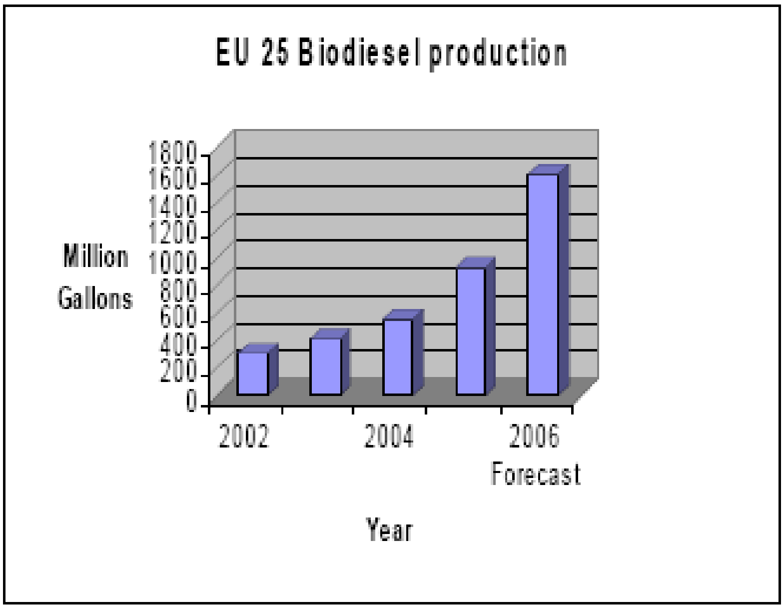

Figure 8 EU Biodiesel Production: Source: Remi Burdairon. November 2006.

There is significant biofuels production potential in neighbouring countries such as Zambia, Angola and Mozambique. These countries currently have far lower liquid fuel requirements. There is thus some potential to consider import of biofuel (processed or feedstock) to the Western Cape. However care is needed to ensure that one does not simply push concerns regarding water, biodiversity or food security issues onto other regions.

Optimism around biofuels potential needs to be tempered, as articulated in DME (2006a, p 93).

> "Given South Africa's limited agricultural land and water availability, it is important to guard against an over-investment in biofuel production. Rather, a healthy balance between the production of food and fuel is needed, and this should guide the level of incentives provided."

3.2.3.3 Production Costs

Production costs for biofuels are evolving significantly – and of course are very vulnerable to the international commodity prices for their main feedstocks (wheat, canola or sunflower in the Western Cape, Maize or soybean in the Free-State and Sugar in KwaZulu-Natal). The following table provides indicative figures from DME (2006a, p 21)

Table 2 Biofuels production costs (DME, 2006b)

		Sugar Cane	Maize	Soybean oil	Sunflower oil
Net crop feed price	cent/litre	231	254	310	493
Net biofuel production price	cent/litre	375	367	364	548

Appendix B provides additional information on Western Cape specific production costs for biodiesel from Canola. Given the significant interplay between agricultural input costs, food prices, and the volatility of diesel and petrol prices, it is very difficult to ascertain reliable indications of the economic viability (or not) of biofuels production. For this reason it is important to have a measure of market regulation to try and create a more secure production environment to stimulate investment.

3.2.3.4 Food Security Issues

Biofuels are reportedly already having an impact on food commodity prices such as sugar and maize. It should be noted that products such as wheat, sugar, maize are traded on international commodity markets. Thus even if South African policies limit in country biofuels production, there will still be upwards pressure placed on the price of these basic foodstuffs as a result of the international market. This will almost certainly have significant benefits for agriculture, and job creation in rural areas – but it will also push up basic food prices.

DME 2006b pg 54 notes the following:

> Food security concerns also stem from the fear that the increased demand for carbohydrate and oilseed crops will increase the prices of underlying raw materials in the food sector. Shell has calculated that in 2005, biodiesel feedstock crops will constitute 2.6% of world vegetable oil production, increasing to 8% in 2010. Major vegetable oil feedstocks are palm oil (31 %), soya (29 %), canola (14 %) and sunseed (9 %). Canola for biodiesel use already constitutes 18 % of world canola oil production and is expected to increase to 56 % in 2010. Already food sector, notably margarine manufacturers in the EU have expressed concern. In Australia in particular, the Livestock Feed Grain Users Group has also expressed concern that the increased demand for grain crops brought on by biofuel production will raise livestock input costs, which in turn will be passed on to the consumer.

DME 2006b makes some assessment of the probable impact of the draft national strategy on food prices and lists the impact as being insignificant (about 5% by 2015), especially when considered against the significant positive benefits noted for the scenario investigated (55 000 job created, a 0.12% contribution to economic growth, and a 3.7 billion impact on the balance of payments). However, this does not inform us how markets will react to international developments in the commodity prices.

3.2.3.5 Energy Balance

Table 3 drawn from DME 2006b, p 110 indicates the energy balance for some example processes. It should however be noted that agricultural and biofuels processing developments are expected to deliver improvements in these yields – particularly once cellulosic conversion processes become a reality.

Table 3 Energy ratios for key biofuels processes

Crop/process	Energy out per unit of energy in
Sugar Cane to Ethanol	6.02
Maize to Ethanol	1.36
Soybean to Diesel	2.40

Wheat has similar energy ratios to maize when used for ethanol production.

3.2.3.6 Production Potential

Appendix B provides a detailed assessment of the production potential for biodiesel in the Western Cape. This takes into account issues such as:

- Land availability (and assumes that only existing agricultural land should be used)
- Existing crop production yields, as well as future potential improvements
- Relative pricing of crops
- Crop rotation (canola can intercrop with wheat to advantage of both)
- Quality of wheat produced (and assumes that only lower grade wheat be used)

Based on this analysis, the following key production scenarios are presented.

Table 4 High production scenarios for biofuels in the Western Cape

	Biodiesel production			Bioethanol Production		
Year	Hectares Used	Production (1000l)	Portion of WC demand	Hectares used	Production (1000l)	Portion of WC demand
1	20,000	8,444	0.78%	150,000	109,620	6.32%
5	50,000	21,945	1.84%	150,000	120,960	6.48%
10	100,000	45,980	3.43%	150,000	137,160	6.71%
15	120,000	58,186	3.86%	150,000	154,980	6.91%
20	130,000	66,295	3.89%	150,000	175,500	7.14%

The above could result in the establishment of several small to medium sized biodiesel plants, and probably only one large bioethanol plant. The possibility of establishing two bioethanol plants has been mooted for the Western Cape. However, based on the assessment in Appendix B, further detailed economic and resource assessment work would be required before this could be confirmed. Note that the proportion of provincial fuel consumption discussed above are similar to those being mooted for the national strategy.

3.2.3.7 Job Creation

One of the key reasons for biofuel promotion is its potential to stimulate and support an agricultural economy. DME 2006a (drawing on prior work by Agama Energy) indicates that over 16 000 jobs could be created per TWh for biodiesel production, and 3 770 for Bioethanol. These figures are subject to significant update as greater insight is gained into this emerging industry.

3.3 Hydro

Hydropower installations can either be primary power generation units – where the flow of water from higher level reservoirs or catchments is allowed to run through turbines to generate electricity, or they can be installed as pumped storage units. In this case water can be pumped from a lower to an upper reservoir (using off-peak electricity) and then released to run through the turbines at times of peak demand. Both plant types are in use in the Western Cape – and some installations are effectively a combination.

3.3.1 Hydro power as a net generator

The only existing ordinary hydropower plant in the Western Cape is the Ceres Municipality unit, which is 1.5 MW, and produced 1082 MWh in 2004 (NER 2004, p 14). Based on high level information on rainfall and topography, there is reasonable potential for small scale hydro power within the province (as indicated by Figure 9).

More recent site specific work conducted by Barta (2007) indicates that there is only in the order of 20 MW of practically realisable potential in the small hydro category (less than 10 MW). These include the rehabilitation of existing small hydro projects, hydro generation at water transfer schemes and new hydro stations at existing dams that do not require major civil works.

- The *known potential* category yields some 6.5 MW, mostly at existing water transfer schemes.
- The *desk study* potential category below is mainly from existing large dams, of which there are 43 listed in the Western Cape Province.

Barta's assessment indicates that some 25 of these dams can be equipped with the small scale hydropower installations ranging between 0,3 and 1 MW to deliver a total capacity of 13MW. The estimated potential is based on the National Water Act requirements for regular releases to the rivers from these dams. Revitalisation of existing schemes such as those at Ceres and Worcester could add an additional 2 MW.

Table 5 Small scale hydro power opportunities in the Western Cape

Known potential		6.5 MW
Desk study potential	Existing large dams	13 MW
	Revitalisation of schemes	2 MW

The desktop potential study has considered only very cursory analysis and it is expected that increased effort in this regard would yield a larger long term potential. Hydro potential is also a function of water supply infrastructure and operations and potential will increase as additional supply infrastructure is added and the energy potential of such infrastructure is recognised early through interdepartmental collaboration and the incremental investment shared between the water and energy budget provisions.

This document has considered 50MW and 100MW of installed small hydro-capacity in the province by 2035 for the progressive and high renewable energy scenarios respectively. This is an optimistic view that more resources will be identified. If these are not identified this gap would have to be filled with one of the other renewable energy technologies.

The costs of hydro power tend to be very site specific. Furthermore, given the above low net energy input available from hydropower, the effect on total scenario generation costs will be marginal. For present purposes we assume a cost of R0.47/kWh for small hydro power (see Table 16), which is based on data used in the Long Term Climate Mitigation study being conducted by ERC.

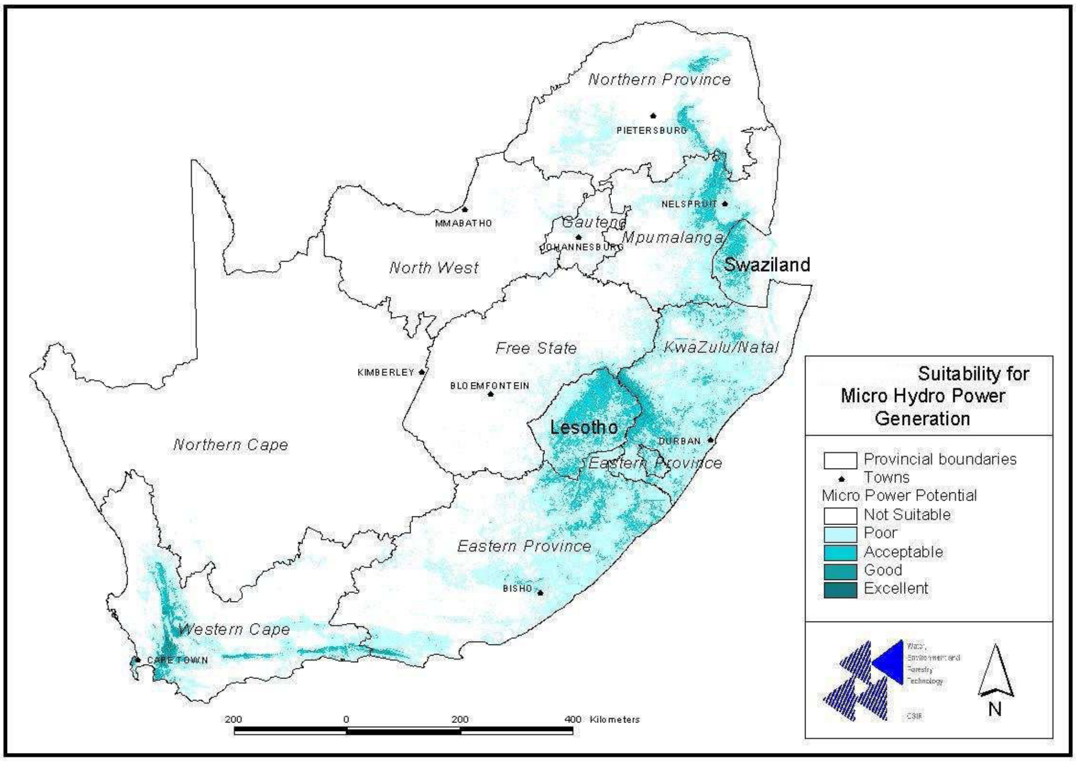

Figure 9 Overview of hydropower resources in South Africa (DME/CSIR/Eskom 2002)

3.3.2 Pumped Storage

Table 6 shows the existing pumped storage schemes in the Western Cape

Table 6 Existing pumped storage schemes in the Western Cape

Name	MW installed	GWH generated	Source
Palmiet	447 (400)	1 416 107 (212 107)	NER 2004
Steenbrass	180	147252 (-210 321)	NER 2004

Pumped storage schemes are typically used to store electricity generated during times of low demand (off-peak), which can then be released at times of high demand (peak periods). However, the large pumps can also sometimes used to move water from one basin to another (e.g. for irrigation or urban water supply). They can also be partially used to generate a net output of energy over the year, if the river on which they situated has a significant volume of water flow.

The figures listed in (brackets) in Table 6 imply that the Steenbrass uses more energy than it generated (in part because of losses, and possibly due to water transfer), while the Palmiet scheme has a net positive generation.

There is identified potential for new pumped storage capacity amounting to approximately 1 800 MW, with preliminary analysis conducted at the following sites (Barta, 2007).

Table 7 Potential pumped storage sites

Elandsberg Pass PSS (near Tulbagh)	Estimated Capacity 1200 MW
Matsikamma PSS (near Vredendal/Vanrhynsdorp)	Estimated Capacity 600 MW

The costs of storing electricity in pumped storage schemes depend strongly on efficiency and the effective capacity factor (how much power is drawn on a daily basis from the unit).

It is argued that if renewable energy is introduced into the mix in a large proportion, then electrical energy storage will become even more critical. This is likely to lead to further investigation of pumped storage sites. Also note that it is technically possible to pump sea water up and down mountains adjacent to the coast – thus scarcity of water may not be the primary limitation for site location. The scenarios developed postulate that an additional 3 000 MW of pumped storage could be installed in the Western Cape over the next 30 years if necessary. Section 3.12 discusses the issues related to load matching and energy storage in more detail.

3.4 Solar Water and Space Heating

Solar energy can be directly used to heat water, space, and in some cases to provide process heat for industrial activities. The resource in the Western Cape is very good (by international standards), although not as good as in north wester parts of the country. (See Figure 10)

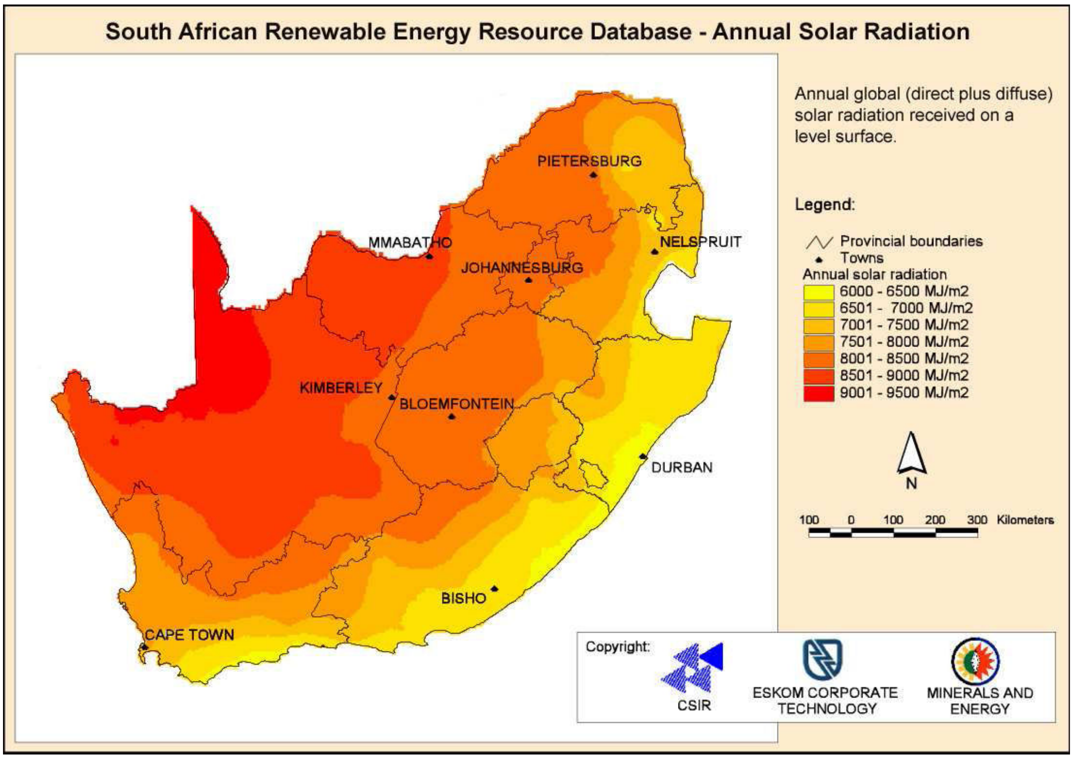

Figure 10 Overview of the Solar Energy resource in South Africa (DME/CSIR/Eskom 2002)