMITED	Wilpena Pound Solar Generation	3043	590	0	590
ALINTA COGENERATION (PINJARRA) PTY LTD	Alinta Pinjarra Generation Facility	4598627	1131711	351	1132062
ALINTA ENERGY FINANCE PTY LTD	Augusta Power Stations	7554644	2113556	9415	2122971
ALINTA ENERGY FINANCE PTY LTD	Braemar Power Station	5872925	919714	1172	920886
ARROW ENERGY HOLDINGS PTY LTD	Braemar 2 Power Station	4450259	738117	2431	740548
ENERGY DEVELOPMENTS LIMITED	Coober Pedy Remote Power Station	43550	8522	0	8522
ENERGY DEVELOPMENTS LIMITED	Mt Magnet Remote Power Station	16167	3008	0	3008
ENERGYAUSTRALIA HOLDINGS LIMITED	Hallett Power Station	122209	33387	2929	36316
ENERGYAUSTRALIA HOLDINGS LIMITED	Waterloo Wind Farm	1229935	86	169	255
IFM RENEWABLE ENERGY PTY LTD	Clements Gap Wind Farm	656001	32	0	32
MERIDIAN ENERGY AUSTRALIA PTY LIMITED	Mt Millar Wind Farm Pty Ltd	664081	19	0	19
SNOWTOWN SOUTH WIND FARM PTY. LTD.	SNOWTOWN SOUTH WIND FARM	743674	0	116	116
SNOWTOWN WIND FARM PTY LTD	Snowtown Wind Farm	1432188	0	200	200
SNOWTOWN WIND FARM STAGE 2 PTY. LTD.	SNOWTOWN WIND FARM STAGE 2	373153	0	73	73
SYNERGEN POWER PTY LIMITED	Mintaro Power Station	28685	6141	147	6288
SYNERGEN POWER PTY LIMITED	Port Lincoln Power Station	2870	1069	401	1470

Energy Pricing and Regulation

Electricity prices in South Australia are driven by factors including demand and supply balance, fuel costs, interconnector constraints and generator bidding behaviour[173]. Whilst many of these issues have been discussed earlier in the context of renewable energy, including the use of various policy incentives, the release of the Australian Government's Energy White Paper[174] clearly highlights the preferred position of the current Government not to intervene in a way that promotes one technology over another, or forces technologies that are not cost competitive into the market at a cost to consumers or taxpayers.

The energy market is governed by the Australian Energy Regulator (AER), who performs economic regulation of the wholesale electricity market and electricity transmission networks in the National Electricity Market (NEM) and enforcement of the National Electricity Law and National Electricity Rules[175].

The Australian Energy Market Commission (AEMC) is responsible for rule making and market development in the National Electricity Market (NEM) and over time the gas market. The AEMC is responsible for administration and publishing of the National Electricity Rules; the rule making process under the new National Electricity Law; and providing policy advice in relation to the NEM.

The Clean Energy Regulator administers schemes aimed at reducing carbon emissions and increase the use of clean energy, including the National Greenhouse and Energy Reporting (NGER) scheme, the Carbon Farming Initiative and the Renewable Energy Target. It also had responsibility for the recently abolished carbon pricing mechanism.

Electricity Infrastructure

Australia's four main electricity grids and many remote 'island' grids were designed for the reliable delivery of electricity to households and businesses across the country. The four electricity grids are:

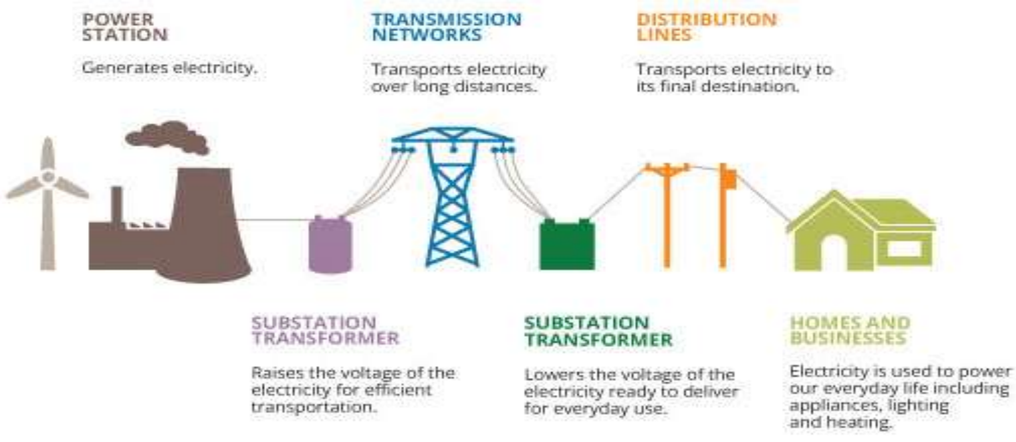
- WA: South West Interconnected System (SWIS)
- WA: North West Interconnected System (NWIS)
- NT: Darwin-Katherine Electricity Network
- Qld, NSW, ACT, Vic, SA, Tas: National Electricity Market (NEM)

There is over 45,000 km of high voltage transmission grid and 850,000 km of distribution grid that deliver electricity to households and businesses. The National Electricity Market one of the largest interconnected electricity markets in the world.

The Heywood and Murraylink interconnectors give South Australia access to the NEM, allowing both imports and exports based on the cost of generation, subject to network limitations. There has been increasing net-energy flow from Victoria into South Australia in recent years, with a compound annual growth rate of 28% over the period 2009–10 to 2013–14[176].

[177]

Figure13: Electricity Generation, Transmission and Distribution (source: AGL)



In South Australia, electricity transmission networks are managed by Electranet, with SA Power Networks operating the distribution system. At present, the regional grid capacity is approximately 2000 – 3000 MW[178] while the existing energy generation (which may not be all grid electricity) is approximately 784 MW in coal, 728 – 780MW in wind and 319MW in gas. The current 33kv electricity line has capacity servicing the Upper Spencer Gulf which includes a total current capacity for Whyalla of 199 MVA. For Pt Augusta total the 33 kv line capacity is 121.5 MVA and for Port Pirie 121.3 MVA[179].

Whilst the grid is currently capable of handling some regional expansion in generation without requiring capacity upgrades, any significant increase would require changes in existing infrastructure. The Australian Energy Market Operator forecast report concludes there may indeed be a need for further network infrastructure in and around the Upper Spencer Gulf. Current network augmentation criteria means that either the customer must fund the augmentation or wait for ElectraNet to undertake a Net Benefits Test and for the costings to be approved by the Australian Energy Regulator before allowing ElectraNet to recover the costs as part of its regulatory asset base. This means there is little incentive for customers to augment network infrastructure as it is expensive and due to open access arrangements[180].

Fortunately, upgrades to the Heywood interconnector between South Australia and Victoria, scheduled for 2016 will increase import and export flow capacity. Growth in wind generation will particularly benefit from the planned upgrade, increasing use and export from South Australia[181].

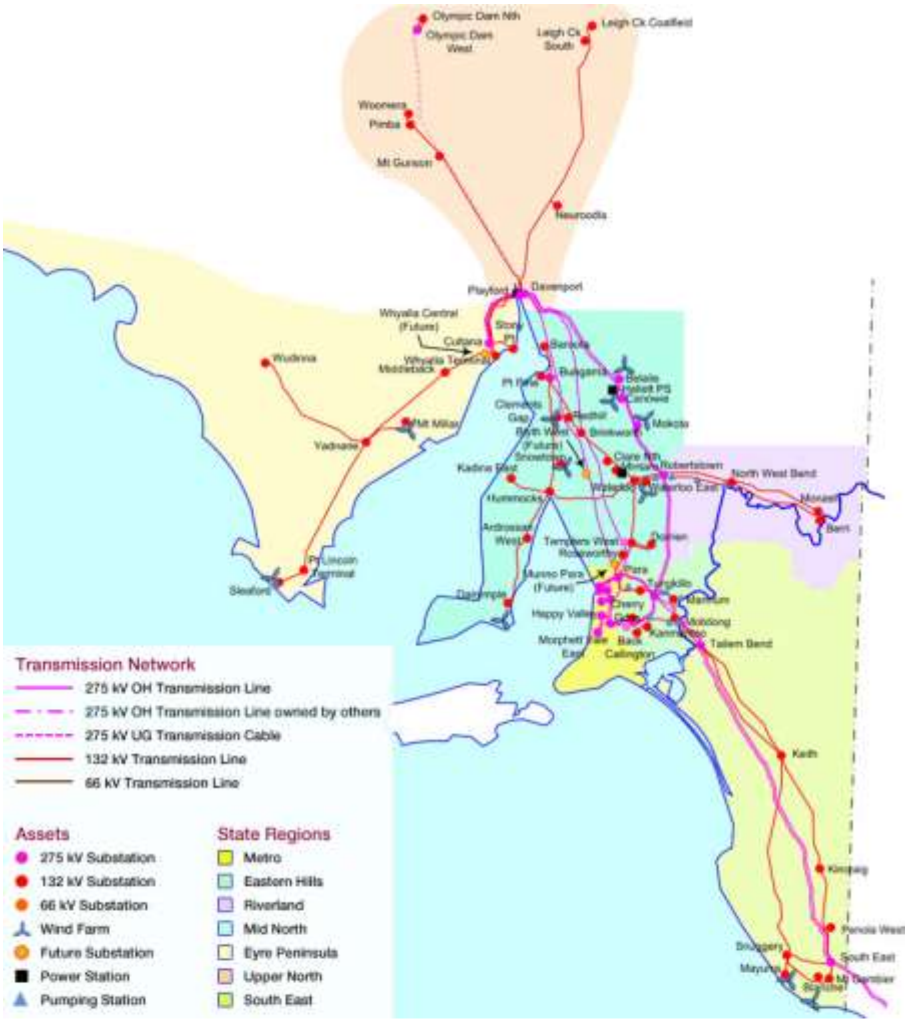


Figure14: South Australia Electricity Transmission System
(source: Electranet)

Gas Infrastructure

Gas provides an important energy source for the Upper Spencer Gulf and is likely to be a key transition fuel in the longer term move towards lower emissions energy.[182 183]

The main gas pipeline in South Australia extends from Moomba to Adelaide. A smaller lateral pipeline extends from the main line at Whyte Yarcowie to Pt Pirie and under the Spencer Gulf to Whyalla. This lateral operates at a diameter of 150mm to Pt Pirie and then 200mm to Whyalla and is near capacity. Approximately 7PJ per annum of gas is piped through this lateral, with main users being Nyrstar in Port Pirie (1PJ) and Arrium OneSteel in Whyalla (5PJ). [184]

There is potential for additional compression at Whyte Yarcowie which could increase capacity to 11PJ per annum at Pt Pirie, however the cost of additional compression has been estimated at around $6m, with duplication of the lateral to 30PJ per annum estimated to cost approximately $84m[185]. In addition, EPIC have estimated a haulage tariff of around $0.30/GJ. To be viable gas prices would require a return on fuel costs in the order of $65-$78/MWh (assuming a gas price of between $7.20 and $8.70/GJ delivered) and a plant heat rate of 9kj/kWh. The short run marginal cost of a gas fired electricity plant would therefore be in the order of $70-$85/MWh[186].

The current spot and forward electricity prices also do not support a case for new gas generation, with the Australian Energy Market Operator forecasting that South Australia will not require additional generation out to 2022/23[187]. New renewable generation and reduction in demand also reduce the likelihood of additional gas capacity being required for electricity generation in the near term.

Figure14: Moomba to Adelaide Gas Pipeline (source: Epic Energy)

Planning and Community Considerations

The South Australian Development Planning and Regulatory System

South Australian legislation establishes the planning and development system and sets out the statutory procedures is the Development Act 1993 and the associated Development Regulations 2008. The Development Act 1993 provides alternate pathways for obtaining development approval - Local Council Process, or Major Development Process.

The South Australian Planning System is currently under review[188], with key reforms proposed to include creation of a network of regional planning boards across the state to facilitate better regional collaboration and consistency on planning issues and provide a more integrated approach to environmental and natural resource management, economic development and infrastructure provision. This new governance model is expected to improve linkages between portfolios, reduce duplication and policy conflict and provide a better basis for meeting the needs of local communities. It will more closely link infrastructure planning with regional strategic plans, allowing for infrastructure corridors and growth area infrastructure requirements to be identified as early as possible.

In addition to the Development Act, all forms of development – including renewable energy infrastructure will be subject to State and some Commonwealth legislative considerations, including:

- State Acts - Native Vegetation Act 1991; Electricity (South Australia) Act 1996; Aboriginal Heritage Act 1988; Pastoral Land Management and Conservation Act 1989;Environment Protection Act 1993; Native Title (South Australia) Act 1994; Native Vegetation Act 1991; Natural Resource Management Act 2004; Occupational Health, Safety and Welfare Act 1986; Dangerous Substances Act 1979
- Federal Acts - Environmental Protection and Biodiversity Conservation Act 1999 Aboriginal and Torres Strait Islander Heritage Protection Act 1984; Native Title Act 1993. The Commonwealth Environmental Stewardship program also requires that landholders declare their knowledge that no wind farm has been proposed or built within two kilometres of the Land[189].

Community Attitudes to Renewables

Whilst a number of policy, infrastructure and market challenges currently hamper growth in renewable energy potential in the Upper Spencer Gulf, community support for renewables has been reinforced through a number of recent investigations, community surveys and engagement initiatives as part of the 'Repower Port Augusta' campaign, development of the 'Green Grid' proposal and development of a 'Low Carbon Prospectus for the Yorke and Mid North Region'.

Repower Port Augusta

As part of the ''Repower Port Augusta" project seeking replacement of the existing coal fired power station with solar thermal[190], a community vote was held in July 2012 to survey the opinion of the Port Augusta population on the future of the power plants. Thirty percent of the Port Augusta population attended the session, with 99% voting in support of solar as a replacement option for the coal plants[191].

Further community polling undertaken by the Australian Youth Climate Coalition also showed overwhelming support in the South Australian metropolitan seat of Boothby for building Australia's first solar thermal plant in Port Augusta. The poll found that 70.8 per cent of the 1237 residents surveyed supported the concept. A large door-knocking survey in the Boothby electorate found that 55 per cent of those polled said they would be more likely to vote for a candidate that supports building solar thermal in Port Augusta, while only 6.3 per cent would be less likely.

Green Grid

The community and environmental assessment undertaken by the 'Green Grid' report indicated broad support for large scale generation occurring in these areas. Sensitive environments including National Parks and reserves of high conservation value, wetlands and coastal views of significant community value were considered as part of the assessment.

Outside of these sensitive environments, large areas of disturbed agricultural land were generally considered to be suitable for wind farms. The assessment also assumed that the community division and concern that are increasingly experienced in areas of higher population density would be less likely in this region, however the report did note these assumptions have not been formally tested. The report also weighed up factors strongly supporting new wind generation on the Eyre Peninsula against the costs to developers and to the energy network of overcoming transmission constraints.

Yorke & Mid North Low Carbon Prospectus
A key component of developing a low carbon prospectus for Yorke and Mid North region, immediately adjacent the Upper Spencer Gulf, quantified feedback from the community regarding their preferences for types of renewable and low carbon energy, scale of deployment and mix of renewable generation and emissions reduction options[192.]

The survey results indicated a strong level of acceptance for renewable and low carbon energy generation technologies, particularly integrated technologies such as domestic solar photovoltaic (PV) systems, which received a 96% acceptance rate. Utility scale solar farms and waste-to-energy systems were also favourably considered by the community (>80%), followed by biomass and wave generated energy (>75%), geothermal and domestic wind generation (60%). Least favourable options were industrial scale windfarms (57%) and nuclear, at less than 40% acceptance. Responses also captured a strong sentiment to improve the efficiency of technologies such as solar, consider innovation in technology and deployment and improve storage technologies. Household and community-scale models of deployment were strongly supported, along with a need to focus on retrofitting existing buildings and promoting new ‘eco-friendly’ development and village models. The need for strong community engagement and ownership over deployment of renewable/low carbon energy was particularly emphasized throughout the study, noting that most current government policy is highly centralized and may not necessarily be considered in alignment with regional ideals of localism and self-reliance.

Upper Spencer Gulf Renewables Workshop
A targeted workshop for representatives of Regional Development Australia, South Australian Government agencies and the university sector was held in March 2015 to consider the key opportunities for regional growth in the renewable energy sector. The workshop reinforced the potential role of the Upper Spencer Gulf in supporting the renewables industry as a testbed for new technologies and research, establishing demonstration and pilot sites, ensuring the timely provision of technical and professional services to the industry and through deployment of commercial-scale renewable energy initiatives.

Summary of Opportunities and Challenges

Summary

Many of the renewable energy options available to the Upper Spencer Gulf are very good to excellent when compared to other parts of Australia and globally. The region is also fortunate that it combines high quality resources with good access to the electricity grid.

This provides a regional advantage in prospective commercial scale renewable energy generation development, providing grid capacity is not exceeded or, if the grid infrastructure is improved and upgraded, to match the increase in generating capacity.

South Australia and the Upper Spencer Gulf has a large renewable energy resource built around its world class solar and wind resources. However, exploitation of this resource will be restricted by the small size of the energy market in South Australia and the current structure of the transmission system within South Australia, which limits the ability to transmit electricity from favourable sites to remote electricity markets[193]. Further development of the transmission system within South Australia and between South Australia and adjoining states will therefore be important to overcoming such limitations. South Australia could also take the lead in some facilitating technologies such as energy storage to maximise the potential for its renewable energy resources.

Despite challenges to existing grid infrastructure, cost reductions are making renewable energy competitive in some circumstances and locations, especially where the decentralised nature of renewables production allows investment in transmission and distribution to be reduced or avoided[194].

Opportunities and Challenges for the Upper Spencer Gulf

The analysis in this report highlights that there are many opportunities for the Upper Spencer Gulf. Within the broader global transition to renewable and low-emissions energy, the region is well placed to be a hub of renewable energy generation technologies. This is evidenced by a range of factors.

- The region has excellent solar resources, and large land areas suitable for solar installations.
- Due to significant cost reductions in the price of solar panels, the business case for small scale solar remains compelling despite the loss of direct incentives such as feed in tariffs.
- The region has excellent wind resources and large areas of open landscape, outside protection zones, for the installation of wind farms.
- The region and surrounding areas also have opportunities to support further research and development in geothermal, bioenergy (particularly algae) and wave energy to the west and south.
- With large open areas and stable geology the region has much to contribute to the debate on nuclear fuel cycle.
- Sites within the Upper Spencer Gulf can provide opportunities for hydro power storage and there is scope for development of co and tri-generation facilities.
- There is still much to be gained from energy efficiency improvements in the region.
- The region's high proportion of trade exposed emissions intensive industries may, over time, benefit from further investment in renewable energy.
- There are several local businesses in the region that already support the renewable energy sector.
- There are cumulative opportunities and synergies across businesses in the Upper Spencer Gulf and opportunities to co-locate and collaborate.

This region is also well supported by reforms, technological advances and policies at the global, national and local scale that support investment in renewables.

- Energy storage solutions are a rapidly evolving technology, and the costs are likely to rapidly reduce over the coming years, including for large scale grid storage solutions.

- The clean tech sector is well advanced in Australia and continues to provide opportunities for industry growth in the Upper Spencer Gulf.
- The region has three large town centres, coupled with heavy industry and a range of complementary specialisations.
- There is a sustained and ongoing global move to reduce emissions and fossil fuel consumption and a compelling business case for doing so.
- Many more countries and major economies are implementing policies for increased uptake of renewable energy, and investment in improving the technology. These jurisdictions will be an important market for renewable energy technologies and practices that may be developed or tested in the Upper Spencer Gulf.
- Although it has softened in recent years, the national policy context still promotes the uptake of renewable energy and other enabling policies.
- The Government of South Australia is supportive of significant renewable energy investment, and in policies that support the Upper Spencer Gulf.
- Initiatives such as Tonsley Park provide a learning hub that could be linked to testbed technologies and training in the Upper Spencer Gulf.
- There is strong local government, regional development and community support for growth of renewable energy in the region.
- There are cumulative benefits that can be leveraged from the many renewable energy and related industries already active in the region.

However, there are also challenges that will need to be overcome to fully leverage these opportunities for the region.

- The current instability of national policies that support the uptake of renewable energy has resulted in uncertainty and risk in the renewable energy investment market[195].
- The three cities all below average in the share of technical, scientific and professional services and will need to build capacity in these areas to support emerging renewable energy and cleantech sectors.
- While the region has access to gas, there are limitations in supply infrastructure that will require substantial investment to address.
- Energy demand is expected to remain static over the next decade as a result of low economic growth and continued energy efficiency improvements.
- Some renewable technologies are still unproven in terms of extraction/production and will require government support and risk sharing through grants and underwriting.
- Local government planning and regulation could be improved to facilitate stronger uptake of renewable energy.
- The local electricity grid has only minor capacity for additional generation, prior to the proposed upgrade of the Heywood interconnector between Victoria and South Australia.
- Access to the grid is heavily regulated and is a barrier to innovation.

Recommendations

The region can do much to take advantage of these opportunities and meet the challenges.

Test-bed for Renewable Technology
The Upper Spencer Gulf provides an ideal site to trial and test renewable energy and complementary technology research and innovation, development and commercialisation. It combines excellent renewable resources with proximity to specialist support to enable research institutions to test their technologies in live situations. This would significantly assist with understanding reliability and commercialisation opportunities and act to bring the technologies to market faster, bolstering the states and region's economy.

A partnership could be established with organisations such as Adelaide University, who are already actively investigating a range of new technologies in partnership with industry in the region. There are also a range of renewable energy innovators active in the region who could also be strategic partners for the deployment and commercialisation of emerging technology. Other potential partners could include the University of South Australia and other universities, South Australian Research and Development Institute and overseas research institutions.

This would provide an opportunity to further leverage funding available through sources including the Australian Research Council, Department of Industry and the South Australian Government.

Recommendations:

1. Develop regional technical and research capacity to support opportunities to trial renewable energy and clean technologies in the Upper Spencer Gulf through partnerships with industry and leading research institutions including Adelaide University.

2. Work with the South Australian Premier's Climate Change Council to implement the state's Climate Change Vision – Pathways to 2050 priority action 8.3 to trial a partnership to develop integrated solutions for industry development based on a low carbon economy in the Upper Spencer Gulf.

3. Work with South Australian and Australian Governments to support development of cleantech industry clusters in the Upper Spencer Gulf and promote opportunities for Industrial symbiosis.

Large Scale Renewable Projects
There are significant opportunities to support large scale renewable energy projects in the region. The Upper Spencer Gulf has abundant renewable energy resources in wind, solar, algae and geothermal, within a global trend of rapidly falling costs of renewables relative to other forms of energy.

The most immediate commercial-scale prospect for the Upper Spencer Gulf is through large scale solar photovoltaic or solar thermal energy, in conjunction with expanded volumes of wind generation. The immediate market would be the established - but unquantified - demand within the region, with utilization of proposed expanded export capacity through the interconnector into Victoria which, when completed, will allow about 650Mw of exports on a continuing basis.

There are also favourable opportunities for low-cost storage in the region, including pumped hydro storage at established dam sites and new opportunities involving high cliffs alongside the ocean. The falling costs of battery storage is expected to make local storage in households and businesses attractive as a supplement to storage on the grid, so long as distribution and retailing systems allow it to be developed efficiently.

Utilisation of the renewables capacity of the region will proceed more rapidly if there is more efficient provision of transmission, distribution and retailing services.

Recommendations:

4. Prepare an energy demand and emissions profile for the Upper Spencer Gulf.

5. Continue to support the implementation of initiatives such as the 'Repower Port Augusta' and 'Green Grid' projects and increase the ability of the region to provide renewable generation into the grid.

6. Work with the South Australian and Local Governments to ensure land-use, zoning and development plan provisions support renewable energy and innovative clean technologies in appropriate locations to maximize synergies and avoid sensitive or high-value environmental or community locations.

7. Work with Local, South Australian and Australian Governments to improve coordination across agencies to support innovative development and deployment of renewable energy, low carbon and clean technologies in the USG.

8. Develop a marketing strategy promoting the capabilities and resources in the region and the opportunities for growth in renewable energy and complementary industries.

Preparing Industry to Capture the Opportunities

The current industry base in the Upper Spencer Gulf will benefit from renewables investment in the region, particularly if it has the skills and equipment to support the industry. It will be necessary to build local capacity to innovate, and up-skill the workforce to participate in the renewable energy supply chain.

A number of companies have already actively participated in renewable energy projects, and this experience should be actively leveraged to provide a basis for further capacity building in the region.

There are opportunities to develop specialised training programs to support upskilling for the renewables industry. This could be coupled with an industry and mentoring program that would provide the basis for significant innovation in the region.

Recommendations:

9. Work with the South Australian and Australian Governments to develop an industry exchange program so that core industries in the region can learn the skills and technologies to support the renewable energy, low carbon and clean-tech sectors.

10. Work with Regional Development Australia and the South Australian Government to undertake a skills audit to identify training requirements in the region and funding mechanisms to support reskilling for the renewable and clean-tech sectors.

11. Work with Australian and South Australian Governments to access support through initiatives such as the Next Generation Manufacturing Investment Program, Regional Infrastructure program, Innovation Voucher program and Business Transformation Voucher program to assist growth in the renewable energy and clean-tech sectors in the Upper Spencer Gulf.

Supporting Local Business and Residents

Beyond preparing for servicing the industry, local organisations can also support the uptake of existing renewable technology. This will not only provide benefits to local business but will further stimulate local jobs, as well as creating opportunities for local product suppliers. Local businesses can be provided assistance to invest in solar, bioenergy and other cost effective small scale renewable energy generation, along with energy storage and energy efficiency as a means of reducing their operating costs and improving profitability and competitiveness.

Similarly, local residents and communities can be supported to invest in solar, storage and energy efficiency, as a means of alleviating the impact of rising energy prices and also stimulating local jobs. There are current funding opportunities and many examples of successful, local and regional initiatives that can be used as case studies for the Upper Spencer Gulf cities to learn from and adopt in pursuit of improving local uptake of renewables and energy efficiency with the community.

Recommendations:

12. Work with the Australian Government, South Australian and Local Governments to promote programs that support the uptake of renewables and energy efficiency across Upper Spencer Gulf communities.

Attracting Energy Intensive Industries

A key outcome from the growth in the renewables sector in the longer term is that the region may become increasingly attractive for energy intensive industries through its growing abundance of clean, cost competitive power. Large scale customers have been identified as a critical factor in gaining support for network augmentation.

The Upper Spencer Gulf could actively promote the benefits of relocation or expansion into the region to large energy intensive industries. This would ideally include a partnership with the South Australian Government to approach target industries and actively seek investment in the region. In addition, the region could explore the opportunities arising through the emerging market in energy importation. The growth in the need for export hydrogen and ammonia, for example, is likely to make the renewable resources in the USG very attractive.

Recommendations:

13. Develop a partnership with the State Government to target energy intensive industries and actively seek investment in the Upper Spencer Gulf.

Glossary of Abbreviations

ABS	Australian Bureau of Statistics
AEMC	Australian Energy Market Commission
AEMO	Australian Energy Market Operator
AER	Australian Energy Regulator
ARENA	Australian Renewable Energy Authority
CEFC	Clean Energy Finance Corporation
CER	Clean Energy Regulator
CPV	Concentrated Photovoltaic
CST	Concentrated Solar Thermal
EGS	Enhanced Geothermal Systems
ERF	Emissions Reduction Fund
IEPI	International Energy Policy Institute
IMER	Institute of Mineral and Energy Resources
KW	Kilowatt
NEM	National Electricity Market
LNG	Liquefied Natural Gas
LRET	Large Scale Renewable Energy Target
MW	Megawatt
MWe	Megawatt equivalent
NGERS	National Greenhouse Emissions Reporting Standard
PV	Photovoltaic
REIC	Renewable Energy Investment Certificate
RET	Renewable Energy Target
SRES	Small Scale Renewable Energy Scheme
USG	Upper Spencer Gulf

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