



Kangaroo  
Island  
Development  
Board inc.



A Report for Kangaroo Island Development Board

# **An Investigation into the Utilisation of End User Generation on Kangaroo Island**

**Author:** M J Davidson  
**Version:** 2.2  
**Date:** January 2009

## Executive Summary

The purpose of this report is to investigate whether there are significant electrical loads that are currently unserved by the existing electricity distribution network on Kangaroo Island.

The objective of determining any shortfall in service is to support ETSA Utilities in its prospective funding submission to the Australian Electricity Regulator (*Electricity Distribution Price Determination 2010 – 15*).

Questionnaires were sent to targetted organisations and to the general public via media. Respondents were asked to provide information on the number, fuel source and purpose of their generation. 51 responses were received between November 2008 and January 2009.

### Key Findings

#### Significant Generation Capacity.

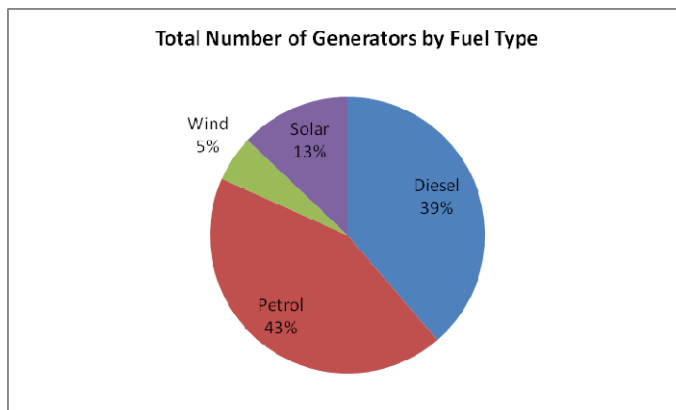
93 generators were reported with a combined (undiversified) capacity of 6,414kVA. It is important to note that the response rate for the survey was below 100%. Therefore this figure is conservative and clearly understates the capacity of generation on the Island.

The peak demand on ETSA's distribution network in Kangaroo Island is currently in the order of 6,500kVA. The installed generation capacity is in the same order of magnitude.

The value of the installed generation is estimated at \$4.02M with an annual operational expenditure in the order of \$1.236M.

#### Type of Generation.

Graph 1 below shows the breakdown of generation by fuel type.



Graph 1

Further analysis shows that whilst small scale petrol generation is used predominantly in the residential and SME sector the majority (99.4%) of the installed capacity is diesel generation used in larger commercial installations.

## **Dependency**

Almost half (46%) of the generators reported were either used as a sole source of power or to augment the network connection.

3,668kVA of the total capacity reported of 6,414kVA (73%) was either the sole source of power or critical auxiliary generation. For larger customers the average capacity of auxiliary generation was 236kVA and the average operation was 1,036 hours per annum.

These figures clearly demonstrate a high dependency on on-site generation on Kangaroo Island.

## **Location**

The location of the sites with the largest installed capacity was predominantly in the Western reaches of Kangaroo Island where the Distribution Network is less robust and there are significant opportunities for development in the forestry, aquaculture and eco-tourism industries.

## **Standby Generation**

It was apparent that 65% of all respondents utilised on site generation for standby purposes. This is a remarkable penetration and was common across all user segments. Whilst the investigation of supply reliability does not form part of the remit of this study it may be of some value to determine if the current configuration of the distribution network is optimal for ensuring a high level of reliability for the Kangaroos Island community.

## Background

Wessex Consult Pty Ltd has been engaged to carry out an audit of the non-network generation on Kangaroo Island. The purpose of the audit is to provide information to support ETSA Utilities funding submission to the Australian Electricity Regulator as part of the current Electricity Distribution Price Determination. The intent is that the information will support increased spending on network asset investment on Kangaroo Island.

The primary objective of this exercise is to gather the following data by business and property:

1. Name and type of business or property.
2. Location of business or property.
3. Contact details of business or property.
4. Number and type of generator(s)/ alternative energy source.
5. Peak output of generator(s)/alternative energy source.
6. Average output of generators when in use.
7. Usual hours of operation.
8. Degree of reliance on non-network power (*qualitative assessment*).
9. Average monthly generator fuel cost.
10. Capacity cost (\$/kVA).

In addition to the base information the audit attempts to identify the reason for installing the embedded generation. Reasons may include:

- Renewable energy for emissions reduction (i.e. small scale wind/PV Cells)
- Remote Area Power Supply
- No available network capacity
- Restricted network capacity
- Peak lopping/demand management (where generation is used to manage demand on the network)
- Supply security

## Data Collection

Wessex Consult met with KIDB on the 20<sup>th</sup> November 2008 to agree the audit strategy.

It was agreed that there would be two main initiatives:

- Direct Contact with targetted major business.
- Indirect communication with residential and small to medium enterprises (SMEs) via the Islander Newspaper.

## Direct Communication

The list of targetted users is detailed below:

	Company Name	Location	Response Rec'd	Capacity (kVA)
1	Destiny Hatcheries KI Pty Ltd	Smith's Bay	Y	210.00
2	Southern Ocean Lodge	Hanson Bay	Y	460.00
3	Seal Bay Tourist Park	Seddon	Y	7.50
4	Sealink	Penneshaw	Y	56.00
5	Cape Cassini Wilderness Retreat	Cape Cassini	Y	5.70
6	Dept of Environment & Heritage	Flinders Chase	Y	7.00
7	Flour Cask Bay Sanctuary	Dudley	Y	0.30
8	Emu Ridge Eucalyptus	Menzies	Y	11.00
9	Dept of Environment & Heritage	Seal Bay	Y	12.00
10	Kangaroo Island Abalone - West	Wisanger	Y	632.50
11	Kangaroo Island Abalone - East	Wisanger	Y	2,250.00
12	Penneshaw Service Station	Penneshaw	Y	110.00
13	Penneshaw IGA	Penneshaw	Y	150.00
14	Drakes Supermarket	Kingscote	Y	140.00
15	Kingscote Hospital	Kingscote	Y	275.00
16	Zealand Concrete	Kingscote	Y	160.00
17	Parndana Wildlife Park	Parndana	Y	6.80
18	Vivonne Bay Outdoor Education Centre	Vivonne Bay	Y	7.20
19	Dudley Partners	Willoughby	Y	35.00
20	Timber Creek Pine	Parndana	Y	1,620.00
21	KIDC	American River	Y	44.00
22	Great Southern Plantations	Cape Borda	Y	0
23	KI Lodge	American River	Y	0
24	Parndana IGA	Parndana	Y	0
25	KI Western Caravan Park	Stokes Bay	Y	0
26	Trethewey Family "farms"	Parndana	N	N/A
27	Ildoura Fruits	Parndana	N	N/A
28	KI Wilderness Retreat	Western KI	N	N/A
29	Abdermel Marron	Parndana	N	N/A
30	Parndana Skills Centre	Parndana	N	N/A
31	Island Pure	Kingscote	N	N/A
32	Fryar Eggs	Kingscote	N	N/A
33	KI Oysters	Penneshaw	N	N/A
34	Vivonne Bay Store	Kingscote	N	N/A
35	Emu Bay Lavender Farm	Kingscote	N	N/A

Table 1: Target Customers

The list as shown above has been developed throughout the audit process.

Each of these companies was contacted on a number of occasions via email and telephone. The companies were asked to complete a questionnaire which was emailed to them. In addition to the email correspondence telephone calls were made to:

- Identify pertinent personnel.
- Encourage businesses to respond.
- Assist with completing forms.
- Gather additional information.
- Verify data.

A limited number of site visits were made where electronic and telephonic communications were unsuccessful.

### **Indirect Communication**

A newspaper article was drafted and appeared in the “The Islander” newspaper on the 26<sup>th</sup> November 2008. A hardcopy version of the questionnaire was inserted into “The Islander” in the following edition. To encourage response a small gift was offered to early respondents. The Islander has a circulation of approximately 2,000.

Digital questionnaires were also sent with an explanatory letter to a number of associations and industry groups active on Kangaroo Island.

### **Questionnaire**

The questionnaire gathered the following information.

#### ***Contact Details***

Respondent Name  
Company Name  
Address  
Telephone Numbers  
Email Address

#### ***Premises Type***

Commercial  
Agricultural  
Residential

### ***Generator Details***

Fuel (Diesel, Petrol, Wind, Solar)  
Rated Capacity (kW)  
Annual Running Hours  
Estimated Annual Running Costs

### ***Generator Type***

Sole Power Source  
Standby Generation  
Auxiliary / Peak Lopping  
Renewable Energy

Primary Objective 8 for this project is to determine the degree of reliance on non-network generation. By determining why the customer used the generator and how often they used it we can make an assessment of reliance.

Understanding generator usage indicates how the distribution network is meeting the demands of the community. Table 2 below explores the drivers for selecting each generation type.

<b>Generation Type</b>	<b>Definition</b>	<b>Indicates</b>
Sole Power Source	User is 100% reliant on on-site generation for power.	No network capacity available.
Standby Generation	User relies on generation when network supply is interrupted.	A high penetration of standby generation indicates a lack of system reliability.
Auxiliary / Peak Lopping	User utilises on-site generation to augment their network electricity supply.	That there is a network constraint or lack of capacity. In other words whilst users can gain access to the distribution network it is not sufficiently robust to meet their requirements. The degree of dependency on auxiliary generation is indicated by the number of annual hours of operation and the level of capacity used.
Renewable Energy	User opts to use renewable energy sources rather than carbon based fuels.	The user places a high consideration on environmental factors.

**Table 2**

The critical generation types for this study are **Sole Power Source** and **Auxiliary**. These indicate a reliance on on-site generation caused by a deficit in the distribution network to meet user requirements.

Clearly generation as a sole power source indicates that the distribution network is completely unable to meet customer requirements. Auxiliary generation indicates a partial dependency on on-site generation. The degree of dependency varies by user. The degree of dependency can be ascertained by the level of installed capacity and the annual hours of operation of auxiliary generation.

## Responses

As at the 22<sup>nd</sup> January 2009 a total of 51 responses have been received.

### Direct Communication

The responses to the direct communication exercise are as follows:

Detail	Number	%
Target Sites	35	100
Responses	21	60
Nil Return (no generation)	4	11
No Response (information yet to come)	10	29

Table 3: Responses

The overall response rate for these customers is 71%.

### Indirect Communication

30 completed forms have been received from inserts in "The Islander".

## Results

The results as at the 22<sup>nd</sup> January 2009 are as follows.

### Targetted Users

The breakdown by premises type is as follows:

Type	Number
Total	21
Commercial	20
Agricultural	2
Residential	1

Table 4: Breakdown of premise type

Notes:

- The majority of customers are identified as commercial only.
- One customer is identified as agricultural only.
- One customer is mixed agricultural commercial.
- One customer is mixed commercial residential.

The total (undiversified) capacity of generation reported by these customers is **6,200kVA**. Given the current peak demand on Kangaroo Island is in the order of **6,500kVA**, this represents approximately **95%** of the network supplied demand.

The breakdown by use of generation is as follows:

Purpose	No.	%	Capacity (kVA)				Total
			Diesel	Petrol	Wind	Solar	
Sole power source	4	19%	2,710.00	11.00	3.50	2.20	<b>2,726.70</b>
Standby	13	62%	2,086.50	18.50	0.00	0.00	<b>2,105.00</b>
Auxiliary	7	33%	1,833.80	9.50	0.00	0.00	<b>1,843.30</b>
Renewable	4	19%	0.00	0.00	3.50	3.50	<b>7.00</b>

Table 5: Breakdown of capacity

Notes:

- 62% of these targetted customers who have generation use it for standby power.
- In total 52% of customers who responded rely on generation totally or in part.
- The capacity of renewable generation capacity is extremely low (0.1%).

Tables 6, below, summarises information by type of generation. The kWh figure is estimated by multiplying the installed capacity by the estimated operating hours. Allowance was made for duty cycling in larger sites.

Detail	Diesel	Petrol	Wind	Solar	Total
Sites	17	4	2	4	
Generators	26	6	2	4	38
Capacity (kVA)	6,163.50	29.50	3.50	3.50	6,200
kWh	14,420,791	28,646			14,449,437

Table 6: Breakdown of Generation by Fuel Type

Notes:

- The vast majority of installed capacity is diesel generation (99.4%).
- Only 0.48% of installed capacity is fuelled by petrol.
- A negligible fraction of installed capacity is renewable.

### SME & Residential Customers

The breakdown by premises type for this customer segment is as follows:

Type	Number
Total	30
Commercial	3
Agricultural	12
Residential	23

Table 7: Breakdown of premise type

Notes:

- The majority of customers are identified as residential.
- There are 4 mixed agricultural/ domestic customers and 1 mixed commercial/residential.

The total capacity of generation reported by these customers is **214kVA**.

The breakdown by use of generation is as follows:

Purpose	No.	%	Capacity				Total
			Diesel	Petrol	Wind	Solar	
Sole power source	7	23%	18.00	34.10	1.80	6.65	<b>60.55</b>
Standby	20	67%	43.40	80.70	0.00	0.00	<b>124.10</b>
Auxiliary	5	17%	6.00	31.50	0.00	0.00	<b>37.50</b>
Renewable	8	27%	0.00	0.00	1.80	9.13	<b>10.93</b>

Table 8: Breakdown of capacity

Notes:

Purpose	Target Customers		SME & Res	
	No.	%	No.	%
Sole power source	4	19%	7	23%
Standby	13	62%	20	67%
Auxiliary	7	33%	5	17%
Renewable	4	19%	8	27%

Table 9: Comparison of generation purpose by segment

- Table 8, above, shows that the split by generation purpose for the targetted customers and SMEs are comparable.
- A slightly reduced percentage of small customers, (40% c.f. 52%) rely on generation for all or part of their supply.

Table 9 summarises the selection of generation by fuel type for domestic customers.

Detail	Diesel	Petrol	Wind	Solar	Total
Sites	7	26	3	8	
Generators	10	34	3	8	55
Capacity (kVA)	61.40	141.30	1.80	9.13	214
kWh	52,288	12,856			65,144

Table 10: Breakdown of Generation by Fuel Type

Note:

Unsurprisingly SMEs selection of generation is biased toward petrol generators. Small scale petrol generators are readily available, inexpensive and convenient. Whilst fuel costs are higher than for diesel, this is less of an issue for SMEs as duty is less onerous (see Operating Hours).

## **Reliance and Operating Hours**

### **SME & Residential**

40% of SME & residential respondents relied completely or in part on on-site generation.

Users in the SME segment reported using auxiliary generation for an average of 74 hours per annum with an average of 7.4kVA.

Specific reasons cited for using requiring auxiliary generation in this segment were for purposes such as welding or shearing where higher supply capacity was required for short periods of time.

### **Targetted Users**

52% of targetted users who responded relied completely or in part on on-site generation.

Users with Auxiliary generators reported an average utilisation of 1,036 hours per annum and an average capacity of 263kVA.

### **Dependency**

It is clear that there is a significant difference in usage of auxiliary generation between the SME/Residential segment and the targetted segment. It is clear that amongst the larger commercial users the dependency on auxiliary generation is much higher. This is evidenced by a higher installed capacity and very much longer operating hours.

## **Capital Costs**

Data provided by customers on operating cost is sporadic and unreliable. Therefore, estimates of capital costs have been based on average replacement costs.

The figures provided below are averaged estimates and are for benchmarking purposes only.

A web based review of the costs of small scale petrol standby generators has demonstrated that for generators in the 1 to 6 kVA range, prices ranged from approximately \$1.45M/MVA to 1.1M/MVA. For the purposes of estimating asset values the conservative figure of \$1M/MVA has been used.

Advice from Cummins Inc, an international leader in the supply and installation of diesel generation, is that the base cost for diesel generation in the range 50 to 500kVA is in the order of \$500,000/MVA.

The capital cost of solar photovoltaic and wind generation have been estimated at \$15M/MVA.

Using these figures and data provided by customers, we can derive the following information.

### Targetted Users

Purpose	Diesel (\$)	Petrol (\$)	Wind (\$)	Solar (\$)	Total (\$)	\$/kVA
Sole power source	1,355,000	11,000	52,500	33,000	<b>1,451,500</b>	<b>532</b>
Standby	1,043,250	18,500	-	-	<b>1,061,750</b>	<b>504</b>
Auxiliary	916,900	9,500	-	-	<b>926,400</b>	<b>503</b>
Renewable	-	-	52,500	52,500	<b>105,000</b>	<b>15,000</b>

Table 11: Estimated replacement cost of installed generation assets for large users.

### SME & Residential

Purpose	Diesel (\$)	Petrol (\$)	Wind (\$)	Solar (\$)	Total (\$)	\$/kVA
Sole power source	9,000	34,100	27,000	99,750	<b>169,850</b>	<b>2,805</b>
Standby	21,700	80,700	-	-	<b>102,400</b>	<b>825</b>
Auxiliary	3,000	31,500	-	-	<b>34,500</b>	<b>920</b>
Renewable	-	-	27,000	136,950	<b>163,950</b>	<b>15,000</b>

Table 12: Estimated replacement cost of installed generation assets for SME and residential users.

Table 13, below, shows the cost to all types of users of providing generation as a sole source of supply or as an auxiliary (to supplement the existing supply).

	Capacity (kVA)	Cost (\$)	Cost/kVA
Targetted	4,570	2,377,900	520.33
SME & Res	98	204,350	2,084.14
Total	4,668	2,582,250	553.18

Table 13: Estimated value of generators used as a sole power source or auxiliary.

## Operating Costs

The average monthly operating costs are detailed below.

	Operating Cost (\$pa)	Avg. Operating Cost (\$pcm)
Targetted	1,223,451	4,855
SME & Res	12,311	34
Total	1,235,762	2,019

Table 14: Average operating costs

The operating costs above are calculated where ever possible using customer supplied data. Where this was not provided average costs of 80c/kWh and 30c/kWh were used for the cost of generation for petrol and diesel fuel respectively (derived from manufacturer data).

## Conclusions

The clear and important conclusions that may be derived from this exercise are detailed below.

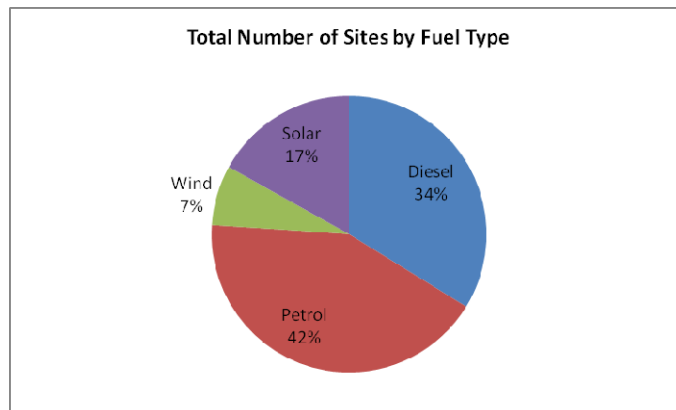
### Significant Capacity

This survey clearly identifies a significant investment in on-site generation on Kangaroo Island. Respondents to this survey reported using **93 generators with a total (undiversified) capacity of 6,414kVA**. This represents approximately **99% of the installed network capacity** (of circa 6,500kVA) serving the island. Clearly this figure is less than the actual total capacity of generation on the island.

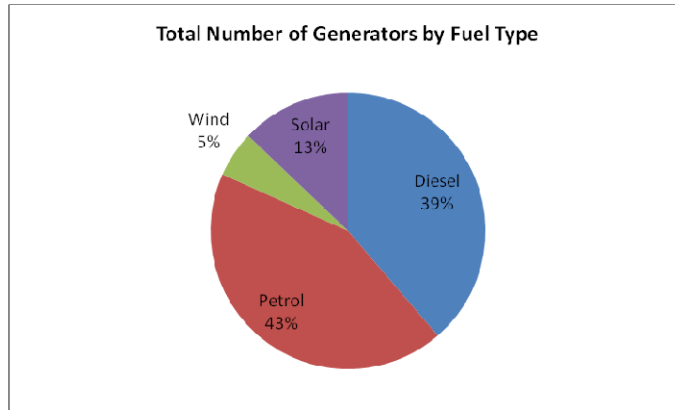
It is pertinent to note that the submarine cable supplying Kangaroo Island has a rated capacity of 10,000kVA. The existing network peak demand is in the order of 6,500kVA. The reported generation used for sole power source and to augment network supply is 4,688kVA. The sum of these figures is 11,188kVA. This figure substantially exceeds the capacity of the submarine cable. Whilst it is true that the sum of the two figures is an undiversified demand, it is also true that the reported level of generation is understated. In absence of absolute data and allowing for growth, it is fair to state that there is a high degree of certainty that the actual coincidental peak demand for electricity on the Island is extremely close to, if not greater, than 10MVA.

What is clear is that a potential future strategy for Kangaroo Island that addressed the extension and augmentation of reticulation on the island, to be successful, would also need to address the capacity of the mainland connection.

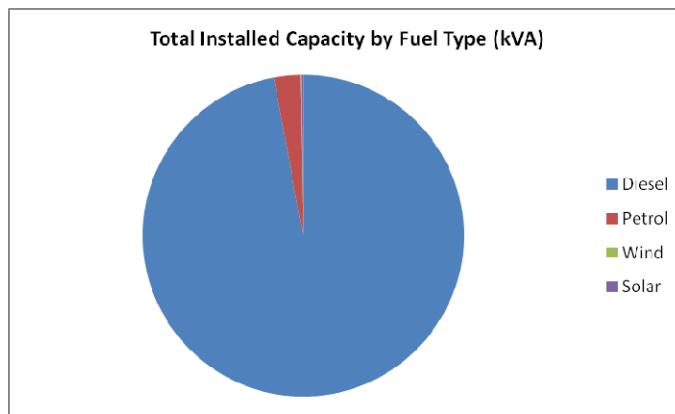
The following charts illustrate the breakdown of sites, generators and capacity by fuel type.



Graph 2



Graph 3



Graph 4

Diesel generation clearly dominates installed capacity with 97.1% of the total. Petrol generation follows with 2.7%, whilst renewable capacity represents only 0.2% of the total.

### High Dependency

The survey demonstrates that a significant number of customers are solely or partially reliant on on-site generation for their energy supply. 52% of respondents from larger targeted users and 40% of SME and residential users reported that they used end-user generation for their sole supply or as an auxiliary.

Clearly those users with sole generation have a complete dependency on their generation assets. In addition, this study has shown that larger commercial customers that use generation as an auxiliary power supply have a high dependency on their generation. On average they utilise 236kVA for 1,036 hours per annum.

Table 15, below, shows the breakdown of the type of generation by site (note that some sites have more than one type of generation).

Purpose	Sites	
	No.	%
Sole power source	11	22%
Standby	33	65%
Auxiliary	12	24%
Renewable	12	24%

Table 15: Breakdown of the Type of Generation by Site

### High Proportion of Standby Generation

Results show that overall 65% of respondents have standby generation on site. This indicates that customers may have experienced issues with supply quality on Kangaroo Island. The replacement value of standby generation reported is in the order of \$1.164M. Lack of supply quality represents a real cost to the community.

To ensure a high quality of supply it is essential that network investment keeps pace with demand growth. The level of electricity demand that is unserved by the network on Kangaroo Island may be an indicator that network investment is not keeping pace with demand. It is well understood within the Electricity Supply Industry that there is an inverse relationship between supply margin and supply quality. As system peak demand tends toward supply capacity supply quality and security fall.

### Significant Investment

Business and residential users on Kangaroo Island have made significant investments in generation assets. The estimated replacement cost of assets reported by respondents is in the order of \$4.02M with operating costs in the order of \$1.236M pa.

The average cost of sole generation in the targetted and SME/Residential segments is \$532 and \$2,805/kVA respectively. The former is near the average cost of diesel generation and the latter represents the costs of a hybrid renewable/fossil fuel installation.

It is important to note that in the business sector effective risk management often calls for redundancy (duty and standby generators are required). This means that the cost of installed capacity is effectively doubled (to approximately \$1,000/kVA).

The instantaneous maximum demand of a new domestic premise is normally lies in the range 10 to 15kW (often higher). At \$3,660/kVA, the cost of supplying 10 to 15kVA is prohibitive.

## Location

The five largest sites by installed capacity are detailed below.

	<b>Company Name</b>	<b>Location</b>	<b>Response Rec'd</b>	<b>Capacity (kVA)</b>
1	Destiny Hatcheries KI Pty Ltd	Smith's Bay	Y	210.00
2	Southern Ocean Lodge	Hanson Bay	Y	460.00
3	Kangaroo Island Abalone - West	Wisanger	Y	632.50
4	Kangaroo Island Abalone - East	Wisanger	Y	2,250.00
5	Timber Creek Pine	Parndana	Y	1,620.00

Table 16

All these sites are located west of Kingscote. This is no coincidence. West of Kingscote the capacity of the distribution network rapidly mitigates. However, many of the opportunities for forestry related, eco-tourism and aquaculture exist on the western side of Kangaroo Island. Lack of distribution capacity may be a significant factor in the suppression of development on Western Kangaroo Island.

## Appendix 1: Location of Significant Generators on Kangaroo Island



