Barcaldine Clean Energy

Project Business Case

Clean Growth Choices

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Extensive resources including case studies are available at: https://www.cleangrowthchoices.org/

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1 Executive Summary

The business case proposes a number of opportunities to build local resilience and economic diversification through targeted renewable energy projects.

A number of steps are proposed to diversify the economy through innovative energy projects and facilitate initial projects with technical assistance where necessary. Three projects have been prioritised by the working group including:

1. Community power opportunities
2. Local optimisation project demonstrating virtual power plant technology
3. A renewable energy development that leverages a local renewable energy development to provide secure renewable power.

The project provides options which will support the Queensland Government's commitment to 50% Renewable Energy by 2030. The recommended projects and their budgets include:

1. Facilitation of community energy projects: $180,000
2. Virtual power plant and microgrid demonstration: $550,000
3. Renewable energy linked to a project: $210,000

This business case proposes a project which will contribute to achieving the Queensland Government Renewable Energy Strategy targets of fifty per cent of power from renewables by 2030.

Our Future State: This business case advances projects that address a number of key Government objectives including:

- Creating jobs in a strong economy by creating and maintaining jobs for regional employees in drought-affected communities
- Keeping Queenslanders healthy by reducing financial pressures on regional families and reducing suicides.

1.1 Communities in Transition: Clean Growth Choices

The CiT Pilot Program delivers on the *Queensland Climate Transition Strategy*'s action to build leadership capacity within communities to develop place-based climate transition roadmaps.

These roadmaps, and this business case, identify opportunities for economic and social development and climate resilience in regional Queensland. These opportunities range across a number of sectors including agriculture, waste, water supply, tourism, energy, manufacturing, transport and human services.

The multidisciplinary nature of these business cases means that other Queensland Government priorities are indirectly being addressed, thus offering an opportunity to leverage efforts across Government.

The CiT Pilot Program contributes to reducing emissions by identifying economic opportunities that support the transition to a low carbon economy, under the *Queensland Climate Transition Strategy.*

Importantly this business case identifies low emissions opportunities and offers economic diversification to build resilience in the Barcaldine economy.

2 Introduction/Background

This project has been prioritised by the Barcaldine working groups under an Enabling Infrastructure pathway. The pathway recognises the importance of robust infrastructure to underpin economic and social resilience and prosperity.

Electricity pricing and network reliability constrain the resilience and competitiveness of Barcaldine Region businesses and may be a constraint to growth. At a time where businesses are facing pressure due to a declining population, they have been facing increasing power prices despite recent large scale solar developments in the region.

Barcaldine has excellent solar access, meaning the opportunity to generate power for local use or to supply low emissions or zero emissions power to the national grid, contributing to national renewable energy and emissions reduction targets.

Reliable and affordable access to power is critical to the region. If the Council and/or businesses are able to reduce their energy expenditure by $47,515[1], they would have saved the equivalent funds to employ another person. Similarly, household funds that can be diverted from energy spending will be available for more value-added local spending.

At the most simple level, the Council, businesses and households can develop local, renewable power resources to provide local supply and employment, whilst establishing Barcaldine as a leader in clean, local energy.

The *Barcaldine Living Roadmap* outlines how a group of Barcaldine residents came together to develop this business case including the options canvassed by the working groups.

3 Overview

3.1 Vision

Take advantage of Barcaldine's natural advantage in energy by facilitating projects that will see a direct benefit to the Barcaldine region and economy.

Develop an energy strategy to:

- Provide a secure, affordable and renewable energy network that is a genuine strength for the local economy and able to attract and secure new business investment in the region
- Provide economic resilience and affordability through energy security and low cost, locally generated electricity
- Maximise asset utilization for local network assets and any existing power infrastructure
- Offer more community control over power options.

1. ———————————

[1] Queensland Government Statistician's Office, Queensland Treasury, Queensland Regional Profiles: Workforce Profile for Barcaldine (R) Local Government Area (2018)

3.2 Organisational Objective

Utilise Barcaldine's energy opportunity to provide:

- A long-term economic benefit to the region, creating options to establish the energy system as a genuine economic strength and catalyst for growth
- A pathway to significantly reduce the region's emissions
- A significant contribution to state and national targets such as renewable energy implementation and greenhouse gas emissions reduction.

4 The Business Case

4.1 Purpose of the Business Case

The purpose of the business case is to identify opportunities to:

1. Outline the potential for sustainable energy development at a number of scales in Barcaldine
2. Analyse a number of options as proposed by the Clean Growth Choices Working Group
3. Identify costs, benefits and risks
4. Develop a proposal to proceed with the project, or to identify a funding source for the project.

The business case proposes three project options to achieve the above outcome. It is a preliminary business case that will provide the working group with:

1. A sound basis for a decision to proceed to a business case
2. The next steps and estimated costs to develop the business case.

Sustainable Development Goals

The project aims to achieve sustainable economic development in Barcaldine and in particular, works towards achieving the following of the https://sustainabledevelopment.un.org/ (SDGs). The SDGs relevant to this project are:

Number	Goal	Explanation
SDG7	Affordable and Clean Energy	Two key targets under the goal include: • **7.2:** By 2030, increase substantially the share of renewable energy in the global energy mix • **7.3:** By 2030, double the global rate of

		improvement in energy efficiency
SDG 8	Decent Work and Economic Growth	Roughly half the world's population still lives on the equivalent of about US$2 a day with global unemployment rates of 5.7%, and having a job doesn't guarantee the ability to escape from poverty in many places. This slow and uneven progress requires us to rethink and retool our economic and social policies aimed at eradicating poverty.
SDG 9	Industries, Innovation and Infrastructure	Investments in infrastructure – transport, irrigation, energy and information and communication technology – are crucial to achieving sustainable development and empowering communities in many countries. It has long been recognized that growth in productivity and incomes, and improvements in health and education outcomes require investment in infrastructure.
SDG 13	Climate Action	Climate change is now affecting every country on every continent. It is disrupting national economies and affecting lives, costing people, communities and countries dearly today and even more tomorrow. Weather patterns are changing, sea levels are rising, weather events are becoming more extreme and greenhouse gas emissions are now at their highest levels in history. Without action, the world's average surface temperature is likely to surpass 3 degrees centigrade this century. The poorest and most vulnerable people are being affected the most
SDG 17	Partnerships for the Goals	A successful sustainable development agenda requires partnerships between governments, the private sector and civil society. These inclusive partnerships are built upon principles and values, a shared vision, and shared goals that place people and the planet at the centre, and are needed at the global, regional, national and local level.

The targets for each of these goals should be taken into consideration in the development of the projects identified in this business case.

4.2 Business Case Sponsor

The sponsor of the business case is the Queensland Department of Environment and Science (DES).

5 Situational Assessment and Problem Statement

The Barcaldine Region has seen the development of a number of utility-scale renewable energy projects in recent years. Projects in Barcaldine and Longreach have added to local power generation, including the Barcaldine Power Station, owned and operated by Energy Queensland (Ergon Energy). At the same time, members of the community consider that power costs have increased and reliability has declined.

There is a significant solar resource in the region with the AREMI Solar Resource Mapping[2] showing Direct Normal Exposure of over 25.1 MJ/m^2 which is amongst the highest in Australia and particularly highest among areas with connections to the National Electricity Market (NEM).

The community feels that there is a greater opportunity for local benefits in renewable energy projects that will provide affordable renewable power whilst creating greater opportunities for the region to increase revenues. *Barcaldine Approaching 2030* under *Section 6.2: Dynamic industries*, identifies the potential for larger renewable energy projects (p. 14)[3], particularly in relation to *Section 7: Infrastructure projects*. The RAPAD vision[4] is:

> *For our region to generate Queensland's electricity needs from renewable energy, in turn facilitating transformative economic and social benefit for our region, while becoming an energy superpower of the low carbon world.*

Participants at the 2016 Barcaldine Futures Workshop identified the potential for renewable energy to diversify the economy (p. 12)[5].

The RAPAD vision recognises that renewable energy could power critical infrastructure such as water treatment plants and new industries in the area such as algae production for energy or nutrients (p. 13)[6]. It also identifies that returning the locus of control to the region is critical to enhancing regional self-sufficiency with the potential to reduce costs and the burden of CSOs (p. 12)[7].

A number of key issues identified by the CGC working group and through wider work in the RAPAD area, include:

- The potential to turn access to reliable energy from a regional weakness to a regional strength
- Escalating power costs
- Decreasing reliability of power supplies in fringe-of-grid areas
- Limited economic return for the community from large-scale energy projects in the region.

The Barcaldine Region should be able to capitalise on the abundant solar resource in a way that offers long-term jobs and economic benefit. At present, with large-scale solar developments, a number of benefits accrue to the local economy including:

- Short- to medium-term jobs and utilisation of local services during the planning, design and approvals phases
- Long-term economic benefit to the owner of the site through leasing
- Short-term construction phase benefit which will vary depending on the goods and services that are sourced from the local community.

1. _____

[2] https://nationalmap.gov.au/renewables/
[3] https://www.barcaldinerc.qld.gov.au/downloads/file/510/brc-approaching-2030-pdf
[4] https://www.rapad.com.au/assets/Uploads/Public-consultation-RAPAD-Big-Vision-1.pdf
[5] https://www.rapad.com.au/assets/Documents/Pathways-to-Futures/Barcaldine-Workshop-Report-2016.pdf
[6] https://www.rapad.com.au/assets/Uploads/Public-consultation-RAPAD-Big-Vision-1.pdf
[7] https://www.rapad.com.au/assets/Uploads/Public-consultation-RAPAD-Big-Vision-1.pdf

The scope for further large-scale developments in the region may now be limited by the capacity of the local electricity grid to accommodate additional generation. Accordingly, a large investment may be required to increase high voltage capacity connection to the National Electricity Market. In addition, the reliability of power in the local area presents a cost and risk to local residents and businesses such as power fluctuations in Muttaburra routinely damaging equipment.

The Clean Growth Choices Working Group identified that to lead to successful diversification of the Barcaldine economy through renewable energy, the following benefits should accrue locally:

- Reduced energy costs to users of local energy
- Greater power system reliability
- More long-term jobs available to the host communities.

What options are available to assist the Council, residents and businesses realise some of these benefits at present?

Option	Benefit to Stakeholder	Local Benefit	Disbenefit
Efficiency actions, such as businesses being able to access the CCIQ ecoBiz program	Reducing the amount of power consumed; saving money and reducing carbon emissions. Many actions are no-cost or low-cost.	Freeing up local electricity grid capacity, allowing for additional businesses.	Short-term Can be difficult to maintain behavioural savings Capital cost of some actions.
Efficient building design – orientation to north Details of optimum efficiency are available at the Your Home Site	Operational cost savings. Improved comfort Low cost. Could be provided through a service to assist land holders to identify the ideal orientation for houses on sites at the time of design Some assistance could be provided to assist people to retrofit to improve energy efficiency such as adding shading, insultation, repainting with light colours or heat reflective paints.	Reduced power costs Unlikely additional construction costs.	Medium- to long-term benefit Lower applicability to existing buildings (other than some potential through renovations).
Solar on individual properties	Cost reductions for properties, possibly some export potential.	Freeing up local electricity grid capacity, allowing for	Large proportion of revenue leaves the local economy

		additional businesses Some local benefit to installers etc Reduces some energy losses by providing local power supply.	(purchase of panels, inverters) Capital cost, possible opportunity cost Difficult to precisely match generation to load, so systems will either: (a) export or (b) waste surplus power.

The project recognises the value of the network assets in place to transport electricity, ie. the poles and wires that make up the distribution and transmission networks. These assets represent a significant sunk capital cost and valuable infrastructure. The project does not seek to make these assets redundant, but to identify opportunities for them to be utilised economically and maintained in a way that provides the basis for economic growth in regional areas. This project provides the opportunity to work towards an understanding of the costs and benefits of solutions that suit local communities in a way that may reduce network management and maintenance cost.

The Australian Energy Market Operator has commenced consultation on an "Open Energy Networks" project[8] to identify how to transition to a two-way grid that allows better integration of distributed energy resources (DER) to deliver better outcomes for all customers. A number of models are being explored and there is the potential for any proposed trials in Barcaldine to be structured to coordinate with this program.

Building our Innovation Economy – Advance Queensland Strategy identifies that one of the 15 key actions is to "work with Government owned energy and water providers to maximize our state assets to build innovation opportunities"[9]. Opportunities discussed to generate value for the region from the abundance of solar resource and include:

- Facilitating community-owned renewable energy developments or community grid projects based on interstate or international models such as the Community Grid Project on the Mornington Peninsula in Victoria
    - Investigating and establishing demonstrations of new energy models such as Virtual Power Plants (VPP) or microgrids
    - Development of electric vehicle charging stations
    - Linking renewable energy to particular projects:
        - Agriculture
            - Protected cropping in containers or greenhouses such as nectar farms (http://www.nectarfarms.com.au/) or vertical farms (http://www.verticalfarms.com.au/) which are energy intensive, water efficient and may offer a local supply of fresh horticulture supplied by a purpose-build energy system
            - Thermal energy storage could assist in managing supply from solar power (1414 Degrees - https://1414degrees.com.au/what/)

1.

[8] https://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/DER-program/Open-Energy-Networks-joint-consultation-with-Energy-Networks-Australia
[9] https://advance.qld.gov.au/innovation-strategy

- A large-scale example of the above is Sundrop Farms in South Australia which uses an integrated solar thermal system to power a large greenhouse system and desalinate seawater for production
- A smaller scale opportunity is Agri-Voltaics, where the solar panels provide some shade for cropping, assisting with water retention, and the crops in-turn, providing some passive cooling of the panels to retain efficiency. Panels could also assist with water capture[10]

▪ Information Technology and File Storage
- Establishment of data centres and servers powered by renewable energy systems where the costs of moving data to centres may be cheaper than the cost of moving power

▪ Producing renewable hydrogen with excess power generation from other projects with the potential to export from the region using the Barcaldine Power Station Gas Pipeline

o Taking a partnership model approach as a catalyst for renewable energy projects (see box) may spread the project development risk and increase the likelihood of delivery.

There are a number of examples of community renewable energy projects in Australia:

- Energetic Communities Association Inc. is a key driver of Community Owned Renewable Energy (CORE) development throughout Queensland. It supports communities establishing Community Owned Renewable Energy on the roofs of community buildings, businesses, local government buildings and not-for-profits' buildings, and undertakes supportive policy development and offers support at the state level - http://www.energeticcommunities.org.au/

- The Community Power Agency is another organization that can assist in facilitating the development of community power projects (https://cpagency.org.au/). It has developed a *how to guide* and a number of other resources to assist in developing projects

- The Distributed Energy Exchange (deX) - is an Australian energy software innovation that allows for the networking of renewable energy and storage to aggregate and share energy.
- The Beyond Zero Emissions group has conducted studies identifying the potential for strong conditions for renewable energy investment that can lead to economic growth for regions, with the development of the Repowering Northern Territory Plan[11]. The plan details that 10GW of power including renewable hydrogen production and generate over 8,000 jobs and over $2 Billion in revenue.

Box 1: Case Study: Rural property, Elis – Savings and lifestyle with renewable energy: A property one hour drive out from Muttaburra relied on a diesel generator costing around $26,000 per annum to meet its electricity needs. The nearest electricity grid node is 16km away which would cost them between $200-300k to connect to.

A $57,000 investment in an 8kW solar photovoltaic and 16kW battery system through an Equipment Finance Load from RaboBank paid for itself in two years. The system is sufficient to run a two person grazing property with the diesel generator used for backup.

1. _____

[10] https://www.mnn.com/your-home/organic-farming-gardening/stories/agrivoltaics-solar-power-crops-bees
[11] https://bze.org.au/research/regional/repowering-nt/

Box 2: Partnership Model for Renewables Development

In a partnership-type model, the Council and community create the conditions for investment and seek industry partners to develop projects. Councils can significantly reduce the risk of projects and may also play a role as the owner of large areas of land. It is suggested that expressions of interest are invited from interested parties to initiate, build, own and operate a project incorporating a local generator such as a modular or containerised farming project. The Council may offer land at reduced rent and a certain amount of water. The working group will compile the following information in the form of a more comprehensive business case to provide to potential proponents:

- Details of the energy network that may be available in the area and any conditions of use
- Tentative commitments from businesses to purchase products from the hub with possible conditions
- Details of potential sites and of any approvals required
- Letters of support from any regulatory authorities.

Proponents would be invited to express interest in developing the project in partnership with the Council and working group, and in their proposals should be asked to provide details of:

- The system and technology that they propose to use and details demonstrating its local suitability by farms
- Their experience in initiating, building, owning and operating such developments
- Their level of commitment to the project
- Their proposed financial model for the project indicating:
    - Rent to be paid to the Council (or other land owner)
    - Revenues and incomes for the produce
    - Local employment opportunities
    - Any other benefits to be accrued to the community.

Box 3: Policy Context. Australia's and Queensland's International, Federal and State Energy Policy Commitments

In 2016, Australia joined 170 countries to become a signatory to the *United Nations Framework Convention on Climate Change (UNFCC) Paris Agreement*. It has committed to reduce its emissions by 26 to 28 per cent from 2005 levels by 2030. However, since 2015, Australia's overall emissions have increased year on year. This includes increases over 10 years to 2018 in transport (16%), industry (16%) and agricultural (6%) and with a decrease in the electricity sector (11%) due to a decrease in gas and coal fired electricity and an increase in renewables (Stephanie March, 2019). Australia's current Renewable Energy Target (RET) requires that 20% of Australia's electricity (33,000 GWh) be produced from renewable energy sources by 2020 with the target remaining unchanged through to 2030. The Emissions Reduction Fund is the main Federal Government program which provides incentives for organisations to voluntarily reduce their emissions. This is an investment of $2.55 billion in 2014 with a further $2 billion in 2019. The Australian renewable energy industry will have installed more than 10 gigawatts of new solar and wind power during 2018 and 2019. If this rate is maintained, Australia will reach 50% renewables in 2025 (Baldwin, Blakers and Stocks, The Conversation, 2018).

At a State level, Queensland has an overall target to achieve 50% renewable energy by 2030 with the goal to reduce emissions and act on climate change, create new jobs and diversify the State's economy. Specifically, the *Powering Queensland Plan* is designed to support the transition to a clean energy sector through stabilizing electricity prices, transitioning to a low-carbon energy sector, maintaining energy security and reliability, and investment in northern Queensland energy infrastructure. The transition to a low-carbon energy sector includes facilitating up to 400 MW of diversified renewable energy, including 100 MW of energy storage through a reverse auction. As part of the *Powering Queensland Plan*, the Government has also created a new publicly owned 'CleanCo' clean energy generator which will secure a cleaner, more affordable, sustainable and secure energy supply for Queensland.

Box 4: Case Study: Innovative Sundrop Farms Uses Sunlight and Seawater to Grow Tomatoes

Sundrop Farms in South Australia uses more than 23,000 mirrors to capture sunlight and direct it to a central receiver at the top of a 127-metre power tower. All the water used for irrigating the crops is piped from the Spencer Gulf and converted into fresh water using a thermal desalination unit. At its peak, it produces 39 megawatts of thermal energy, which is used for electricity, heating and making water. The commercial facility cost about $200 million to build, with private equity firm Kohlberg, Kravis and Roberts (KKR) investing $100 million. The facility produces about 17,000 tonnes of truss tomatoes a year and holds a 10-year supply contract with Coles Australia. See https://www.sundropfarms.com/innovation/.

Could an initiative such as this be adapted to Barcaldine? Could a smaller version be established to desalinate brackish groundwater to water suitable to grow leafy greens or fodder for local use?

*Information and image source: https://www.abc.net.au/news/rural/2019-05-15/port-augusta-sundrop-farms-sold-to-investment-fund-morrison-co/11108046

6 Assumptions and Constraints

This business case provides a pre-feasibility level assessment of the project. It has been prepared by the Clean Growth Choices team under the direction of the Clean Growth Choices working group. The working group largely consists of volunteers who are providing guidance and input. Accordingly, the accuracy and reliability of data is referenced where available and provided to a pre-feasibility standard.

7 Identification and Analysis of Options

This is a high-level analysis of the possible alternatives that could be employed to bridge the gap between the current situation and what is proposed, as outlined in Section 4.

7.1 Identification of Options

There is a large range of opportunities available to the region as outlined in Appendix D. Members of the working group have identified a number of options to be investigated for this project including:

1. Community renewable energy: A decentralised/in front of the meter local energy generation program with a community investment model
2. Microgrid or virtual power plant: Using Internet-enabled technology to manage energy flows locally, sharing the generation and battery storage of from local systems
3. Catalyst for a major project: A renewable energy project as a catalyst for, or linked to, another economic development project.

7.1.1 Option 1: Community Renewable Energy

This model is similar to Hepburn Wind Farm (details in appendix 3).

Community energy projects are invested in by local community members and supply electricity to local consumers via a retailer. The project offers the opportunity to allow participants to purchase power from a local generator at a reduced consumption rate, though as it still delivers energy through the network, network costs are still applied. They are able to offer reduced generation costs, offering power cost savings as well as dividends to local owners of the project.

Ergon Energy is trialling small in-front of meter battery energy storage solutions to provide grid support/stabilisation services.

The option involves establishing the conditions for a community-owned renewable energy project in Barcaldine.

7.1.2 Option 2: Virtual Power Plant or Microgrid

This project may ultimately result in the consideration of acquiring a portion of the region's electricity grid under local management. One of the region's towns could be a test case for this.

Initially, the project would involve metering to test the concept. In this step, a number of houses or properties in a community would be connected with suitable real-time metering and software for analysis and study of power flows to understand consumption and existing generation. Then, existing solar panels could be retro-fitted with VPP-enabled inverters and batteries and additional devices could be installed at optimum locations based on batteries.

This may provide valuable data for the network operator to understand local power flows to and within these communities. It may also lead to a conversation about relative costs of connecting networks to remote communities and consideration of selective islanding or disconnecting from the national energy market where a net benefit can be demonstrated, similar to the way in which Horizon is doing in Western Australia.

7.1.3 Option 3: Link to a major project

This option involves jointly developing a new project that requires a stable renewable energy supply where the generation and consumption profiles match. The project would see an economic development opportunity.

Such a proposal could underpin a range of new businesses, as outlined above, such as protected cropping, data storage and management, cold stores, or small scale manufacturing such as breweries; value-adding to the region's primary produce.

The project could involve an initial planning exercise to consider opportunities based on a number of studies currently underway, including:

- Identifying suitable industries
- Approach sectors to determine risks, opportunities and costs
- Rapid pre-feasibility of these (such as the market for produce from protected cropping)
- Opportunities for an integrated precinct project with renewable energy as an underlying opportunity, but including The Quilpie Wellspring Project[12] or a Green Logistics hub for vehicles passing through Barcaldine.

An example of renewables linked to a major project is shown in the Box 4 case study, outlining the Sundrop Farms project in South Australia.

The Partnership Model (Box 2, above) provides a low-risk opportunity to encourage such projects in the region, where the Council and the community create the conditions required for investment, and then work in partnership with proponents to facilitate delivery.

7.2 Comparison of Options

The table below compares the options by summarising the benefits, disbenefits and costs of each.

Criteria	Option 1: Community owned	Option 2: VPP or microgrid	Option 3: Linked to a project
Benefits:	• Community has a share in the ownership and	• Energy costs could be reduced • Greater	• **Reduced cost to maintain network for** new **user**

1.

[12] https://quilpie.qld.gov.au/wp-content/uploads/2019/09/1357_001.pdf

• Energy users • Barcaldine community and businesses • Ergon Energy	governance of the project • Community share of profits • Reduced energy costs to customers.	understanding of energy consumption from real-time metering • Opportunity to reduce costs	• Employment growth • Integrated planning and industry development opportunity
Disbenefits: • Energy users • Barcaldine community and businesses • Ergon Energy	• Additional local management may be required • The more hands-on the community is, the less the potential costs.	• The project would involve an initial virtual trial or demonstration	• Coordination of opportunities can be challenging: more than one project needs development • Failure of one may lead to failure of the other
Costs: • Direct • Indirect • Recurrent	• **Development costs and organisation costs could be outsourced to an experienced developer**	• Feasibility study and demonstration costs	• Project development costs may be borne by potential developers

Further benefits analysis is provided in Appendix A.

7.3 Recommended Option

The working group identified the need to investigate all options. Details of a range of energy options are available in Appendix D.

8 Risks and Benefits

8.1 Matters to be considered

A number of key challenges exist:

- Anecdotal advice suggests that the existing distribution network infrastructure is at or near capacity, limiting the scope for exporting significant amounts of renewable energy from sites
- Any new significant generator would require significant capital infrastructure investment
- The National Energy Market rules currently apply network charges to all power that is consumed via the network, such that purchasers of exports from a renewable energy plant must pay the network charges regardless of the distance from the plant. Accordingly, some ability to reduce costs is available through a direct Power Purchase Agreement (PPA), but this limits the discounted pricing that can be applied to discounts on the generation and retail components. True cost reductions will be achieved if a network pricing model can be established that will allow energy users in an area to share or trade power virtually, paying a small network fee reflective of the short distance the power has travelled (and acknowledging the backbone security provided by the wider grid).

The key to gaining return on investment on individual sites is a function of utilization and the difference between the Levelised Cost of Energy (LCOE) from the plant, and what the tariff paid would otherwise be.

Utilisation: The more closely-matched the size of the solar PV system is to the site power demand, the better the return will be. For example:

- Identify what efficiencies or load shifting could reduce the size of the system site power consumed and demand, and therefore potentially reduce the size and capital cost of a system
- If a site that draws a maximum of 50kW of power has a 100kW system installed, it is likely to be overcapitalized (unless a conscious decision has been made to allow for the 50kW to be provided even in overcast conditions, or if the panels are aligned so that the system can deliver 50kW for an extended daily period).

Matching Generation to Load: Due to varying demands and generation, it is difficult to precisely match a solar PV system to a load behind the meter and, as such, there is always likely to be some surplus generated power or import required. For example, schools, business premises (such as a mechanical workshops and public pools) all have either seasonal loads or may only operate five days per week. In these situations, there may be days or weeks where there is a significant over capacity, such as school holidays, businesses over weekends, and some home systems during the day. In these systems, the most economic outcome may be through networked systems in a peer-to-peer or virtual power plant arrangements.

Tariff and LCOE: The project needs to be able to supply power at a cheaper cost than is currently being paid. The LCOE is the net present value of a unit cost of electricity over the operating life, ie. the break even price. If a site is on a low tariff, it may be difficult to build a plant to compete with that cost. The business case needs to consider the extent to which the project will assist in reducing costs by reducing demand charges.

Key issues for all options that will need further investigation are:

- Grid structure and capacity: What is the structure of the grid in the area? Ie. 132kV substation, but the YellowDot solar farm feeds into a 22kV networks. A plan of the local power network and substations should be provided to determine the towns connected to each network and what capacity there might be in these networks. It might lead, for example, to demonstrate that there is some local network capacity for additional projects.
- Lack of Capacity in System: The Ergon Network Capacity Map indicates a capacity in the 22kV feeder network of 0.5 – 1.0MVA[13]
- Willingness of Ergon Energy networks to work towards an integrated solution
- What energy-intensive sectors could be attracted on the back of local clean energy:
    - Refrigeration-based industries
    - Data storage and bitcoin mining
    - High speed Internet connection
    - Water-based industries
    - Some aviation
    - Heat using industries (or absorption chilling) where the heat requirement can be matched to the waste heat of the gas turbine.

1. _____

[13] https://www.ergon.com.au/network/contractors-and-industry/developers-toolkit/network-capacity-map

8.2 Risks

An initial risk assessment of the options has been undertaken in Appendix B.

8.3 Potential Benefits

Below is a list of benefits that may result from the projects. They have been classified into direct and indirect. An assessment of some benefits is attached in Appendix A.

No	Topic	Direct/ Indirect	Details
1	Whole of system energy Benefits	Direct	Taking a whole of system approach to energy management may assist in reducing costs of generating, distributing and consuming power by allowing informed decisions to be made about energy investments. The project may also allow for the optimisation of electricity at the local level.
2	Skills for future jobs	Direct	Building up the renewable energy capacity and energy management strategies in the region will lead to more employment and training opportunities. As part of the O&M considerations, can local trades be trained to accreditation by the technology providers to maintain the systems?
3	Reducing losses	Direct	Studies following the development of the Barcaldine Solar Farm indicate that the development has had the added benefit of reducing losses[14].
4	Energy efficiency	Direct	The first stage of the VPP project is simply to provide real-time meters to a group of energy consumers to enable energy flows across the network. The meters will also provide real-time data to the users to enable them to understand their energy consumption patterns and take efficiency steps. This will lead to low-cost energy savings.

9 Implementation Strategy

9.1 Project Title

Barcaldine Clean Energy

9.2 Target Outcomes

The target outcomes are:

Virtual Power Plant and Microgrid: 4 Steps

1.

[14] https://arena.gov.au/assets/2019/06/lessons-from-the-fringes-australian-off-grid-projects-arena-portfolio.pdf

1. Use real-time metering to model power flows and trade virtually – Can we show that the network power flows will benefit from a more integrated local power supply and consumption (ie. testing whether the grid connection into Muttaburra or Barcaldine could be more stable because the power is managed at that local level, gather information on grid conditions – voltage, capacity etc)?
2. Measure the costs and benefits. Answers to the following questions: What is the true network cost of moving over to a 'tolling' model rather than current market arrangements of generator-network-customer?
3. Test potential to move to real-time trading
4. Potential for consideration of local management of the local grid.

Linked to a Project: Concepts

- Power generation linked to a new economic development project such as abattoir, data centre, containerised or controlled-system agriculture, etc
- Local power supply recognising lesser grid impacts leading to lower costs
- Establishing electric vehicle charging with dedicated local power supplies
- Solar thermal where heat might be utilized either in the existing power station or other development
- Supporting direct local investment, ie. another diversification project
- Integrating the existing gas pipeline/power station
- Potential export from the region or a partial PPA with CleanCo (the Queensland Government Renewable Energy Company).

9.3 Outputs

The likely outputs for each of the projects would include:

Option 1: Community Energy

- An agreed site(s) for the project
- Technology identified, operating model and estimated pricing
- Technical issues resolved or a plan to resolve
- Customer base identified and engaged
- Next Steps planned.

Option 2: Local Metering and Virtual Power Plant Model

- A modelled Virtual Power Plant consisting of a discrete group of buildings
- Real-time meters installed at sites to monitor energy
- An energy dashboard for the participants to model flows
- Energy efficiency and renewables advice for participants and other businesses and residents
- A final report demonstrating the concept, including next steps to 'switch on' the plant.

Option 3: New Power linked to a Major Project

- A concept plan for an integrated site or sites
- Potential businesses and renewables developers engaged

- Technical analysis of concepts
- Next Steps and actions including approvals and funding strategy.

9.4 Work Plan and Budget

For each of the projects it will be important to consider the following:

- Project scope: Identify boundary, participants etc.
- Identify costs and benefits to be measured
- Determine the extent of 'demonstration' and gain support from Queensland Government to support/facilitate
- Gain support for the concept from AEMO, AEMC, Energy Queensland
- Identify investment/funding for the measurement phase (CEFC, ARENA etc).

Indicative budgets have been prepared for each of the options.

Option 1: Community Energy

Work Package	Details Discipline	Est Cost.
Project facilitation	Part-time resource to facilitate the project as Council's representative. Facilitate grid and water studies.	$80,000
Establish the operating conditions	Seek Council agreement on potential sites and likely planning conditions and potential exclusivity.	$10,000
Market development and customer engagement	Engage potential customers – local shops and businesses.	$10,000
Technical and scientific advice	Grid connection study, technical studies, due diligence.	$50,000
Legal advice, agreements etc	Optional – could be conducted in-house by Council	($30,000)
Approvals	Cost of preparing reports to gain necessary regulatory and financial approvals needed to gain an Investment decision.	$30,000
TOTAL		$180,000 - $210,000

Option 2: Local Metering and Virtual Power Plant Model

Work Package	Discipline, Details	Est Cost.
Stage 1: Metering – install meters and establish overall system dashboard	Energy Monitoring: Around $1500 per house and small business with a single connection. It is likely businesses will have 2 or more connections requiring more devices.	$100,000
Stage 2: Small solar systems	Solar Supply and installation with VPP enabled Inverters: Around $10,000 - $15,000 per house for 10 – 20 houses with a small solar system and battery. A small number of houses could be chosen initially. VPP-enabled inverters may	$200,000

	initially be retrofitted to existing solar systems to reduce costs or extend the reach of the program with limited funds.	
Program management	Project management: A part-time project manager and facilitator for 2 years to oversee the project and maintain contact with stakeholders.	$100,000
Engineering assessment	Electrical engineering and power systems.	$100,000
Approvals and licences	Allowance for gaining necessary approvals.	$50,000
TOTAL		$550,000

Option 3: Renewable Energy linked to a Project

Work Package	Details Discipline	Est Cost.
Project facilitation	Part-time resource to facilitate the project as Council's representative. Facilitate grid and water studies.	$80,000
Establish the operating conditions	Seek Council agreement on potential sites and likely planning conditions and potential exclusivity.	$20,000
Market development and customer engagement	Potential takers of produce: Local shops and businesses.	$20,000
Technical and scientific advice	Grid connection study, water study, technical studies.	$50,000
Market sounding and procurement advice	Optional: Could be conducted in-house by Council, with some technical and financial advice provided.	$10,000
Legal advice, agreements etc	Optional: Could be conducted in-house by Council.	($30,000)
Approvals	Cost of preparing reports to gain necessary regulatory and financial approvals needed to gain an Investment decision.	$30,000
TOTAL		$210,000 - $240,000

9.5 Other Resources

There are a number of opportunities to seek development assistance, project facilitation or funding, including the following:

- Building Better Regions Fund with two streams for 'Infrastructure Projects' and for 'Community Investments' - https://www.business.gov.au/assistance/building-better-regions-fund)
- Northern Australia Infrastructure Fund (NAIF) - https://naif.gov.au/
- Australian Renewable Energy Agency (ARENA) may consider funding certain aspects of the demonstrations where they showcase new technologies or new applications of technologies

- The regional and Remote Communities Reliability Fund may be an opportunity to fund the Options 1 or 2 Projects - https://www.energy.gov.au/government-priorities/energy-programs/regional-and-remote-communities-reliability-fund
- Regional Development Australia Fitzroy and Central West facilitates economic development opportunities for the region by collaborating with government, community and business. A number of funding opportunities are available from time to time, and might be suitable for the project - https://rdafcw.com.au/funding/.

10 Project Management Framework

10.1 Governance

A key question for this project is “Who Owns the Project?”

It is important to ensure that this project continues to facilitate the participation of working group members and other interested members of the community such that local people continue to have a say in the future of their region.

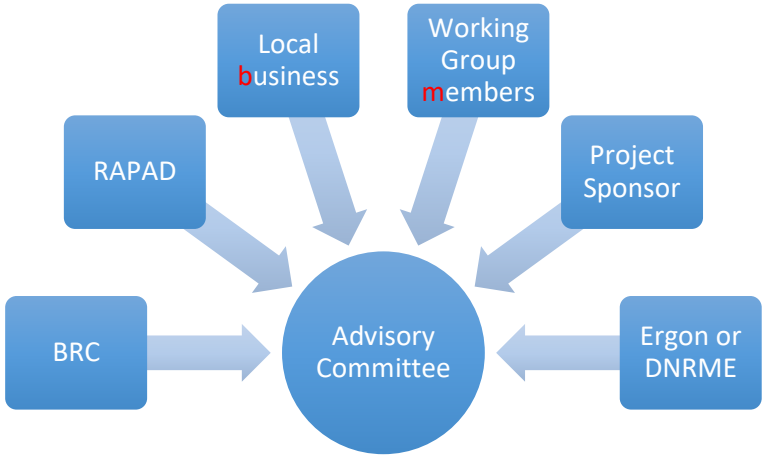
The governance system is proposed to deliver the business case as follows, with the exact representation to be determined at the commencement of the project:

- Advisory Committee: Responsible for the delivery of the project, meeting its objectives on time and within budget. The Steering Committee members will also consult strategically with external stakeholders to ensure the project has the support of a wider network
- Working Group: Responsible for advising the Project Manager on technical and operational aspects of the project and will meet to advise the Project Manager
- Project Manager: Reporting to the Advisory Committee. The Project Manager should sit within or close to the RAPAD or BRC structures and have access to relevant expertise, including through regular meetings of the Working Group.

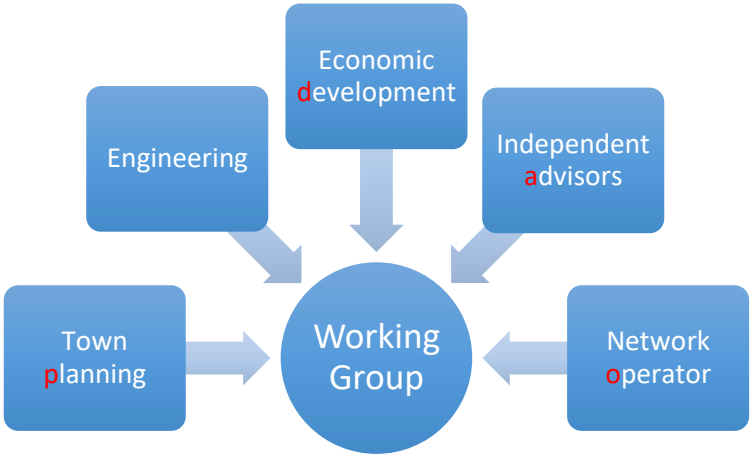
The Project Manager will be responsible for the delivery of the project.

The Advisory Committee should be established with representatives from the Barcaldine Regional Council, RAPAD and industry representatives. The Project Sponsor should be represented, particularly if funding is provided.

The potential structure of the Project Advisory Committee:



The potential structure of the Project Working Group:



The business case should be progressed by a Project Manager, with the close advice of key agencies and advisors in an operational working group as suggested above.

10.2 Project and Quality Management

A detailed project plan will need to be prepared incorporating a number of factors including:

1. Organisational Impact: How the work undertaken during the project will impact on the organisation and how will these impacts be addressed
2. Outcome Realisation: How outputs will be managed once they are delivered, and who will be accountable. This may change as the project evolves
3. Quality Management: Define suitable standards, requirements and best practices for the project to deliver against, and the internal quality requirements
4. Post-project Review: How the group will capture the lessons learnt throughout the project and what review will be done to assess whether the initiative delivered the intended benefits.

The Project Manager will need to ensure that the final project developed is robust and based on sound science. Methodologies for calculating carbon abatement should be recognised and calculations should be accredited, or conducted by an accredited person. Financial analysis should be sufficiently robust to allow decision making, so initial consultation should occur with potential funders and financiers about the level of detail required.

Appendix A: Benefit Analysis

This is a brief assessment of how each key stakeholder group (or individual stakeholders) may be impacted by the project and how they may impact on the project. The impacts may be positive or negative.

Option 1: Community Energy

Stakeholder	Positive Impact	Negative Impact	Overall
Businesses	• Potential for more competitively priced energy • Opportunity to invest in a local energy project		Positive
Council	• Potential for more competitively priced energy • Opportunity to invest in a local energy project • Opportunity for new business in the region		Positive
Electricity industry (including network businesses)	• Additional revenue		Positive

Option 2: VPP and Microgrids

Stakeholder	Positive Impact	Negative Impact	Overall
Businesses, community	• Greater understanding of energy consumption and demand through real time energy monitoring • Potential to save money through optimum investment in energy, rather than overcapitalisation in renewables and storage	• Project may take time to gain approval then fund • Project outcomes uncertain	Positive

Council	• Potential for innovative local energy projects, building on the region's renewable energy opportunity		Positive
Electricity industry (including network businesses)	• Greater understanding of network energy flows • Potential for greater network utilisation • Low risk demonstration project		Positive

Option 3: Linked to a Project

Stakeholder	Positive Impact	Negative Impact	Overall
Businesses	• Potential for a new significant local business		Positive
Council	• Potential for new businesses in Barcaldine		Positive
Electricity industry (including network businesses)	• Opportunity to demonstrate an outcome – integrating a new generator with a new power user		Positive
Community	• Catalyst for new jobs		Positive

Appendix B: Risk Analysis

As a pre-feasibility level business case, this is an initial consideration of risks, and strategies that can be put in place, or investigations in further work that can mitigate these risks.

Option 1: Community Energy

Major Risk and what does it do to the project	Mitigation Strategy
Lack of interest from customers leading to a project not achieving revenue targets	Communications plan required to engage customers. Financial model to communicate likely benefits.
Failure to meet technical requirements for grid connection	Early and regular consultation with Network business to ensure that project is likely to be able to connect (ie. capacity and technical requirements)
Proposed model does not achieve anticipated savings	Early financial modelling and updating as information is refined throughout the project.
Regulatory issues delay or obstruct the project	Detailed risk plan required. Early consultation with regulators and refine project. Identify any areas where assistance may be required to navigate regulatory requirements or seek demonstration status.

Option 2: Metering and Virtual Power Plant

Major Risk and what does it do to the project	Mitigation Strategy
Project not understood	**The project is initially a demonstration and does not propose to change any regulated grid operation. The project is an investigation**.
Regulatory issues delay or obstruct the project	Detailed risk plan required. Early consultation with regulators and refine project. Identify any areas where assistance may be required to navigate regulatory requirements or seek demonstration status.

Option 3: Renewables Linked to a Project

Major Risk and what does it do to the project	Mitigation Strategy
Complexity: Coordination and cross-referencing of ideas and concepts	Project Manager capable of conceptualising the projects. Need to be able to communicate a complex project effectively.
Technical feasibility	Ensure some budget is available to engage suitable people to test some technical concepts.
Lack of interest from customers leading to a project not achieving revenue targets	Communications plan required to engage customers. Financial model to communicate likely benefits.
Failure to meet technical requirements for grid connection	Early and regular consultation with Network business to ensure that project is likely to be able to connect (ie. capacity and technical requirements).
Proposed model does not achieve anticipated savings	Early financial modelling and updating as information is refined throughout the project.
Regulatory issues delay or obstruct the project	Detailed risk plan required. Early consultation with regulators and refine project. Identify any areas where assistance may be required to navigate regulatory requirements or seek demonstration status.
Testing concept: Project does not go to plan or results are not as expected, resulting in a perception of failure	Understand the potential benefits, risks and range of outcomes and ensure stakeholders understand the range of potential outcomes. For example, testing the potential for a VPP concept in the examples listed above may demonstrate that there is no benefit in proceeding to a VPP.

Appendix C: Background Information

Resource Availability

The Queensland Government has mapped availability of biomass residues and integrated it with the Commonwealth Government AREMI Mapping - https://www.statedevelopment.qld.gov.au/industry-development/queensland-biomass-mapping-and-data.html

Government Policy

Queensland Government *Waste Management and Resource Recovery Strategy* - https://www.qld.gov.au/environment/pollution/management/waste/recovery/strategy

Biofutures Roadmap

https://statedevelopment.qld.gov.au/resources/plan/biofutures/biofutures-10yr-roadmap-actionplan.pdf

Energy from Waste

The Queensland Government released the *Energy from Waste Policy Discussion Paper* for public consultation in July 2019 -

https://www.qld.gov.au/environment/pollution/management/waste/recovery/energy-waste

Details on gas pipeline to the Barcaldine Power Station - https://www.aemc.gov.au/energy-rules/national-gas-rules/gas-scheme-register/qld-cheepie-to-barcaldine-gas-pipeline

Australian Government

ARENA Distributed Energy Integration Program - https://arena.gov.au/where-we-invest/distributed-energy-integration-program/

Relevant Case Studies

Location	Details
Hepburn wind farm	Hepburn Wind is the owner and operator of Australia's first community-owned wind farm, at Leonards Hill, about 100km north-west of Melbourne, just south of Daylesford Victoria. The 4.1 MW wind farm hosts two turbines, called Gale and Gusto, that produce enough clean energy for over 2000 homes. Hepburn Wind is the trading name of Hepburn Community Wind Park Co-operative Ltd, a co-operative registered in Victoria, Australia. Hepburn Wind was established in 2007 by the Hepburn Renewable Energy Association, now known as SHARE -

	https://www.hepburnwind.com.au/about/
Gippsland Dairy Farmers	Electricity trading trial using blockchain in Victoria - https://arena.gov.au/news/latrobe-valley-virtual-microgrid-allow-dairy-farms-trade-energy-via-blockchain/

Potential Technologies to assist with VPP implementation

Technology	Web Link	Explanation
Flux Power	https://fluxpower.io/	Software technology that provides real-time electricity metering, with trading capability. Uses Watt Watcher device
Planet Ark's Power Dynamic DVS	https://planetarkpower.com/solutions/planet-ark-powers-dynamic-dvms/	Device allowing solar export in real time
Redback Technologies	https://redbacktech.com/homeowner-small-business/	Storage and control systems
RedEarth Energy Storage	https://redearthenergystorage.com.au/about-redearth/	Larger scale storage and control systems

Appendix D: Table of Options

There are a number of models available to the community to achieve the objectives, each of which would need further investigation. Some options will involve extensive collaboration.

	Details	Advantages	Disadvantages	Opportunities	To Work it needs….
Efficiency and purchase of solar PV for individual sites	• A walk-through assessment or energy audit at each site would be used as the basis to: ○ Reduce the sites power consumption through cost-effective measures ○ Design an appropriately sized system • Council would purchase separate solar PV systems for individual sites • Systems matched to individual site requirements with most power to be	• Projects and sites can be prioritised by ROI • Energy bills at key sites can be reduced • Solar PV system size may be matched at the individual site level. • Reasonably short paybacks (3 – 5 years) particularly where tariffs are high for individual facilities.	• Slightly higher capital cost per installed MW of capacity	• Identify cost-effective efficiencies to achieve energy savings and therefore reduce capex – eg. tender to provide solutions for the site	• Energy audits at high consumption sites to determine most suitable sized solar plant • Approval from Ergon Energy networks

	Details	Advantages	Disadvantages	Opportunities	To Work it needs….
	consumed on site (target zero export)				
Buy a large solar plant	• Purchase a larger solar plant to locate on Council land • Ideally supply Council facilities with a direct connection	• Cheaper per-installed MW capital cost than smaller systems and via tender	• Ability to build a larger plant for export (then purchase at nearby sites) subject to Ergon networks • Capital cost – opportunity cost (ie. what else could BRC do with the funds) • Current National Energy Market rules dictate that the solar farm would be to sell the power – possibly via a Commercial PPA with the Council – it would only result in a small reduction in bills as the network charges would still apply.	• May reduce power bills, but there may be opportunity costs – a more transformative project that may cost the same • May offer investment opportunity for local residents and businesses such as Hepburn Wind	• A site with grid connection • Technical suitability (Ergon) • Assessment of suitable size

	Details	Advantages	Disadvantages	Opportunities	To Work it needs….

Private sector solar plant	• Council may provide land and issue a tender	• Cheaper power may be available
		• Competitive tension amongst bidders on:
		  ○ Delivered cost of energy
		  ○ Other community benefits
			• Discount limited to generation and retail margins, may not lead to network price reductions
			• Contract period may be take or pay arrangements
				• May offer investment opportunity for local residents and businesses such as Hepburn Wind	• A site with grid connection
					• Technical suitability (Ergon)
					• Assessment of suitable size

Renewables for a particular project	• Offer a renewable energy project as an enticer to a new entrant to the region • Provide a site for a new entrant with contiguous and attached for a solar farm to be developed. • New businesses is able to use predominantly renewable power supplemented by grid power.	• Provides power security to a new business considering establishing in the region • Offers lower-cost power to a new entrant • Council could manage the process and become the 'retailer' for power to recover funds	• Capital outlay or debt for the project • Revenue risk	• This could be considered as enabling infrastructure for any of the projects being considered by the CGC working groups – eg. Macropod abattoir • May offer investment opportunity for local residents and businesses	• A site with grid connection • Technical suitability (Ergon) • Assessment of suitable size for a prospective industry
Integrated Virtual Network	• Microgrid system of behind -the – meter solar PV and batteries combined with	• Provides a path to an energy future where community shares generation storage	• Time to set up the demonstration	• Option to do a trial with a small number of homes – such as Aramac or Barcaldine	• A strategy, a plan – then careful approach to engage partners to develop the

	Details	Advantages	Disadvantages	Opportunities	To Work it needs….
	efficiencies • Virtual Power Plant • Complex partnership project: The development of a demonstration would be required involving a number of parties such as Ergon, the Australian Energy Market Operator (AEMO), Department of Natural Resources, Mines and Energy and a Technology partner	technology to manage costs and also manage network demand • Opportunity to highlight the region as an energy innovator • Increases network utilization, manages network demand • Reduces likelihood of individual over-investment in infrastructure • Lower cost – participating homes and businesses may invest in components of the scheme		businesses • Could combine with a demand response initiative in town • Become involved in an existing trial	demonstration • Possible ARENA funding for the program itself under the Distributed Energy Integration Program • Possible DES funding to follow CGC to initiate project • Possibly a Clean Growth Choices project to develop a project plan and undertake initial discussions
Gas hybrid	• The Combined Cycle Gas Engine (CCGE) power plant consists of a		• Not sure if steam Turbine is actually running[15] • Gas pipeline	• Can steam from solar thermal or gas from biodigestion be	• Engineering assessment of existing power station

1. _____

[15] https://www.abc.net.au/news/2008-05-29/green-power-plant-changes-puzzle-barcaldine-mayor/2452236

	Details	Advantages	Disadvantages	Opportunities	To Work it needs….
	gas and steam turbine (38MW Gas 15MW Steam) • Opportunity to pre-heat or boost with some solar thermal • Gas supply via local biogas?		infrastructure Cost[16] needs to be maintained regardless of gas used	provided cheaper than the gas supply? • Is there an industry with process heat that could be partially supplied by flue heat?	• Assessment of current use and price to operate existing power station
Solar thermal pilot project	• Offer a site as a solar thermal power site • Hold a market sounding to determine interest • Allocate the site by tender to a proponent that offers: ○ Local power price ○ Local employment ○ Other community benefits	• Solar thermal sites incorporate storage • Identify region as an innovator in energy • QLD Clinton Feasibility Study (2010) highlights the quality of Barcaldine solar thermal resources	• Constrained network • Technology price	• Constrained network could be mitigated by integrating the solar thermal field with the gas power station (ie. gas boosted solar thermal • Queensland Government has allocated $50M for a solar thermal project • Likely to attract ARENA funding	• A package to facilitate development – need to assemble resources to de-risk the site (approvals, water etc)

1. _____

[16] https://www.aemc.gov.au/energy-rules/national-gas-rules/gas-scheme-register/qld-cheepie-to-barcaldine-gas-pipeline