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4 NEED FOR AND DESIRABILITY OF THE PROJECT

This chapter provides an overview of the interaction between electricity demand and supply, the impact of the delay in the implementation of capacity expansion and the economic recession on electricity demand and the various options being explored to balance these. It further provides a motivation for the need and desirability for additional base-load electricity generation capacity and specifically nuclear generation capacity.

In many countries, including South Africa, economic growth and social needs are resulting in substantially greater energy demands, in spite of continued and accelerated energy efficiency advancements. As a result, new generating capacity must be installed to cater for the growth in energy demand or to replace aging plants.

In South Africa the need for capacity expansion was identified as far back as 1998 when it was reported that Eskom's generation capacity surplus, at that stage, would be fully utilised by approximately 2007. This figure was based on Eskom forecasts for an assumed demand growth of 4.2% and it was recommended that appropriate strategies, including those with long lead times, were implemented in time[1]. Yet despite clear recommendations, the government didn't act timeously and begin building additional capacity. By 2007, electricity demand exceeded supply and South Africa's power utility was forced to implement load shedding to ensure that the network remained stable. Load shedding was necessary to ensure that the generation and transmission systems did not collapse, by rotating the load in a planned and controlled manner[2].

4.1 Electricity demand and predicted future trends

The Government is mandated to ensure the secure and sustainable provision of energy for socio- economic development. The Integrated Resource Plan (IRP) 2010, in its current format, must be viewed as the Government's policy commitment to the mandate and the manner in which it proposes to meet current and projected energy demands (See Chapter 6 for a more in depth discussion of the IRP). Several different projections for the future increase in electricity demand have been produced, based on different scenarios for the development of South Africa's economy. The IRP 2010 indicates different scenarios investigated to plan South Africa's supply options in response to demand. The scenario used in the "policy adjusted" IRP 2010 is the Moderate Maximum Demand as illustrated in **Figure 4-1.** This scenario shows a growth in maximum demand from approximately 39 GW in 2010 to about 74 GW 2034 i.e. a planning horizon in excess of 20 years.

The National Development Plan (National Planning Commission 2012) further seeks an increase of Gross Domestic Product (GDP) by 2.7 in real terms by 2030, which implies GDP growth of 5.4 % per year. If this growth rate or even a more modest growth rate is assumed, the growth in electricity demand can be anticipated to continue and it will remain necessary to build new electricity generating capacity in South Africa. Thus, taking these figures into account, the IRP 2010 predicted an increase of around 21 GW of maximum demand by 2025 and around 29 GW by 2030 (**Figure 4.1**).

[1] White Paper on the Energy Policy of the Republic of South Africa (http://www.energy.gov.za/files/policies/whitepaper_energypolicy_1998.pdf)
[2] What is load-shedding? (http://loadshedding.eskom.co.za/whatis.htm)
[2] What is load-shedding? (http://loadshedding.eskom.co.za/whatis.htm)
[3] See Text Box 1 in Chapter 1
[4] A comparison of fuel and other operational costs of different generation technologies are provided in Chapter 5.

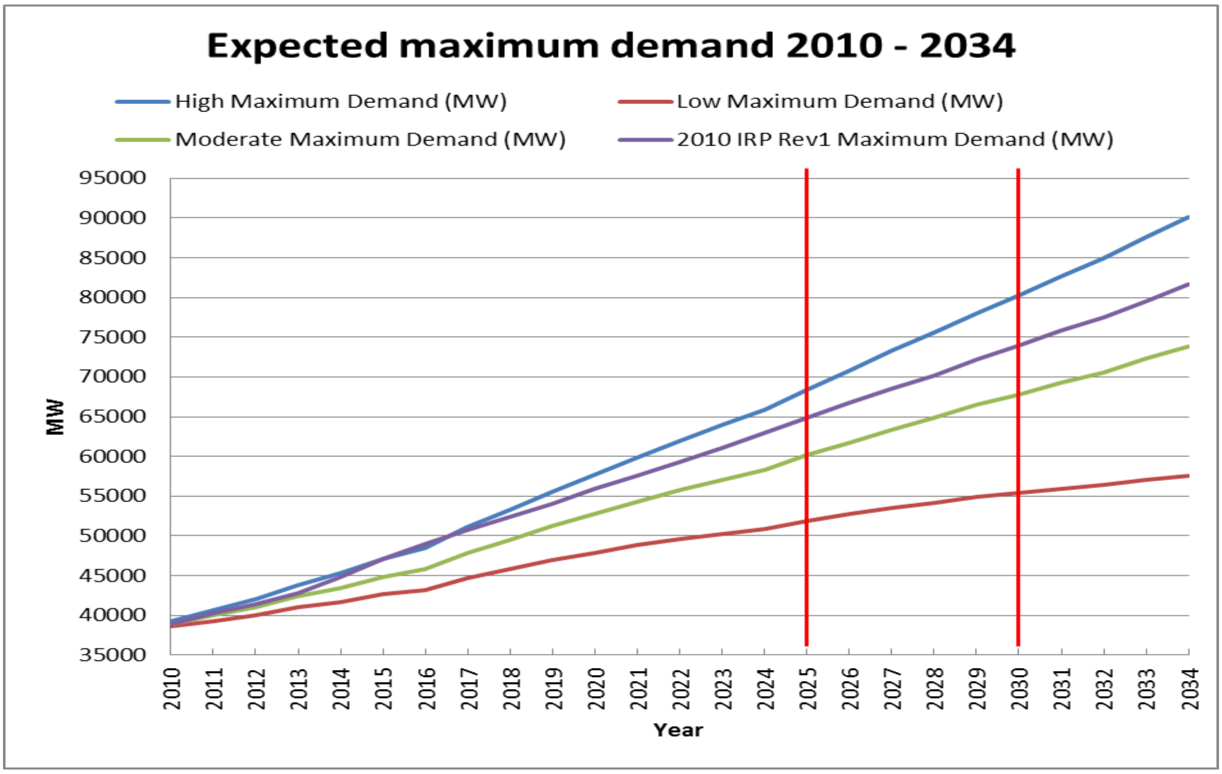

Figure 4-1: Projected electricity requirements for South Africa to 2034 based on different scenarios (IRP 2010)

Although South Africa's electricity supply remains constrained currently, demand for electricity in the five years since the publication of the IRP has been less than what was projected in the 2010 IRP. As such stakeholders have questioned the need and desirability for nuclear power in general and the proposed NPS specifically because that need and desirability is based principally on the projected electricity demand contained in the 2010 Integrated Resource Plan (IRP).

The approach used in this EIA has been one of defining the need and desirability for the project as a function of the nationally developed IRP and must remain so. An EIA is by definition project specific and thus cannot objectively present an assessment of national policy dictates such as the IRP and even less so potentially usurp the requirements of that policy. What cannot be disputed in the EIA, however, is that there has been a significant reduction in demand for electricity since the publication of the 2010 IRP although the future need for base-load generation remains even if the load growth does not materialise. Based on a projected demand for electricity, the IRP defines a mix of generating technologies to ensure that the demand can be met. As stakeholders have highlighted, if the demand is less than what was projected, then the proposed timing of supply options and energy mix may change.

Therefore as there is no formally published revision to the 2010 IRP that can be used to revise this chapter and this is why much of what are in this chapter remains rooted in the 2010 IRP.

4.2 Peak demand vs. installed and nominal capacity

The total demand for electricity in South Africa varies on a 24-hour basis, with peak demand in the early morning and more so late afternoon / early evening. Similarly, electricity requirements vary on a weekly basis, with the demand during the working week exceeding that over weekends. Furthermore, the demand in winter exceeds that of summer periods. To optimally meet the total demand, it is therefore necessary to have both base-load electricity generating power stations to meet the minimum needs, as well as peak-load power stations to meet the needs during peak periods. This can be achieved by applying a combination of appropriate technologies and energy sources.

Eskom uses a combination of base load and peaking power stations. The electricity generated by base load power stations (coal and nuclear) is used by peaking power stations, such as pumped storage power stations. These stations pump water between two dams with different elevations at night and weekends when the base load in the country is at its lowest. During peak hours the water from the higher dam is released via generators to the lower dam and in the process generates electricity to supplement the additional energy requirements. If the stored capacity of water is not sufficient, gas turbines assist during the peak periods.

The increase in the installed capacity (**Figure 4-2**) between 2005 and 2008 is mainly due to the commissioning of gas turbines in the Western Cape (Gourikwa and Ankerlig). The reduction in the gap between the nominal and installed capacity is mainly due to the return to service of previously moth-balled power stations. It is also obvious from this figure that the maximum demand of the country has not increased since 2007. This is mainly due to agreements between Eskom and large consumers to reduce demand during peak hours as well as the programme of demand side management initiatives by Eskom and the Department of Energy.

It is also important to note that the maximum demand for 2013 is the maximum recorded up to 01 July 2013. This maximum occurred during the evening peak on 18 June 2013 and is substantially lower than the previous year partly due to the modest winter to date. It is therefore possible that this figure may increase towards the end of the winter of 2013. The reserve margin will also proportionally decrease with an increase in peak demand.

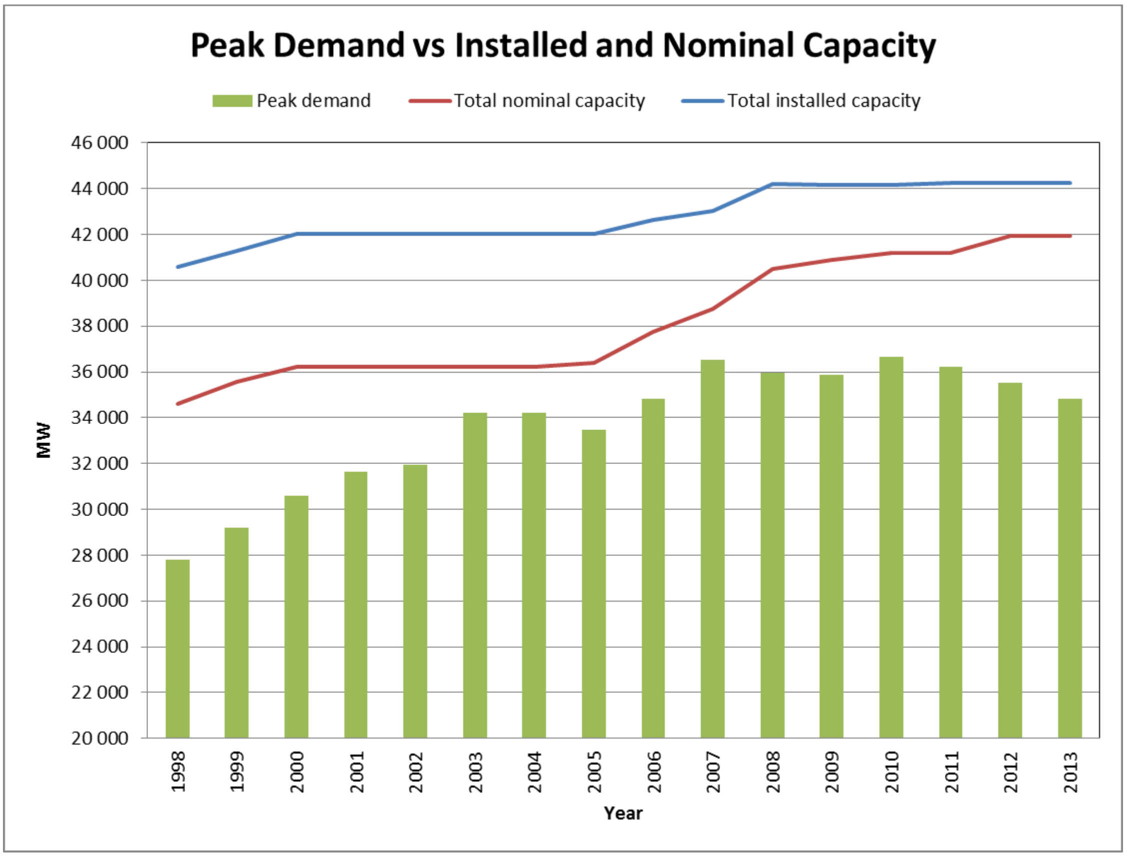

Figure 4-2: Actual peak demand vs. installed and nominal capacity per year (Eskom 2013)

The projected increasing demand for electricity over the next two decades impacts both the base-load demand as well as the peak-load demand. The Nuclear-1 project is aimed at increasing the base-load supply capacity, whilst there are a number of other projects (refer to **Section 4.5**) aimed at increasing the peak supply capacity.

4.3 Reserve margin

The reserve margin is defined as the difference between the peak demand and nominal capacity and is regarded internationally as a key benchmark for assessing the health of a country's electricity supply and transmission system.

South Africa's reserve margin has been gradually decreasing from an acceptable level in the late 1990's to unacceptably low levels in the first decade of the 21st century. Shortages in electricity in 2008 resulting in load shedding were brought about by a drop in the reserve margin to levels that were too low to cater for unexpected shutdowns of operating power stations. Figure 4.3 shows the actual trend in the reserve margin in recent years. It is essential to maintain a reserve margin above 15 % whilst the demand for electricity continues to grow in order to provide security of supply, especially for periods of high demand.

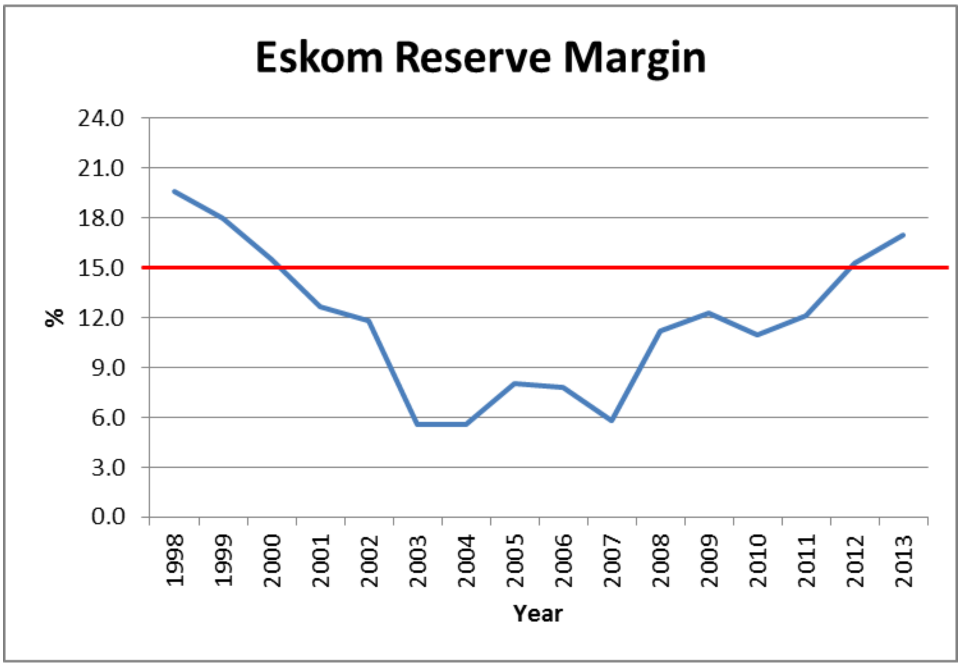

Figure 4-3: Net reserve margin (Eskom 2013)

4.4 Impacts of the economic slowdown on electricity demand

Despite the drop in electricity demand in 2008 to 2013, brought about primarily by steel and ferrochrome producers switching off their furnaces due to poor demand, South Africa is still experiencing an electricity base load-capacity deficit. Eskom needs to increase its generation capacity to improve the reserve margin back to within acceptable limits. **Figure 4-3** shows that, in spite of the recession, electricity demand was not drastically reduced and the subsequent steady rise in production since then to cater for increasing demand. It is clear from this figure that the reserve margin is improving and that will give confidence to investors to invest in South Africa. Despite the exceptional efforts by Eskom and the Department of Energy in the demand side management programme to reduce maximum demand, a major impact of this demand reduction has also been a slowdown in industrial activities in the country, with a negative impact on employment creation. Economic growth and subsequent growth in electricity demand is imperative for the well-being of all the people of the country by creating new employment opportunities.

4.5 Balancing electricity supply and demand

4.5.1 Impact of demand side management on electricity demand

The growth in the demand for electricity is expected to continue into the future, despite Government and Eskom having initiated energy-efficiency **(Demand Side Management or DSM)** and electricity conservation programmes. Although DSM has already realised demand savings of 2,997 MW for the combined financial years 2005 to 2012 (Eskom 2012), and **DSM must form an essential part of the strategy to meet South Africa's energy demand, the IRP 2010 has predicted that DSM would be able to provide savings of only up to 3 422 MW by 2020 (Department of Energy 2010b). DSM is, therefore, only one of a number of solutions to increasing demand that needs to be implemented.**

4.5.2 Current initiatives to increase electricity generation capacity

The choice of electricity generation technologies by Eskom is conducted within the context of the South African energy policy framework, the legal and regulatory framework, resource requirements and taking into account the required mix of generating technologies. This is done to optimally meet the daily, weekly and seasonal variations in demand for electricity and meet the sustainability aspirations of the country. In South Africa, Eskom currently uses a number of different technologies to convert primary energy sources into electrical energy (electricity), including both renewable technologies and non-renewable technologies.

Additional generating capacity could potentially be obtained from a variety of energy sources, for example clean coal, liquid fuels, gas, uranium (nuclear), water, wind and solar energy. The challenge is to correctly match the supply and demand, to facilitate sustainable economic growth and development as well as environmental sustainability. There are a number of factors that must be considered whilst evaluating options for electricity generation, including costs, lead time for construction, environmental impacts and operating characteristics relative to base and peak load[3] power generation.

There are a number of existing power generation initiatives under construction or already completed to meet both base load and peak load power demands. These include open cycle gas turbines (OCGTs), coal-fired power stations and pumped storage schemes.

OCGTs have been installed in the Western Cape, but they can only be used to a limited extent for peak supply to make up for the base load shortfall, due to their high operational costs[4]. Camden, Grootvlei and Komati power stations are being returned to service (RTS) and the construction of the Medupi and Kusile coal-fired power stations and the Ingula pumped storage scheme is ongoing. Together, these RTS and new build power stations account for 12,476 MW of additional generation capacity. However, prior to these initiatives, South Africa had not increased its base load[5] supply capacity since the Majuba coal-fired power station was brought into operation in the late 1990s. This underscores the backlog in electricity supply that South Africa is faced with.

[3] See Text Box 1 in Chapter 1
[4] A comparison of fuel and other operational costs of different generation technologies are provided in Chapter 5.
[5] **See "base load" definition in Chapter 1**

Figure 4.4 shows the capacity increase in the final policy adjusted moderate scenario of the IRP 2010. It should be noted that some coal fired power generation units will be decommissioned by 2030. The coal contribution in the energy mix is planned to increase in absolute terms but its contribution to total capacity is proposed to change from the current 85% in 2013 to 46% in 2030. This is despite a number of new coal fired power stations being under construction. **Table 4-1** below was used to provide the data for **Figure 4-4**.

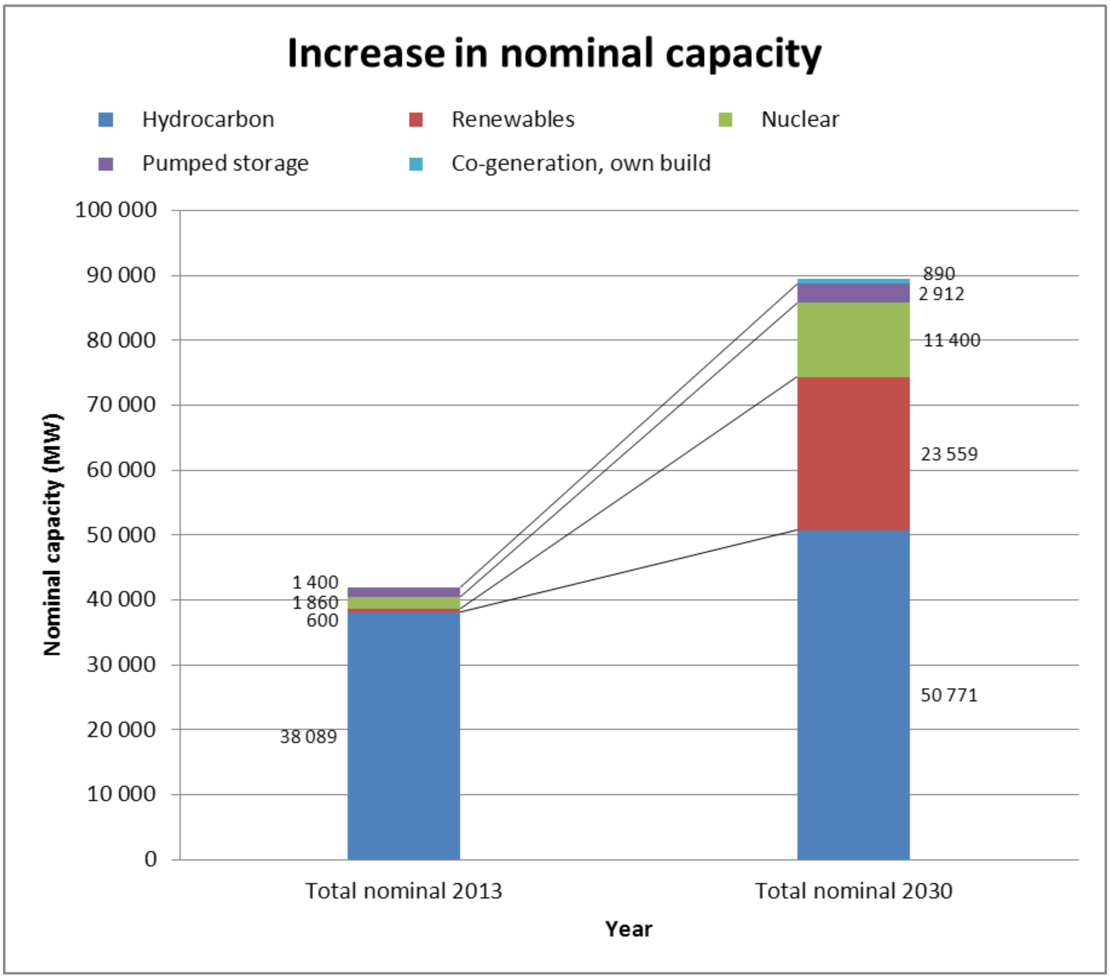

Figure 4-4: Capacity expansion as recommended by the IRP 2010

Table 4-1: Data for nominal increase in capacity

Technology	New nominal (MW)	% Total	Total nominal capacity 2013 (MW)	Total nominal capacity 2030 (MW)	% of total (2013)	% of total (2030)
Hydrocarbon	23 683	41.89	38 089	50 771	90.80	56.71
Coal	16 383	28.98	35 680	41 071	85.06	45.87
OCGT (diesel)	4 930	8.72	2 409	7 330	5.74	8.19
CCGT (gas)	2 370	4.19	0	2 370	0.00	-
Renewables	21 534	38.09	600	23 559	1.43	26.31
Wind	9 200	16.27	0	9 200	0.00	10.28
Solar (PV)	8 400	14.86	0	8 400	0.00	9.38
Solar (CSP)	1 200	2.12	0	1 200	0.00	1.34

Technology	New nominal (MW)	% Total	Total nominal capacity 2013 (MW)	Total nominal capacity 2030 (MW)	% of total (2013)	% of total (2030)
Imported hydro	2 609	4.61	600	4 759	1.43	5.32
Landfill, small hydro	125	0.22	-	-	-	0.00
Nuclear	9 600	16.98	1 860	11 400	4.43	12.73
Pumped storage	1 332	2.36	1 400	2 912	3.34	3.25
Co-generation, own build	390	0.69	-	890	0.00	0.99
Total	**56 539**	**100.00**	**41 949**	**89 532**	**100.00**	**100.00**

4.5.3 Choice of generation mix for future supply

Demand for electricity in South Africa varies spatially (geographic) and temporally (with time). Spatially, South Africa's land surface area of 1.1 million km^2 consists of a mix of urban and rural areas, each with different requirements with respect to electricity. Areas of high electricity demand are not correlated with power generation centres. Coal resources, which accounted for 85 % of the electricity generated in South Africa in 2007 (International Energy Agency 2009), are primarily located in the north-east of the country. However, the demand for electricity prevails throughout the country, with the mining and industrial sectors accounting for approximately 40 % of the electricity demand[6].

Only a few energy sources capable of providing a sustained power supply are available in sufficient quantities suitable for base-load power stations. In South Africa, coal and nuclear power are used for base load electricity generation, while the OCGTs (using liquid fuel, such as diesel), two hydroelectric power stations on the Orange River, and pumped storage schemes are used for peaking and emergency electricity generation. At present, identified renewable forms of energy (e.g. wind and solar), have intermittent supply and lower load factors, typically less than 30% (Department of Energy, 2010c). Therefore, they are unable to equal viable large-scale power generation facilities in terms of supplying a reliable base load and easy integration into the existing power network in South Africa.

Internationally, natural gas and hydro power are also used for base-load electricity supply. However, South Africa does not have sufficient quantities of indigenous natural gas and does not have the large rivers required for base load hydro-electric power stations. Eskom imports hydro-electric power from Southern African countries, mainly from Cahora Bassa in northern Mozambique. Opportunities for importing hydro power from Southern African countries in the future are being investigated. This option will require the construction of new dams in the other countries and transmission lines between those countries and South Africa. These projects are thus longer-term projects and they require careful environmental consideration and consideration of the impacts of political instability on long transmission lines. Such imports would need to be limited to the equivalent of the prevailing reserve margin for South Africa.

In light of the above, coal-fired and nuclear power stations are currently the only feasible options in South Africa for base load electricity generation.

4.5.4 Climate change considerations

Currently around 85 % of the generating capacity in South Africa comes from coal-fired power stations. While it will be necessary to continue to use coal-fired power stations into the future, security of supply considerations and the global requirement for low carbon growth to prevent climate change dictates that the reliance on coal should be reduced.

[6] White Paper on Energy (1998)

At the international climate change negotiations held in Copenhagen in December 2009, emerging developing countries (including South Africa) were asked to submit their emission reduction plans to the international community to show that while will relying on coal for a period, the intention is to reduce this reliance and reduce absolute greenhouse gas emissions. South Africa is currently a significant emitter of carbon dioxide: In global terms, in spite of its relatively small economy, South Africa ranks fourteenth in the world for cumulative CO_2 emissions due to its reliance on coal for electricity production. Measured by the quantity of electricity produced from fossil fuels, South Africa ranks sixth in the world (Table 4.2).

South Africa announced at the December 2009 Copenhagen climate change negotiations and again in 2011 at the 17th Conference of the Parties (COP 17) to the UN Framework Convention on Climate Change (UNFCCC) that it intends to undertake a range of voluntary nationally appropriate mitigation actions (NAMAs) to reduce its emissions. This undertaking will enable the country's emissions to deviate by 34 % and 42 % below the projected business as usual emissions by 2020 and 2025 respectively. This level of effort would enable emissions to peak between 2020 and 2025, plateau for approximately a decade and decline in absolute terms thereafter. The achievement of this aspiration is dependent on the use of non-fossil fuel electricity production such as nuclear and renewable sources, especially given that electricity generation currently contributes 45 – 50 % of South Africa's greenhouse gas emissions.

Table 4-2: Electricity production from fossil fuels (top 10 countries) (Based on International Energy Agency 2007a)

Country	Annual production (Terawatt hours)
United States of America	2 154
People's Republic of China	1 972
India	480
Japan	309
Germany	305
South Africa	229
Australia	201
Russia	166
Korea	149
Poland	145

Eskom is therefore aiming to reduce the contribution of coal-fired electricity to approximately 70 % of the total capacity by 2025 (Eskom 2009). Eskom is committed to assess options to retard the rate of increase in CO_2 emissions and ultimately begin to decrease it. Its stated intention is to reduce its relative CO_2 (Mt CO_2/MWh) footprint until 2025, and thereafter to continually reduce absolute emissions in support of national and global targets (Eskom 2009).

Nuclear power provides Eskom and South Africa with a mitigation strategy for greenhouse gas reductions, since nuclear power generation produces significantly less carbon dioxide emissions than conventional fossil fuel technologies. When replacing coal-fired power, a 1 GW nuclear power plant can avoid emission of some 6-7 million tonnes of CO_2 per year (International Energy Agency 2007b). Over the full life cycle of nuclear power, from mining of the uranium, iron ore and other minerals, manufacture of the components and construction of the power station, operation and maintenance of the power station through to decommissioning and the management and disposal of waste, nuclear power emits less than 11 grams of carbon equivalent per kilowatt-hour (gC_{eq}/kWh) (Dones *et al.* 2003), which is even less than wind and solar power. This is also two orders of magnitude below (i.e. one hundredth of) the average for coal, oil, and natural gas **(Figure 4-5)**. Apart from these benefits, nuclear power generation does not emit sulfur dioxides (SOx), nitrous oxides (NOx) and requires much less fresh water than coal-fired power stations when constructed near a coast line.

Examples of the reduction in fossil fuel emissions can be found in France and Germany. France's carbon dioxide emissions from electricity generation fell by 80 % between 1980 and 1987 as its nuclear generation capacity increased. Prior to Germany's decision to phase out its nuclear programme (after the Fukushima incident in 2011) its nuclear power programme prevented the emission of over two billion tons of carbon dioxide from fossil fuels since it began in 1961.

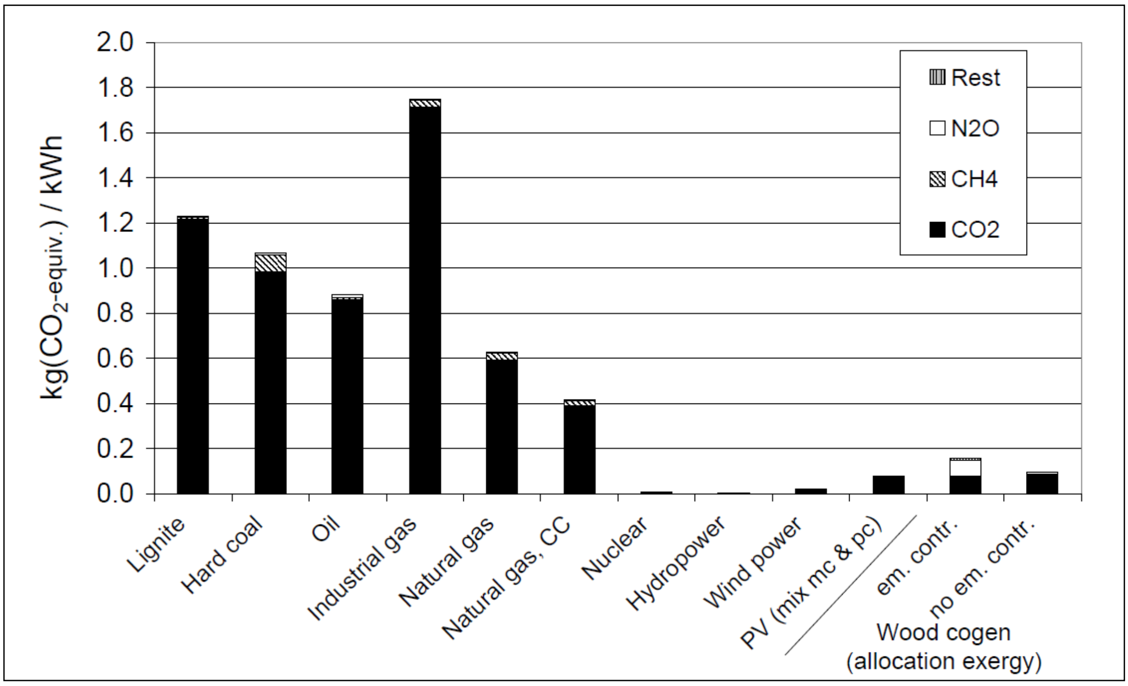

Figure 4-5: Comparison of life-cycle greenhouse gas emissions of different electricity generation systems (Dones *et al.* 2003)

4.6 Summary of the need for Nuclear-1

It is clear that as part of South Africa's development of new electricity generating capacity to meet the needs outlined in the IRP 2010, a component of nuclear energy is essential for the following reasons:

- Although DSM has resulted in significant reductions in electricity demand in South Africa, its capacity to continue to deliver such savings is limited;
- Even with the RTS coal-fired power stations and new build coal-fired power stations, there may still be a need for new generation capacity to meet South Africa's future electricity needs;
- Together with coal-fired electricity generation, nuclear generation provides the most reliable form of base load generating capacity. Not all technologies are capable of providing reliable base load;
- Greenhouse gas generation from nuclear technology is very low compared to coal-fired electricity generation and provides an effective means of reducing South Africa's Greenhouse Gas (GHG) footprint and thereby meeting our commitments to reduce our overall GHG production and the relative contribution of GHG production per unit of electricity produced; and
- Nuclear generation has a very favourable GHG footprint over its life cycle even when compared to renewable electricity generation technologies such as wind and solar generation.

The points presented above remain valid but it should be recognized that the scale of new generation capacity could reduce and the technology mix for achieving that new generation capacity could also change.

There has for example been a significant reduction in demand for electricity in South Africa since the publication of the IRP (2010). A key driver of this reduction in demand has been falling commodity prices and it is simply not clear when the commodity prices will recover to the point of increasing demand again. The demand projections of the IRP (2010) have not realized in 2015 and are well below the low growth scenario contained in the IRP. If this trend continues the IRP will need to be revised to account for the changed demand scenario and it seems likely that a revised IRP will be published in 2016 although it is not confirmed.

Should the need for nuclear power generation be retained in the revised IRP, then the need and desirability for the NPS as presented in this chapter would remain valid. If the revised demand projections and the technology options for meeting that revised demand change to exclude nuclear power generation, then the need and desirability for the proposed NPS may need to be reconsidered.

Importantly it is argued here that an EIA cannot usurp national policy dictates such as those contained in an IRP, but can raise questions regarding the validity of such policy.

4.7 Eskom motivation for using Pressurised Water Reactor Technology for Nuclear-1

There are various nuclear reactor types available on the international market. This section provides a basic comparison of the reactor types / technologies and indicates Eskom's motivation for its choice of Pressurised Water Reactor (PWR) technology.

Nuclear power plant alternatives belonging to the Pressurised Water Reactor (PWR) technology family are under consideration by Eskom for the proposed nuclear power station. PWRs are the most commonly used nuclear reactor technology both locally and globally. Eskom is familiar with the family of technology from health and safety and operational perspectives based on its experience with the existing Koeberg Nuclear Power Station.

Eskom's preference for a PWR is thus based on the following principles:

- Eskom has experience with the family of PWR technology;
- It is advantageous to have the same nuclear power technology in South Africa as PWR technology has already been used successfully. The skills and experience required to use the technology are therefore readily available in South Africa; and
- Standardisation in terms of world trends in technology is preferred (82 % of the 68 nuclear units currently under construction worldwide use PWR technology) (World Nuclear Association 2013).

4.8 Need and desirability guidelines

The DEA and the Western Cape Department of Environmental Affairs and Development Planning (DEA&DP) have guidelines on how need and desirability must be addressed in an EIA. The following section addressed the questions on need and desirability raised in these respective guidelines. The issues raised in the national guideline (Department of

Environmental Affairs 2012) and provincial guideline (DEA&DP 2011) are different but all relevant issues raised in either guidelines are discussed here. Although the competent authority in this instance is the national Department of Environmental Affairs, the provincial guidelines has also been considered, since the Bantamsklip and Duynefontein sites fall within the Western Cape Province.

Need and desirability as discussed in the guidelines are two interlinked concepts and are defined as follows:

Need

Need addresses why the development is required when it is required. How would the development benefit the local / regional / national community? By indicating how communities or the country would benefit from the development, the applicant will automatically emphasise the need for the development.

Desirability

Desirability addresses why the development is required in the locality where it is proposed. Why must it be there and not somewhere else?

Questions 1-6 are focused on need while questions 7-14 are focused on desirability. Questions 1-5 are focused primarily on the compatibility with the existing planning policies and tools, and are clearly focused on "conventional" small scale developments that do not have an overriding strategic objective like ensuring South Africa's security of electricity supply.

Table 4-3: Summary of Need and Desirability Questions (in terms of the DEA & DEA&DP EIA Guidelines on Need and Desirability).

Questions marked with an ***** are found in both national and provincial guidelines. Those not marked with an ***** are found only in the DEA&DP guideline.

Question	Response
NEED	
* Question 1: Is the land use (associated with the activity being applied for) considered within the timeframe intended by the existing approved Spatial Development Framework (SDF) agreed to by the relevant environmental authority? (i.e. is the proposed development in line with the projects and programmes identified as priorities within the credible IDP?).	The land use is not necessarily in line with the SDF and IDP of the respective local authorities, since the need for the power station is driven by national objectives, while the objectives in the SDFs and IDPs are driven by local needs. See Question 6 below. Duynefontein site: • The Nuclear 1 facility is not specifically mentioned in the Municipal SDF, but existing surrounding land uses are compatible with proposed land use. • The Nuclear 1 facility is not specifically mentioned in the Municipal SDF, but existing surrounding land uses are compatible with proposed land use. Bantamsklip site: • The Nuclear 1 facility is not specifically mentioned in the Municipal SDF. • Surrounding land use is compatible with the proposed Nuclear 1. • The future planning suggests that the proposed use could be accommodated on the proposed site.

Question	Response
	Thyspunt site: • The Nuclear 1 facility is only briefly mentioned in the Kouga SDF. • Surrounding land use is compatible with the proposed Nuclear 1. • The future planning suggests that the proposed use could be accommodated on the proposed site. All three municipalities have legislative processes in place that will allow for the submission of an application to the respective municipalities to obtain the rights for the proposed land use.
Question 2: Should development, or if applicable, expansion of the town/area concerned in terms of this land use (associated with the activity being applied for) occurs here at this point in time?	The development of 9600 MW of base load nuclear generated power by 2030 is mandated by the IRP 2010, which is the South African government's official strategy for ensuring security of electricity supply. Nuclear-1 will supply a maximum of 4,000 MW. In order to provide the mandated 9,600 MW of nuclear power by 2030, and taking into account the long lead time and nine-year construction period for a nuclear power station, construction of Nuclear-1 is required to commence as soon as possible. However as described earlier it is argued that the need for and timing of the proposed NPS could well change given the change in demand for electricity that has manifest in the period from 2010 to 2015. The need and desirability presented here is premised on the dictates of the 2010 IRP. It is expected that a revised IRP that reflects the change in demand since 2010 and accordingly revises the proposed mix of generating technologies and the timing of implementation of those technology options would be required to properly define the timing of the proposed NPS.
Question 3: Does the community/area need the activity and the associated land use concerned (is it a societal priority)? This refers to the strategic as well as local level (e.g. development is a national priority, but within a specific local context it could be inappropriate).	South Africa will continue to experience an electricity base load-capacity deficit into the future if it does not construct additional base load generation capacity to cater for future increased demand and for replacing existing power stations that will be decommissioned in the next few decades. Eskom needs to increase its generation capacity to improve the reserve margin back to within acceptable limits. Despite the exceptional efforts by Eskom and the Department of Energy in the demand side management programme to reduce the maximum demand, a major impact of this demand reduction is also an economic slowdown in industrial activities in the country. Economic growth and subsequent growth in electricity demand is imperative for the well-being of all the people of the country. On a provincial level, the proposed power station is proposed in the Eastern or Western Cape Provinces, both of which import the majority of their electricity over very long transmission lines from Mpumalanga, which is ineffective as it results in significant losses in

Question	Response
	the transmission system. The current losses in Eskom Cape network amount to 400 MW. Although the Western Cape has the Koeberg Nuclear Power Station (KNPS) and several peaking power stations, the peaking stations are expensive to run and do not provide cost-effective base load electricity, whilst the Cape Metropole's electricity needs are now much greater than what the KNPS can supply. Approximately 55% of the Western Cape's needs are supplied by the transmission network. On a local level, communities such as St. Francis and Pearly Beach may not perceive a need for a large power station at Thyspunt or Bantamsklip, but the need remains on a national and provincial level. There is a need for additional base load electricity supply at a metropolitan level in Cape Town with respect to the Duynefontein site.
Question 4: Are the necessary services with adequate capacity currently available (at the time of application), or must additional capacity be created to cater for the development?	There are significant current service backlogs in service delivery in the Kouga Municipality at the Thyspunt site. Although services at the Bantamsklip site are sufficient for current land uses, they would not be sufficient for the expected influx of personnel during the construction phase of the project. Development at both these sites would require agreement between Eskom and the local authority on the apportionment of financial responsibility for upgrades to infrastructure such as sewerage and waste management. It is anticipated that such agreements would be similar to the agreements that Eskom reached with the Lephalale Municipality for the upgrades of services that were required for the construction of the Medupi Power Station. Although minor road upgrades (particularly intersections) would be required in proximity to the Duynefontein site, services around this site are by and large sufficient to cater for the proposed development. It must be noted that none of the local authorities would need to supply water operation of the power station, since the project would exclusively use desalinated seawater during operation. Limited municipal supply may be required during early construction, whilst construction of the desalination plant is in progress.
Question 5: Is this development provided for in the infrastructure planning of the municipality, and if not what will the implication be on the infrastructure planning of the municipality (priority and placement of services and opportunity costs)?	Duynefontein site: • The proposed development will have an impact on future development of the region i.t.o. land that can be utilised for future development. Areas around the site will need to be protected, densities may need to be lower than if the development was not there and infrastructure upgrades will be required, especially roads. Bantamsklip site:

Question	Response
	• The proposed site is not in the growth path of future urban development. • The impact of urban expansion will be limited due to the rural character of the towns. Growth of towns as a result of the Nuclear 1 facility being located at the proposed Bantamsklip site will need to be managed and directed to areas where development and expansion can be accommodated. • The evacuation model, taking into consideration that people must be able to evacuate the area within a specified timeframe, will also influence densities and the location of land uses. Thyspunt site: • The proposed site is not in the growth path of future urban development. • The impact of urban expansion will be limited due to the rural character of the towns. Growth of towns as a result of the Nuclear 1 facility being located at the proposed Bantamsklip site will need to be managed and directed to areas where development and expansion can be accommodated. • The evacuation model, taking into consideration that people must be able to evacuate the area within a specified timeframe, will also influence densities and the location of land uses.
Question 6: Is this project part of a national programme to address an issue of national concern or importance?	The proposed power station is being planned in response to the requirements in the IRP 2010 for the development of nuclear generated electricity, which the IRP 2010 requires in parallel to significant enhancements of renewable electricity production to meet South Africa's projected needs up to 2030. After public consultation the IRP was revised early in 2011 and passed by cabinet in March 2011. The IRP 2010 outlines the country's electricity demand, how this demand needs to be supplied, and what it is likely to cost. Its recommended balanced scenario represents a trade-off between least investment cost, climate change mitigation, diversity of supply, localisation and regional development. The IRP requires 52 GWe of new capacity by 2030, assuming 3.4 GWe of demand-side savings. According to this scenario, South Africa's generation mix by 2030 should include: 48% coal; **13.4% nuclear**; 6.5% hydro, 14.5% other renewables; and 11% peaking OCGT. Again, however, the timing of new plant and the energy mix may well be changed in a revised IRP although the need to replace the current Eskom base load (coal) fleet in the period 2015 – 2035 remains.
DESIRABILITY	

Question	Response
Question 7: Is the development the best practicable environmental option (BPEO) [7] for this land/site?	Nuclear power provides Eskom and South Africa with a mitigation strategy for greenhouse gas reductions, since nuclear power generation produces significantly less carbon dioxide emissions than conventional fossil fuel technologies and its carbon footprint per unit of production is similar to many renewable technologies such as solar and wind. All three of the alternative sites assessed in the EIA have been found to be environmentally feasible for the development of a power station, although the Bantamsklip site has been found to be least feasible due to significant logistical construction challenges and potentially significant cumulative environmental impacts. Either the Duynefontein site or the Thyspunt site could be regarded as a BPEO. Duynefontein, in spite of the site being situated in a private nature reserve, is regarded as a brownfields site when it is considered that it is located within a major urban centre and that there is an existing nuclear power station on the site, which has already transformed the environment. The considerable investment that Eskom has already put into power generation and transmission infrastructure for this site makes it attractive to continue to develop the Duynefontein site for power generation rather than developing a greenfields site elsewhere in the Western Cape. With the exception of the potential impacts on palaeontological resources and the impacts on an already compromised dune system at Duynefontein, the majority of the impacts at this site are of relatively low significance. With regards to the Thyspunt site, the site as a whole has a number of sensitive elements, the primary one being the Oyster Bay Headland Bypass Dune system and its associated wetlands, as well as the Langefonteinvlei Wetland (a large hillslope seep wetland) and a coastal strip rich in stone age heritage features. The proposed placement of infrastructure in the vegetated dunes of this site avoids these sensitive features. Owing to the poor state of conservation of the bypass dune system and the surrounding ecosystems, particularly due to alien plant invasion, the creation of a *de facto* nature reserve around the power station (the power station footprint will be less than 20% of the total Eskom property) is considered to be a significant benefit for conservation by all biophysical specialists on the EIA team. Given this benefit, and the acceptance by Eskom of a recommendation that additional land needs to be purchased to secure the conservation of poorly

[7] According to NEMA the "BPEO" means the option that provides the most benefit and causes the least damage to the environment as a whole, at a cost acceptable to society, in the long-term as well as in the short-term. In determining the best practicable environmental option, adequate consideration must also be given to opportunity costs.

Question	Response
	conserved wetlands, the proposed development will result in an overall long-term positive impact for terrestrial ecosystem conservation, although there will (as with all the sites) be short-term negative impacts. At Thyspunt there will be negative construction-related impacts on the squid fishery due to the offshore pumping of spoil and limited impact due to the release of warmed cooling water into the sea. The mortality of squid paralarvae from increased water turbidity and warmed cooling water would be negligible. Assuming a worst-case scenario, approximately 18km^2 of offshore habitat would be lost to squid spawning due to spoil disposal. This will result in an estimated 13.43% of catches by the inshore jig fishery being displaced, as adult squid move to other spawning grounds. The long-term positive conservation impacts at Thyspunt need to be weighed against the short-term negative terrestrial impacts and the spatially limited disruption of squid during the construction phase.
Question 8: Would the approval of this application compromise the integrity of the existing approved and credible municipal IDP and SDF as agreed to by the relevant authorities?	Refer to Question 5 above. The SDF's for the Duynefontein and Bantamsklip sites do not specifically mention the Nuclear power station. However the Kouga municipality does mention the Nuclear-1 facility. All three municipalities have legislative processes in place that allow for the submission of an application to obtain the relevant land used rights for the Nuclear-1 facility.
* Question 9: Would the approval of this application compromise the integrity of the existing environmental management priorities for the area (e.g. as defined in EMFs), and if so, can it be justified in terms of sustainability considerations?	There are no environmental management frameworks for any of the affected sites, and other conservation planning tools such as Biodiversity Sector Plans and Conservation Planning Reports identifying Critical Biodiversity Areas (CBAs). Duynefontein falls in the southernmost area of the West Coast Biosphere Reserve and designates this area and the surroundings to the north as "buffer zone" in terms of conservation land use. The Bantamsklip area is shown as a priority expansion area for conservation in the National Spatial Biodiversity Assessment of 2004. As shown by the Koeberg Private Nature Reserve around the KNPS, the development of a nuclear power station does not necessarily preclude the possibility of conservation land use. The land at Bantamsklip is not currently conserved and all the biophysical specialists on the EIA team agreed that the conservation benefits of managing the remainder of the property outside the power station footprint for nature conservation would be significant enough to offset the development of a small portion (less than 20%) of the property. The majority of the high value ecosystems (extensive wetlands) occur on the northern portion of the site, which is not to be developed.

Question	Response
* Question 10: Do location factors favour this land use (associated with the activity applied for) at this place? (this relates to the contextualisation of the proposed land use on this site within its broader context).	As indicated in response to Question 3, both the Eastern Cape and Western Cape have a lack of base load generating capacity relative to their electricity needs and import their electricity from other provinces over long transmission lines, which results in significant losses on the transmission lines. It is projected that both provinces will continue to show significant growth in electricity demand. Providing generation close to the source of demand holds significant benefits in terms of stabilisation of the grid and limiting losses on transmission lines. Location factors at Duynefontein are favourable for a nuclear power station, since Koeberg Nuclear Power Station (KNPS) has already been developed at the site and it is close to the large urban complex of the Cape Town, which is the main load centre in the Western Cape. At the time when the KNPS was developed, Cape Town (with the exception of Apartheid-conceived dormitory town such as Atlantis) had not expanded in a northerly direction, but Cape Town's current main growth axis is in a northerly direction up the West Coast. Thus, the Duynefontein site can increasingly be regarded to be part of the City of Cape Town. With the Emergency Planning Zones for Nuclear-1 being smaller than those of the KNPS, the net effect on urban planning and expansion in the area around Duynefontein should be negligible. The Western Cape currently has installed capacity of 4300 MW (including Koeberg, Palmiet, Ankerlig and Gourikwa), whilst the Eastern Cape has installed capacity of only 171 MW. The Eastern Cape therefore has more significant difference between demand and supply than the Western Cape, hence Eskom's preference to construct new electricity generation capacity in the Eastern Cape first.
* Question 11: How will the activity or the land use associated with the activity applied for, impact on sensitive natural and cultural areas (built and rural/natural environment)?	The siting of the power station on all three alternatives sites has been carefully considered to avoid the most sensitive natural and cultural features on the sites. At all three sites, the most sensitive heritage features occur within 200 – 300 m of the coastline. A 200 m wide coastal strip is being maintained free of development at all three sites. At Duynefontein, these are palaeontological resources, whilst at Bantamsklip and Thyspunt, they are primarily iron age archaeological resources. Both the latter sites are very rich is archaeological resources, but they are concentrated in a narrow coastal strip and very few heritage sites occur within the proposed footprints of the power station. Although impacts on heritage sites can be mitigated by responsible excavation prior to construction, the Heritage Impact Assessment has found unmitigable

Question	Response
	impacts on the cultural landscape at Thyspunt due to the presence of the large industrial-character buildings. As indicated in response to Question 7, although there are a number of sensitive terrestrial ecological features at Thyspunt, the placement of the Nuclear-1 footprint (including associated on-site infrastructure) avoids these features. There will be limited impact (displacement of 13.43% of catches) on the inshore jig fishery during construction. The Bantamsklip site has sensitive natural features such as outcrops of Limestone Fynbos, but these have been avoided by the placement of the power station. The northern portion of the site, which is not planned to be developed at all, contains extensive sensitive wetlands.
* Question 12: How will the development impact on people's health and wellbeing (e.g. in terms of noise, odours, visual character and sense of place, etc.)?	Noise impacts have been found to be low at all three sites. Noise impacts will be low during construction and negligible during operation. The visual character of the Duynefontein site will not change appreciably because the KNPS on the site is already recognised as an industrial landmark in Cape Town. The KNPS and the proposed position of Nuclear-1 are 2km from the R27 (the closest public road) and the visual impact at this site is therefore mitigated by distance. The visual impact at Bantamsklip will be higher than at Duynefontein as the landscape is very flat and the proposed position of the power station is approximately 1.2km from the closest public road, the R43. The Heritage Impact Assessment indicates that The natural heritage landscapes of the place are excellent and make a substantial contribution to the character of the region. Hence, un-mitigatable cultural landscape impacts are expected. At Thyspunt, the proposed power station will not be visible from the nearest settlements (Cape St. Francis or Oyster Bay) due to the distance and the intervening landforms. However, the Heritage Impact Assessment indicates that wilderness qualities of this portion of the coast, in contiguity with the archaeological heritage, are exceptional and make a substantial contribution to the character of the region. Hence, un-mitigatable cultural landscape impacts are expected.
* Question 13: Will the proposed activity or the land use associated with the activity applied for, result in unacceptable opportunity costs?	There are no opportunity costs at Duynefontein as the site is already used for electricity generation. Although a small portion of the Koeberg Private Nature Reserve will be transformed, this represents only approximately 9.3% of the total property. The most likely alternative land use at the Thyspunt

Question	Response
	site is coastal development (residential or leisure), as this has been the dominant developing land use on the eastern and western sides of the Thyspunt site. The primary reason why Thyspunt has remained undeveloped until now is the fact that the property had been acquired by Eskom several decades ago. The opportunity for conservation at Thyspunt would not be lost by development of a power station, since the power station footprint is only around 14% of the total property. One of the key recommendations of the terrestrial biophysical studies is that Eskom must acquire additional properties to secure the land for conservation. In view of this recommendation, there is in fact greater opportunity for conservation with the development of Nuclear-1 than without it, since it is unlikely that the affected properties would have been acquired for conservation by any other party if Nuclear-1 was not proposed. The most feasible alternative land uses at the Bantamsklip site are residential development or conservation and flower farming. Residential holiday town development is the main activity along this section of coastline and similar to Thyspunt, had the property not been acquired by Eskom, it might ironically have been acquired for residential development long ago. The only other feasible opportunity that may be lost is the acquisition of the property for expansion of conservation areas such as Agulhas National Park. However, no formal offer has been made by SanParks for acquisition of the property.
* Question 14: Will the proposed land use result in unacceptable cumulative impacts?	The EIA has determined that there are no fatal flaws at any of the proposed Nuclear-1 sites. Please refer to Chapter 10 for more information.

4.9 Conclusion

The provision of reliable and affordable electrical energy is vital for the future prosperity of South Africa and, indeed, elsewhere in the world. The upliftment of impoverished populations everywhere is intimately connected to it. In a world of finite resources and increasing population reliable nuclear energy may be an essential part of the energy mix. The case for nuclear energy in South Africa can be expressed as six basic propositions:

- In coming decades South Africa will need to increase base-load electricity generation capacity. All environmentally acceptable generation options must be considered.
- For environmental reasons and to conserve resources, the burning of coal, oil and gas (fossil fuels) and the associated emission of carbon dioxide must be minimised.
- Nuclear power is well proven in thirty-one countries, including South Africa and can, in principle, provide essentially all the electrical energy required.
- Viable renewable energy technologies are intermittent, relatively expensive per unit of production and have a low capacity factor and will require nuclear or fossil-fired back-up.

- Nuclear generation is a proven and reliable base-load generation source. With breeder reactor technology and known reserves of uranium and thorium, nuclear fission will be a major source of energy far into the future.
- All major means of electrical generation impact the environment in one way or another. Impacts associated with nuclear energy are manageable and are diminishing as the technology evolves.

- The initiation of a new build nuclear fleet programme has been well supported by key Government role players. The Nuclear Energy Policy 2008 lays out the foundation not only for nuclear power but also in support of growing the South African nuclear industry whilst the Integrated Resource Plan (IRP) of 2010 supports the creation of 9.6 GW of nuclear capacity by 2029.

  Deputy President Kgalema Motlanthe stated the following in the Presidency Budget Address (13 June 2013): "*South Africa is an energy-driven economy. As such alongside South Africa's objectives to ensure energy security is the need to pursue an appropriate energy mix that includes clean and renewable resources to meet the demands of our economy. More than at any point in our history, energy is assuming increasing importance as the lubricant of our country's development. At the same time, we continue to face pecusliar, fundamental development issues. Government sees energy as central in meeting basic human needs and improving living standards. To this end, South Africa's electricity generation has to be increased significantly in the next few decades to facilitate economic growth. Therefore the way to go for us in the long term is to become globally competitive in the use of innovative technology for the design, manufacture, and deployment of state of the art nuclear energy systems. Nuclear power is ideal in this sense, because we can build large nuclear power plants at points around our southern coastline, and potentially elsewhere in the future. Nuclear power plant construction is a major undertaking, which will bring significant economic benefits to local industry. South Africa has well-established regulatory health and safety standards critical to the management of nuclear systems and facilities. These measures include regulation on licensing, nuclear construction and fabrication, health and safety monitoring, and the training of the required skilled personnel. Nuclear safety assurance and South Africa's good record in this respect should be maintained and enhanced as a primary foundation upon which consensus on more nuclear electricity generation can emerge. Government has approved the establishment of the National Nuclear Energy Executive Co-ordination Committee to make high level recommendations concerned with the nuclear energy programme*".

Within the IRP 2010 planning process a mix of all feasible generation technologies has been balanced to optimise the achievement of the national objectives. The IRP sites the following as examples of the various objectives utilised within the modelling:

- Reduction of carbon emissions;
- New technology uncertainties such as costs, operability, lead time to build etc.;
- Water usage;
- Localisation and job creation;
- Southern African regional development and integration; and
- Security of supply.

These objectives automatically become the objectives of the nuclear new build programme. Again, however, the case for nuclear power needs to be supported by the revised IRP which is expected to be published in 2016. This chapter on need and desirability is based on the 2010 IRP. The demand in electricity has not increased as predicted in the IRP 2010. If the revised IRP dictates the requirement for nuclear power as part of the generation technology mix, then the need and desirability will be confirmed.