Renewable Energy on the Ningaloo Outback Coast

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Abstract
The WA Sustainable Energy Development Office and Shire of Carnarvon commissioned the Environmental Technology Centre to conduct a study into energy efficiency and renewable energy options for proposed ecotourism developments in the Ningaloo Outback Coast region. The study will develop a model taking into account many factors including building construction and thermal comfort, renewable resources (Wind, Geo-thermal, Solar and Biogas) and occupancy levels (current and projected) to determine the mix of generation systems that are most environmentally and cost effective for the specified nodal types of accommodation along the coast. This paper outlines the proposed work to develop the model and the work to date.

1.0 INTRODUCTION

Renewable Energy is an essential component of remote eco-tourism developments, especially in the case of environmentally sensitive areas like the Ningaloo Reef Marine Park in Western Australia. The coastline along the reef has been earmarked for ecologically sustainable low-key developments that promote the unique natural features, retain the sense of wilderness and provide local and regional economic and social benefits (WAPC, 2004). The current use of renewable energy along the reef is quite limited considering the vast natural resources of the region. The WA Sustainable Energy Development Office and Shire of Carnarvon commissioned the Environmental Technology Centre to conduct a study into energy efficiency and renewable energy options for proposed ecotourism developments in the region. The study will develop a model taking into account many factors including building construction and thermal comfort, renewable resources (Wind, Geo-thermal, Solar and Biogas) and occupancy levels (current and projected) to determine the mix of generation systems that are most environmentally and cost effective for the specified nodal types of accommodation along the coast. The collection of accurate data is essential in the success of any energy generation design. If existing technical data is insufficient further data will be gathered by I-Button Data loggers (for thermal comfort levels) and anemometers (for wind). The Model will propose suitable levels of energy consumption for accommodation and tourism node types for current and projected occupancy levels and the most suitable mix of energy generation technology for these energy outcomes.

The project’s main focus is to provide options of renewable energy for the proposed Point Quobba Blowholes development. In doing this we can also create an energy management model that is suitable for the whole Ningaloo Reef Outback Coast Region. The models will consider all aspects of energy supply and demand including current energy practice, occupancy levels, type of accommodation, type of nodal development.

Objectives set by the the brief include the development and documentation of an energy strategy, for the low-impact tourist node planned for the Ningaloo Coast, which will:
- maximise energy efficiency and the use of renewable energy in site layout, building plans, facilities and infrastructure;
- document the findings on energy needs into formal specifications;
- prepare an energy budget; and
- prepare a maintenance and sustainability plan, including supply arrangements and service agreements.
2.0 BACKGROUND

The Blowholes at Quobba point are situated about 70 km north of Carnarvon. It is a popular location for visitors (both local and international) due to the proximity to tourist attractions, a beach protected by an island and the existence of an extensive reef system (It is located at the southern tip of the Ningaloo reef).

The Area is used for many different activities including windsurfing, snorkelling, sand boarding and sightseeing. It is a hot spot for caravan stopovers, day trips and overnight stays. There are no specific camping grounds and the site is under-managed allowing people to camp wherever it suits them best, normally on the sensitive foredune. (SMEC et al, Carnarvon Coastal Strategy 2001)

The Quobba Point Blowholes area consists of privately owned beach shacks which are located on the fragile foredune. These beach shacks impact on the visual landscape, they have no appropriate wastewater treatment and generators are the main source of power though a lot of shacks are unpowered. The existence of the shacks also jeopardises the full and unfettered use of the Blowholes area by the broader community, both locals and tourists.

The Blowholes have been earmarked for a low key development (DEP et al,1999). This will involve the development of under roof accommodation, located back from the sensitive foredune, as well as managed campsites. It will offer the site an improved environmental management plan (as funds from the development are channelled back into management). It will also clear and rehabilitate the foredune so that all users can enjoy this site.

2.1 Energy

There are no power lines to the area. This means shack owners are using generators, gas, oil lamps and a small percentage are using solar/ wind systems to run their everyday requirements. This has implications for noise, air quality and possible pollution through oil/petrol spills.

Proposed tourism developments will require energy for water heating, air cooling, refrigeration, lighting, general electrical appliances and water pumps. The Office of Energy suggests that viable alternative energy sources are available (such as passive and active solar, wind, gas and geothermal) as noise produced by conventional power generators may spoil the wilderness experience.

The Western Australian Tourism Commission is investigating the viability of alternative sources of power generation for heating, air cooling and power generation for low-impact tourist development locations along the west coast (Ministry of Planning et al 1999).

Energy is just one aspect of an eco-tourism development. For an integrated renewable energy system to be successful and viable it depends on a lot of contributing factors including solar passive design, use of materials (thermal mass and embodied energy), ventilation and climate.

2.2 Climate

The Climate along the Ningaloo Reef Outback Coast is fairly consistent throughout. Average monthly temperatures range from 16 to 28 degrees throughout the year, though some days reach maximum temperatures above 40 degrees during summer. There are on average 320 clear sunny days per year. Rainfall for the region is quite low and can vary greatly from year to year; average 200mm/year. Water is a large issue for people in this region. Winds blow constantly for 6 months through spring, summer and autumn from the South, South-West and afternoon breezes are common through the winter period.

3.0 ENERGY DEMAND AND EFFICIENCY

Reducing energy demand and maximising efficiency is the key to successful integration of cost effective renewable energy in the development. By reducing overall energy consumption we can reduce the size of the renewable energy system required, limit the cost and reduce the associated payback periods. Our aim is to have energy efficient accommodation to do this we need to eliminate air conditioning through passive solar design and the use of suitable thermal mass. The climate lends itself to acceptable comfort levels all year round though there are days which may need some type of
cooling (fans may be required). Below is a list of accommodation identified by the project team at different points along the reef. Our aim is to research and test these accommodation types for thermal comfort to see which building type performs best under the climatic conditions of the region.

Types of accommodation include:
- Semi-Permanent Lightweight Tents similar to those at Ningaloo Reef Retreat;
- Light weight pre-fabricated transportables with steel framed floor like those at Quobba Station;
- Light weight pre-fabricated transportables with concrete floor like those at Bay View Coral Bay;
- Permanent dwellings constructed of stone and wood like those at Gnaraloo Station (and various styles at Coral Bay (lightweight block work, timber veneer, all generally with concrete slab on ground and Cl roof);
- Straw Bale dwellings similar to the care takers house at Red Bluff;
- Rammed Earth Building such as the Milyering Visitor Centre in Cape Range National Park.

Hot water is another process that consumes a lot of energy. During the project team’s first field trip it was found that the groundwater (from confined aquifers as deep as 900m below the surface) comes out of the ground at 60 to 70°C in many places. Encouragingly separate water systems are used in some of these places eliminating the need for any hot water units. It is the cool potable drinking water that is the main problem. The water is brackish so it needs to be cooled in ponds and then filtered (reverse osmosis) or distilled.

Therefore typical energy consumption will depend on the level of facilities, appliances and occupation levels. The ‘Ningaloo Coast Regional Strategy-Carnarvon to Exmouth’ (WAPC, 2004) outlines five node development categories for potential of existing and proposed accommodation sites which are summarised in Table 1.

<table>
<thead>
<tr>
<th>Type of Development</th>
<th>Major Tourism nodes (up to 500 Beds equivalent)</th>
<th>Minor Tourism Nodes (up to 200 beds equivalent)</th>
<th>Ecolodge nodes(up to 100 beds equivalent)</th>
<th>Homestead Tourism nodes(up to 50 beds equivalent)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acceptable locations</td>
<td>Blowholes</td>
<td>Red Bluff</td>
<td>Gnaraloo Bay</td>
<td>Warroora Homestead</td>
</tr>
<tr>
<td></td>
<td>Quobba Station</td>
<td>Three Mile Camp</td>
<td>Elle’s Camp</td>
<td>Giralia Homestead</td>
</tr>
<tr>
<td></td>
<td>Gnaraloo Station</td>
<td>Bruboodjoo point</td>
<td>Ningaloo Reef Retreat</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lighthouse Beach</td>
<td></td>
<td>Mandu Mandu Gorge North</td>
<td></td>
</tr>
<tr>
<td>Type of accommodation</td>
<td>Self contained and basic chalets, caravans and camping</td>
<td>Basic Chalets (proposed) camping</td>
<td>Wilderness tents, semi permanent tented cabins, and camping</td>
<td>Homestead rooms basic chalets and camping</td>
</tr>
<tr>
<td>Facilities</td>
<td>Kiosk, ablutions, cooking facilities</td>
<td>ablutions</td>
<td>Communal kitchen</td>
<td></td>
</tr>
</tbody>
</table>

Coastal camping does not require energy so it is not included in this table or discussion.

Each category has different types of accommodation and energy consumption levels. The Tourism nodes tend to have different types of semi-permanent/permanent accommodation some fitted with a kitchen, fridge, lights and other appliances (kettle, toaster etc)

3.1 Occupancy Levels
The occupancy levels determine the use of accommodation and this then corresponds to energy consumption. Accurate occupancy levels are still being sourced at this time, but generally peak times are experienced the period late April (Easter) to the end of September (School Holidays). The energy demand during these times grows rapidly.
4.0 ENERGY SUPPLY

Supply side factors need to be examined in detail to provide an accurate model for the successful use of energy design tools. Wind, solar, diesel, occupancy levels and biomass data need to be collected over the longest period of time possible. This will give us the levels of each resource available and the ability to design for projected loads within the development.

4.1 Solar Energy
Solar energy has great potential for this region. There are on average 320 Sunny days per year with almost 6 peak sun hours a day. There are already systems installed in various properties along the coast that are performing to acceptable levels. Solar insolation levels are being sourced through various providers.

4.2 Wind Resources
The wind resources also have great potential for the region. 60kW of wind turbines have been installed in Exmouth and small portable wind turbines are becoming more widespread throughout the region (Milyering Visitors Centre, Red Bluff and Visitors – on their Caravans. Wind Data is still being collected and processed through a number of anemometers located on the coast.

4.3 Other Technology
There are two other potential alternative energy systems being examined for this area including biomass/gas systems and solar thermal systems. The conditions are favourable for the running of these technologies but costs need to be examined further.

5.0 EXISTING ENERGY CONSUMPTION

From field investigations and talking with owners and operators of tourism facilities on the coast we have discovered a wide-ranging level of consumption among the different places. This is due to the size and nature of the developments, the level of comfort/facilities offered and the occupancy levels. Examples include:

**Ningaloo Reef Retreat (Eco-Lodge Node)** - 2.5 kWh max. per day is used for the accommodation of 10 people and recharging the electric cart (for deliveries of food, water and other goods). The only electrical devices installed in the wilderness tents are a light and a smoke detector (both 12V). The main emphasis is on the environment so TV’s and other appliances are not required. Food is prepared in a communal kitchen/dining tent containing a gas fridge (soon to be run electrically) and a gas cooktop. All the electrical energy consumed is produced by solar power systems within the area.

**Coral Bay (Townsite)** – 2 x 250kW diesel generators are the main source of power. On average they use about 1200L diesel/day or about 6000kWh/day but this is used to power a lot of facilities including:
- The caravan park consisting of self contained air-conditioned chalets, powered caravan and camping sites.
- The shopping centre consisting of a bakery, a supermarket and other small shops.
- The backpackers accommodation
- Water pumping and desalination plant (reverse osmosis)

The Caravan park may be useful for upper limit estimations of power consumption for the Blowholes site. The park can cater for up to 1500 people (3 times size of the Blowholes) and has similar accommodation ratio (chalets : caravans : powered sites : unpowered sites).

**Quobba Station (Major Tourism Node)** – Have a 9kW solar system installed reducing the requirements on the diesel generator substantially. The Homestead and 2 of the chalets are completely powered by the system (about 45kWh). Details are still being received on this system after the project team’s field trip to the Ningaloo Coast (Oct 2004). The station run by Tim Meecham has many levels of accommodation ranging from self contained pre-fabricated chalets to shared rooms and camping. The diesel generator runs regularly under full occupation so he is interested in purchasing more renewable energy to handle extra demand.

More detailed consumption figures are been processed/ investigated so that comparison can be made to occupancy levels and a suitable model can be formed for all regions and types of accommodation.
6.0 CONCLUSIONS AND SUMMARY

The project is progressing consistent with proposed timeframe and a preliminary model is being developed to account for all the above mentioned criteria. Some of the data collection is proving more difficult than first thought (accurate records on energy consumption and occupancy levels are the hardest to obtain). The project team have chosen five sites from the list of development types, two from Major Tourism, one each from Minor Tourism, Eco-Lodge and Homestead to detail extensively energy consumption, supply, occupancy and renewable resources available. Bay View Coral Bay will also be studied in more detail to obtain helpful comparisons to the Major Tourism Nodes.

Renewable energy is looking extremely promising for the region. The natural solar, wind and geothermal resources are very prominent contributing to the belief that systems can be well designed to contribute most of the electrical loads all year round for developments of this size. Thus reducing impact on the environment and improving the wilderness experience that is so unique in this part of the world.

7.0 ACKNOWLEDGMENTS

We acknowledge the vision and support of the Shire of Carnarvon and the Sustainable Energy Development Office in Western Australia. Thanks also to Department of Planning and Infrastructure and Owners and Operators along the Ningaloo Reef for their continuing contributions to this project. Thanks must also go to the various commercial tourism operators that provided support for the first field trip and that have agreed to participate in this ongoing project.

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