Renewable Energy for Far North Queensland:

A discussion paper

Cairns and Far North Environment Centre

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Executive Summary

This discussion paper has been produced to initiate a dialogue regarding a renewable energy future for Far North Queensland (FNQ). It aims to inform the community and key stakeholders about the options available for making this transition to renewable energy, and to lay the foundations for a more detailed report on how to progress towards a region powered by 100% renewable energy.

The FNQ region is particularly suited to the production of renewable energy due to the abundance of high quality wind and solar energy resources. This region already produces up to a maximum of around 40% of its power from existing renewable energy projects including wind, hydro, solar and the waste product (bagasse) from sugar cane production.

Globally, the level of investment in solar and wind energy projects is increasing and there is a rapid rate of development in renewable energy technologies and products. At the same time there is a growing understanding of the need for increased efficiency in generation and transmission, and for demand management. There is the potential to increase the capacity of the region's existing assets as well as supplement with new assets. There are a number of wind farms currently proposed in the region, highlighting the attractiveness of this region for renewable energy investment.

"The FNQ region is particularly suited to the production of renewable energy due to the abundance of high quality wind and solar energy resources"

Another incentive to generate renewable energy locally is the distance from current power stations which results in high transition losses. Queensland has the largest electricity distribution network in Australia and as a result incurs significant transmission losses in the distribution of the electricity in regional and remote locations in Queensland. These losses are subsidised by the Queensland Government and in 2009-10 this was $250M. The Queensland Government has made a commitment to reduce Queensland's carbon footprint by one third by 2020 and increase the amount of renewable energy power produced.

There is a clear business case for the Queensland Government to increase the amount of renewable energy generation in FNQ as this has the potential to:

- significantly reduce the transmission loss subsidies provided by the Queensland Government;
- drive investment in the region and create jobs; and
- reduce Queensland's carbon emissions.

To realise these benefits it is vital that a holistic master plan is developed that outlines how this region can transition to 100% renewable energy in the most economically, socially and environmentally sustainable manner.

1. Introduction

This paper aims to stimulate an informed discussion regarding the opportunities for generating 100% of our electricity needs from local renewable energy sources. It should be noted that the information obtained to identify the renewable energy supply and demand for the region has not been obtained from one consistent source. This is due to the many different parties involved in electricity generation, transmission and distribution. Further studies need to be undertaken to verify and consistently identify the actual renewable energy supply across the region. However, the information gathered has enabled a high level overview of the current situation and opportunities for increased renewable energy that exist for the region.

2. National Renewable Energy Targets

The Australian and Queensland Governments have both made commitments to generate 20% of Australia's electricity supply from renewable energy sources by 2020.

Queensland has the highest greenhouse gas emissions per person in Australia and among the highest in the world, with over 43 tonnes of greenhouse gases emitted per person each year compared to the national average of 28 tonnes per person. [1]This is due to Queensland's use of coal-fired electricity generation; a large, energy-intensive industry base, and a dependence on road transport. The Queensland Government aims to reduce the State's carbon emissions by one third by 2020.

3. Overview of Electricity Distribution in Far North Queensland

Queensland's electricity grid is an extensive network that extends from NSW-Queensland border with a backbone transmission line which runs north to Cairns and west to regional communities. Queensland has the largest and most diverse electricity network in Australia, with a grid which supports densely populated cities as well as sparsely populated rural areas.

Supplying low cost and reliable electricity to Queensland, particularly in the north and west of the state, presents particular challenges for the providers. Weather extremes including tropical storms and cyclones, extreme heat and bitter cold, population growth and increasing demand for electricity are growing challenges for this network.

The vast distances that electricity is carried by the network also results in substantial line losses for areas in north and western Queensland. North Queensland is also endowed with some natural assets more suited to a range of renewable energy options, when compared with other parts of the state.

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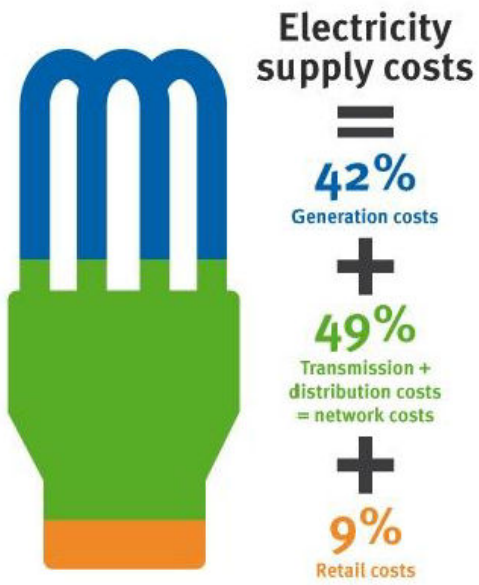
[1] Climate Q Report (Queensland Government) 2009 from www.climatechange.qld.gov.au/

Regional and remote Queensland's electricity supply is highly subsidised by the Queensland Government. The Queensland Government provides a subsidy, known as community service obligation (CSO) payments, to Ergon Energy to meet the difference between the cost of supply and the prices Ergon Energy can charge. In 2009-10, CSO payments of approximately $250 million were paid to Ergon Energy.[2] This is largely as a result of the significant transmission losses that occur across the distribution network in regional and remote areas of Queensland. The cost of this subsidy will likely increase substantially in the future as a result of the increasing costs of the distribution network, which is driven by increasing population, increasing power demand and the need to upgrade existing infrastructure. The largest proportion, 49%,[3] of the price paid by the consumer for electricity is associated with the distribution cost. Other factors such as the proposed carbon tax on fossil fuels will only increase the business case for installing renewable energy plants at strategic locations across the distribution network in FNQ.



Source: Queensland Department of Mines and Energy

"Other factors such as the proposed carbon tax on fossil fuels will only increase the business case for installing renewable energy plants at strategic locations across the distribution network in FNQ"

4. Current Renewable Energy Generation in Far North Queensland

There are a number of existing renewable energy generation assets which have been established for some years in FNQ, including a wind farm and four hydroelectric power stations. These projects combined have the capacity to generate up to approximately 50% of the annual energy demand for the region. At present, however, these projects do not operate to their full capacity and many sources are intermittent (wind) or seasonal (bagasse). At any given time these

[2] Department of Employment, Economic Development and Innovation (DEEDI) *Ergon Energy's role in a competitive Queensland electricity market*, accessed from http://www.dme.qld.gov.au

[3] Energex data courtesy of Evolve Energy

resources probably provide between 5 and 40% of the region's electricity. Some changes to the patterns of use of these facilities would be required in order to make the most of these energy sources. One of the oldest renewable energy generation plants in the region is the Barron River Gorge Hydro Power Station.

Current peak demand in the FNQ region is approximately 360 MW. Existing renewable electricity generator contributions in the region are listed in the table below (Table 1).

Table 1 – Summary of Renewable Energy Generation in FNQ

Site	Renewable	Approx. Power	Owner
Windy Hill Wind Farm	Wind	12 MW	Transfield Services
Kareeya Hydro	Hydro	86.4 MW	Stanwell Corporation Ltd
Barron Gorge Hydro	Hydro	60 MW	Stanwell Corporation Ltd
Koombooloomba Dam	Hydro	7.3 MW	Stanwell Corporation Ltd
Tinaroo Dam	Hydro	1.6 MW	Sunwater
Tully Sugar Mill	Bagasse	10.0 MW	Tully Sugar Ltd
Mossman Sugar Mill	Bagasse	Small quantity	Mossman Central Mill Company Ltd
Mulgrave Sugar Mill	Bagasse	2.3 MW	Maryborough Sugar Factory
South Johnstone Sugar Mill	Bagasse	Unknown	Bundaberg Sugar
Tableland Sugar Mill	Bagasse	3.0 MW	Bundaberg Sugar
Photo voltaic grid connected systems (Roof mounted solar panels)	Solar	4.4 MW	Various private householders and businesses
Total		187 MW	

Note: The information included in Table 1 has been obtained from various published and unpublished sources as a result of the many different organisations involved in generating electricity. A number of the published sources used refer to the total generating capacity of the asset. Due to the intermittent nature of these renewable energy sources this study has been unable to confirm the actual energy generated by these plants on an annual basis. In addition, there are also a number of bagasse power plants in the region but these are co-located with sugar mills that produce renewable energy but export very little power back to the grid as the electricity is utilized by the sugar mill. Further work is required to confirm the total amount of renewable energy actually produced in the region.

5. 100% Renewable Power Generation in Far North Queensland

There is a growing awareness among the business, environment and community sectors in the region of the positive economic, environmental and social outcomes that the transition to 100% renewable, locally generated energy would bring.

Roam Consulting prepared a report in 2009 identifying a number of potential sites between Mackay and Cairns that would be suitable for solar thermal, bagasse and wind generation. The report indicated that FNQ is particularly suited to wind farms as published wind data indicates that this region has among the most consistent and appropriate wind speeds in Australia for wind power. Hydro, micro-hydro, tidal and wave power were not considered in the report.

"FNQ is particularly suited to wind farms…this region has among the most consistent and appropriate wind speeds in Australia"

In 2008, the Queensland Government announced a strategic collaboration with the Clinton Climate Initiative to help Queensland reduce its greenhouse gas emissions.[4] As part of this collaboration, a study was undertaken to explore the potential for large-scale solar thermal power generation by gaining an understanding of the quality of Queensland's solar resource, site requirements, preferred locations and any financial and economic implications. The study identified that the solar resource at many locations throughout Queensland is comparable to the best in the world.[5]

Increasing the efficiency and utilisation of existing hydro power stations in the region could be considered in order to increase the reliability of renewable energy power supply, as the existing hydro power stations typically operate for limited hours each day. There are also potential opportunities for the installation of micro-hydro turbines in limited areas across the region. However, there are significant environmental, economic and social costs associated with increasing the amount of hydro power in the region, and development of additional hydro power stations is not recommended.

There are a number of companies currently assessing the feasibility of installing new wind farms and increasing the capacity of an existing wind farm across the region. The following table (Table 2) presents a summary of the proposed projects.

"…the solar resource at many locations throughout Queensland is comparable to the best in the world."

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[4] *The Queensland Renewable Energy Plan*, June 2009, accessed from www.cleanenergy.qld.gov.au

[5] *Building large-scale solar in Queensland: Path to growing Queensland's large-scale solar industry*, 2009, accessed from www.cleanenergy.qld.gov.au.

Table 2 – Proposed Wind Farms

Wind Farm	Power Generation	Anticipated Operational Date	Proponent
High Road, Atherton Tablelands	40MW	September 2013	Transfield Services
Mount Emerald, Atherton Tablelands	220MW	December 2014	Transfield Services
Windy Hill II (Upgrade to Windy Hill), Atherton Tablelands	24MW	2015/2016	Transfield Services
Archer Point, Cooktown	120-220MW	Unknown	Unknown
Total	404-524MW		

Another renewable energy source that should be considered but is not listed in the above table, is the use landfill gas to generate electricity. Generating electricity from methane and other gases from old landfill sites not only provides a consistent energy source, but also greatly reduces the negative impacts of releasing these gases into the atmosphere.

As the planned renewable energy developments are realised, this region will theoretically exceed our target of being 100% powered by renewable energy. Should this be achieved this could also provide benefits in attracting clean, green and smart industries to the region as well as providing a competitive advantage to existing industries in the region such as tourism. There is also the possibility of providing baseload (reliable 24-hour) power from renewable energy, if a solar thermal power station was constructed in the region with capacity to store electricity, or if landfill gas generation capacity was installed.

6. Reliability of renewable energy generation – achieving base load power

Achieving this goal of being powered by 100% renewable energy is not as simple as just increasing the amount of renewable energy generated in the region. We will also need to adopt new technologies that allow for energy storage, to address the issue of base load power supply. Continuity and reliability of power supply is critical for the distribution network, the economy and the community. In Australia, base load power has generally been provided by coal power stations, with renewable energy, until now, typically considered as a 'top-up' power supply to the base load power supply.

With most renewable generation, intermittency remains a major challenge, as power output varies according to the availability of the natural resource e.g. wind, solar, hydro. However, this is becoming a less critical issue as new technology is introduced into the market that allows generation, distribution and supply to be more holistically and efficiently managed. There are

now technologies that allow for production of base load power from renewable sources, such as molten salt storage with solar thermal power stations.

7. Electricity Distribution Network and the need for energy efficiency

The electricity distribution network is currently designed to meet the maximum peak demand, which may only occur on a few days of the year for a limited period of time on those days, resulting in a significant amount of redundancy in the network. This means that there is billions of dollars of electricity infrastructure that has to be installed and maintained that is not utilised for most of its life. The cost to construct, operate and maintain this infrastructure accounts for 48.8% of energy costs to customers in Queensland. This is why there is such a big drive by Ergon Energy and other utility suppliers to reduce the electricity demand by being smarter and more efficient about how we use electricity.

It is clear that if electricity can be generated, distributed and managed in a more efficient manner significant savings could be achieved with a significant reduction in Queensland's carbon footprint.

"The cost to construct, operate and maintain this [peak demand] infrastructure accounts for 48.8% of energy costs to customers in Queensland"

8. A New Paradigm in Energy Generation, Transmission, Distribution, Consumption and Management

Technology is being developed that allows renewable power generation to be controlled and supplied into the distribution network when required as opposed to when generated. For example, photovoltaic grid connected systems traditionally supply power to the network as and when it is generated and not necessarily when required. However there is new, locally developed technology available that allows the electricity generated to be fed into the grid only when needed. In addition, technology is now being incorporated into appliances, equipment and machinery that are consuming the electricity to 'communicate' with the distribution network to deal with the peaks and troughs through smart grids. Smart grids also allow the points in the distribution network that have the highest transmission losses to be identified, which would allow renewable electricity generation to be strategically located to the areas where the losses are highest.

The opportunities afforded by this new technology will allow energy demand to be reduced particularly at peak periods. Small scale generation, particularly renewable energy, will become more feasible and should increase the resilience and quality of power supply and provide more certainty on the cost of power supply in the future. In this region, it could be utilised to allow better coordination and management of power supply between the region's hydro and wind power supply.

Investment in Renewable Energy – Barriers and Opportunities

A major barrier to investment in renewable energy projects in Australia is the lack of certainty in government policy relating to the industry. This includes the renewable energy target, the carbon emissions reduction target, renewable energy certificates and the carbon price. This uncertainty discourages investment in the industry as businesses have no assurance that any level of support will continue for a given length of time. In addition, the lack of certainty and continuity in the feed in tariffs generates confusion and discourages investment.

In order to promote the rapid growth in the renewable energy industry that we need to see on a national scale, the government will need to pass federal legislation to demonstrate strong and ongoing support for the industry. A national feed-in tariff is one mechanism that has been suggested as a way to provide equitable and reliable assistance to the industry. Other options are government-back loan schemes for companies establishing large-scale renewable energy plants.

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9. Renewable Energy Master Plan for FNQ

Our region has abundant solar and wind resources, large areas of land available for energy generation and a relatively small population. These factors combine to place the region in a good position to generate its energy requirements locally from renewable sources. At the same time, there are some key challenges that will need to be overcome in order to achieve the goal of being powered by 100% renewable energy. These challenges include the intermittency of power from renewable sources, and cyclonic events that could potentially damage power stations.

It is entirely feasible that in the next 5 years local renewable energy projects could be generating more electricity than the region currently requires. As the electricity grid infrastructure is already in place, we could continue to use power from outside the region at times when local stations are not generating sufficient power to meet our requirements. This level of investment in clean energy project in the region could generate new jobs and help to diversify the local economy.

"It is entirely feasible that in the next 5 years local renewable energy projects could be generating more electricity than the region currently requires"

To lead this transition to 100% renewable energy, a master plan could be developed to:

- strategically identify the locations in the distribution network with the highest transmission losses;
- identify the most appropriate renewable energy technology that should be installed in these locations;
- identify areas where the efficiency of existing infrastructure can be optimised both for generation and distribution;
- develop appropriate demand management strategies that educate and change consumer behaviour to reduce peak demand and the increasing cost of electricity infrastructure.
- identify political and legislative blockages that prevent feed-in tariffs being provided for micro hydro, mini wind turbines, waste to energy plants etc; and
- quantify the savings for the Queensland Government due to reduced line losses and any other savings to the electricity subsidy.

To create this master plan, the following information will be required:

- Reliable data on the amount of renewable energy produced in the region, both current and projected, with actual real-time production figures;
- Identification of areas in the network that have high transmission losses and highdemand and are therefore key locations for new sources of renewable energy generation;
- Analysis of how the carbon tax and other market pricing mechanisms will affect investment in renewable energy;
- Analysis of the key issues and opportunities associated with improving efficiency and capacity of existing renewable energy assets in the region.

This master plan would ensure that any new power generation projects in the region should:

- Reduce the region's reliance on fossil fuelled base power generation for base load power;
- Provide a reliable and resilient source of low-carbon electricity;
- Improve the efficiency and capacity of existing renewable energy assets in the region; and
- Be resilient in a tropical climate that will likely incur more intense and frequent cyclones as a result of climate change.

10. Conclusion

There is significant existing renewable energy infrastructure in the region and proposed projects indicate that the region has the potential to be generating renewable energy in excess of its current requirements in the near future. The transition to renewable energy could be done in two phases:

1. Phase one - generation of equivalent to 100% of the region's energy needs while maintaining a reliance on the grid for baseload power.

2. Phase two – production of baseload power from renewable sources in the region.

This region is particularly suited to further investment in the provision of renewable energy primarily due to:

- Its geographic location and climatic conditions that are among the best locations in Australia for the consistent supply of wind and solar energy;

- Significant transmission losses annually as a result of the distance from the source of generation. The Queensland Government subsidises the cost of these transmission losses to ensure customers in regional and remote areas pay the same rate as those in larger cities. In 2009-10 this subsidy amounted to $250M.

- There is a clear business case for the Queensland Government to invest in renewable energy generation in FNQ to reduce the CSO payment that is pays Ergon Energy and to assist achieving the State Government's goal of reducing Queensland's carbon footprint by one-third by 2020.

Significant investment in renewable energy will increase the diversity and resilience of the local economy by attracting new innovative, low carbon industries to the region. It will also provide a significant competitive advantage to the tourism and agricultural industries by reinforcing the clean, green identity of the region. The transition to renewable energy will require a commitment by State and Federal Government to support the renewable energy industry.

Windy Hill Wind Farm, Ravenshoe

11. Recommendation

It is recommended that a renewable energy master plan be developed for the region, outlining how the region can make the transition to 100% renewable energy, and including a detailed cost benefit analysis.

Additional references – reports

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