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Electricity Supply and Demand Management Options for Namibia. A Technical and Economic Evaluation.

Executive Summary - March 2008

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Executive Summary

The Namibian electricity industry stands at a cross roads. Internationally high oil and commodity prices have had a ripple effect on the price of gas and coal. Energy prices are escalating at alarming rates. Global warming and a growing awareness of the damage generated by fossil fuels is seeing increasing pressure on countries to turn to other ways of generating energy. Within Namibia there are growing misgivings about the Van Eck dry coal fired power station on the outskirts of Windhoek. And Eskom, the South African power utility that supplies half of Namibia's electricity, has not been able to keep pace with electricity demands in South Africa and is being forced to reduce power to parts of South Africa and neighbouring countries. Compounding this is the historic availability of cheap electricity from Eskom which has been an inhibiting factor to the construction of any new power stations in Namibia and to this day dominates the price expectations in Namibia.

At the same time Namibia has very limited options with using the traditional generation technologies of coal fired, hydro or nuclear power. Namibia does not have any coal reserves that have been proven to be exploitable and must import coal. It is simply cheaper to import electricity from South Africa than import South African coal. Namibia is a very dry country which limits hydro options. Nuclear is an option but is constrained by high capital costs and a relatively small skills base.

Yet there are opportunities. Namibia is one of the sunniest countries in the world. There are feasible wind resources at the coast. There is a major offshore gas field. In the north of the country there are thousands of hectares of alien vegetation that desperately need clearing and are an obvious fuel source. There is the Kunene River that holds promise for additional hydro power.

This report will show that decisions need to be made and these decisions need to be made quickly. The price for a lack of action today will be very high, already in the near future.

This study develops eight generation scenarios that aim at illustrating different applications and interpretations of the Namibian energy policy as defined in the 1998 White Paper on Energy Policy. This energy policy spells out a number of goals that should influence the decisions on how to procure electricity. The Energy White Paper identifies self-sufficiency, security of supply, inclusion of renewable energy source, sustainability and cost effectiveness and efficiency as potential policy objectives.

This study therefore aims to inform the policy interpretation and application process in Namibia by illustrating what the various policy drivers might mean in practice, both at a technical and financial level and in terms of the economy. To our knowledge this is the first comprehensive study for Namibia that considers alternative energy sources and fossil fuel and hydro electricity generation options. It also explores in detail the financial and economic implications of various possible supply mixes.

THE CHALLENGES:

Namibia produces power locally and imports about half its electricity, with the bulk of this being supplied by Eskom in South Africa and the balance by ZESCO in Zambia. NamPower also imports on a smaller scale from Zambia for supply to the Caprivi Region and exports on a small scale to Angola and Botswana. There are currently three power stations in Namibia which are owned and operated by NamPower, i.e. the Ruacana hydro-electric power station, Van Eck coal-fired power station, and the Paratus diesel power station.

The challenge faced by Namibia is that domestic generation is not adequate to meet current and future projected demand. To complicate this, supply constraints in South Africa are resulting in Eskom not being able to meet South African electricity needs let alone those of Namibia. For the past twenty years Eskom has had surplus generating capacity and has sold electricity at very low prices by world standards. However, slow and stagnant electricity supply industry (ESI) reforms and government intervention in South Africa have delayed Eskom capacity extension plans, resulting in the capacity shortages that are now prevalent.

Namibia has in the past had very favourable long-term contracts with Eskom, based on the excess capacity in South Africa. A new contract has been negotiated recently, but this no longer offers firm supply and prices are escalating rapidly due to the change from excess capacity to supply shortages in South Africa. The nominal cost of sourcing electricity as reported by NamPower has almost tripled in the last eight years.

Namibia therefore finds itself in a difficult position. Its security of supply is compromised and power shortages are likely during the coming years because of insufficient local generation capacity and constrained imports. This is an unprecedented occurrence in a country that has enjoyed a reliable and stable power supply in the past. Power outages were an uncommon and rare occurrence in recent Namibian history. At the same time electricity prices are rising dramatically due to a conglomeration of factors. This places strain on people and business as well as on the utilities struggling to fund the necessary investments and still provide quality service.

THE APPROACH

This study set out to address potential solutions to the pending electricity crisis and to explore the role that renewable resources could play in the solution. The results to the analysis were technical results, on the one hand, to ensure the supply of electricity is adequate to meet growing demand at a reasonable price. On the other hand the analysis also aimed at showing the economic, social and environmental implications of the technical analysis.

The approach that was adopted was to start with the technical analysis and use the results as an input into the economic analysis.

The **technical analysis** starts with a demand forecast about the likely increase in demand for electricity in Namibia. Second a range of generation options and demand management options were identified, assessed and costed. Finally, these inputs were processed through an electricity dispatch model.

Nine feasible generation options were identified and three demand side management options. The generation options are:

- Baynes Hydro-Electric Power Generation
- Coal-Fired Power Generation
- Natural Gas Power Generation
- Nuclear Power Generation
- Electricity Generation from Biomass
- Concentrating Solar Thermal Power Plants
- Solar Photovoltaic Power Plants
- Wind Energy Power Generation
- Integrated Solar Combined Cycle Plant

On the demand management side the options are:

- Compact Fluorescent Lamp roll out
- Ripple Control for water heating
- Solar Water Heater roll out

Following the determination of likely future demand and identification of potential generation and demand management options an electricity dispatch model was developed. The model takes a specified constellation of generators, demand side management options and load growth and solves the dispatch equation until supply and demand balance. If it cannot match demand with existing supply then there is a residual called unserved energy.

The dispatch of generators and the revenue requirement for transmission and distribution define the cost to be recovered through electricity sold and thus determine the end consumer costs. As distribution consumers are price sensitive higher prices result in reduced consumption, and a different dispatch pattern for the generators. The model is designed to iterate this sequence and solve for the lowest cost and least unserved energy.

Following this the generation and demand side management options were grouped into eight scenarios where each scenario attempts to depict a particular policy option. The scenarios are:

Scenario 1: Base Case. This scenario depicts a policy of using proven and conventional, large scale, centralised generation options. In this scenario only two power plants are built, namely a 350MW coal plant commissioned in 2011 and 360MW of additional hydro on the Kunene River in the form of Baynes in 2017. This is augmented by increasing imports from Eskom, based on the assumption that Eskom will be able to supply increasing capacity again starting from 2012. Van Eck power station is retired as soon as replacement capacity can be obtained from Eskom. This scenario does not implement demand side management or energy efficiency options.

Scenario 2: No New Local Generation. This scenario centred on the analysis of doing as little generation as possible within Namibia and relying primarily on electricity imports. It could also be seen as depicting a scenario where no investment decision is made even though there are possible options. This scenario produces severe amounts of unserved demand, meaning that wide spread load shedding cannot be avoided. This scenario also does not implement demand side management

Scenario 3: Price minimised. This scenario centred on providing the cheapest electricity possible while still avoiding extensive load shedding. A biomass power plant is built in 2009 and expanded in 2010. A small coal plant in 2011 and a small concentrating solar plant is built in 2010. This is necessitated in order to cover the time before Eskom capacity again becomes available. Baynes hydro opens in 2017 to harness additional the hydro potential of the Kunene River.

Scenario 4: Maximum Supply Diversity. This scenario centred on the analysis of diversifying the generation options as much as possible in order to minimise the risk exposure to any one particular energy carrier or plant technology. In this scenario a coal fired station opens in 2011; biomass production starts in 2009 and is scaled up over the next three years; concentration solar starts in 2009 and is doubled in 2013; wind power takes off in 2009; and CCGT from Kudu kicks in 2017. Solar PV is not build because of cheaper alternatives nor is nuclear because of the very long lead time. Van Eck is retired and Baynes is not built because it utilises the same river as Ruacana, posing correlated risk. Demand side management is included in this scenario.

Scenario 5: Generation Self Sufficiency. This scenario centres on generating as much electricity within Namibia as possible. Imported fuels are part of the mix as are the imported components of capital and operating expenditure on both the supply and demand side. This scenario calls for the construction of a small coal plant which, because of the short lead time opens in 2011; a gas power plant which opens in 2012 as well as the Baynes hydro plant that would come on line in 2017. These are augmented with smaller renewable plant, which offer short implementation times and contribute to long term supply stability and diversity. Demand side management is implemented.

Scenario 6: Energy Imports Minimised. This scenario is similar to scenario 5 but apart from just limiting electricity imports it aims at also minimising imports of fuel and coal. This generation mix consists of biomass starting in 2009 and scaling up over the next two years; concentrating solar and wind both coming on line in 2010 and Kudu gas coming on line in 2012. It would also be necessary to build a small coal station as base load support until the gas power station can be completed. Demand side management is included.

Scenario 7: Maximum Renewable Energy Options. This scenario centred on using as many renewable energy generation options as possible and seeks, as far as possible, to avoid fossil fuel generation. The resulting generation portfolio relies heavily on concentrating solar (with storage) as well as biomass and wind, while also building Baynes hydro and continuing reliance on imports from Eskom. This is one of the few scenarios where even a solar PV plant is built despite its high price. Van Eck is retired later than in the other scenarios. Demand side management is implemented.

Scenario 8: 'All options considered'. This scenario was compiled because it mixes a strong renewable focus with a strong concern for supply diversity to minimise risk exposure to energy carriers and technology types. It is intended as the main "counterpoint" to the base case scenario, and also seeks to bring in strong decentralised elements. This scenario relies on a small coal plant, biomass and Baynes hydro as the backbone for 24 hour electricity supply. This is complemented by an array of diverse renewable generators, each limited in size to ensure grid stability and cost effective grid integration as well as a balance between dispatchable (firm) and intermittent generators. This scenario implements demand side management. The scenario has excluded the building of nuclear or gas plants. Nuclear is excluded because of its environmental issues and long lead time. Gas is not built because of the current difficulties in getting the Kudu project going.

Two types of **economic analysis** were used. These are a cost benefit analysis and a macroeconomic analysis. Cost benefit analysis is a means of taking all the direct costs and all the direct benefits of a proposed project and comparing these. It is the conventional method that is used in project appraisal. The outcome of this analysis is the reporting of a net present value (NPV), a benefit cost ratio (BCR) and an internal rate of return (IRR). This analysis is done by adjusting for shadow prices and wages and removing the potential distortions caused by taxes and subsidies. A high BCR is usually a good indicator that it would be possible to raise finance to implement a project. In the case of a private sector investment the good BCR would be part of the business case to funders. If it is a public infrastructure project, a high BCR should give confidence that it is worth funding the project directly from its Treasury or, alternatively, to make suitable institutional arrangements for the involvement of the private sector in the project's funding.

The second type of analysis is macroeconomic analysis. This focuses on the overall contribution of the proposed project to the national economy. It reports on contribution to GDP, job creation, tax generation, etc. The size of a national or regional economy is measured in terms of the sum total of all economic activities taking place within the area concerned, both in the public and private sectors. For countries like Namibia, this necessarily includes measures of informal sector activity as well. The name given to the measure of the size of the economy is Gross Domestic Product (GDP). Sometimes this is referred to as Gross Value Added (GVA) which is a slight variation on GDP. The unit of measurement is the national currency.

While there are a number of different types of macro-economic effects, the two most important are contribution to GDP and the creation of jobs. The importance of job creation is obvious. Increases in GDP are synonymous with increases in peoples' economic standards of living. Increased GDP – i.e. increased production – is experienced in the form of more jobs, higher wages and reduced economic hardship.

ANALYTICAL RESULTS

The analytical results of this study are presented in nine parts:

1. Cost of the Generation Options

A calculation was made of the capital cost for each generation option as the cost per MW of generating capacity. These costs include the overall capital costs, which consist of the overnight capital cost, the interest during construction and the decommissioning costs. It was found that the generation option with the lowest capital cost is the combined cycle gas turbine, followed by wind, biomass and clean coal. The most expensive option is concentrating solar, followed by nuclear, Baynes and solar PV.

2. Cost benefit analysis:

All amounts are given in N$ million, 2007 prices				
Comparison Table	**NPV Total**	**PV Costs**	**PV Benefit**	**B:C Ratio**
Base Case Without EE	15,385.3	14,086	29,471	2.09
No New Local Generation	-13,325.1	13,362	37	0.00
Price Minimised	20,750.1	14,804	35,554	2.40
Maximum Supply Diversity	20,578.0	17,225	37,803	2.19
Generation Self-Sufficiency	18,800.0	18,183	36,983	2.03
Minimum Energy Imports	18,114.0	18,098	36,212	2.00
Renewables Maximised	20,463.3	15,859	36,322	2.29
All Options Considered With EE	23,168.8	13,697	36,866	2.69

Table 0.1: NPVs, incremental costs, incremental benefits and BCRs

The results of the economic cost benefit analysis are presented in Table 0.1. The cost benefit analysis is a comparative exercise which is why the 'no new local generation' scenario has a BCR of zero - the benefits of all the other scenarios are compared to this scenario. The scenario with the highest BCR is the 'all options considered' (2.69) followed by 'price minimised' (2.40), 'renewables maximised' (2.29), 'maximum supply diversity' (2.19) and the base case (2.09). The 'minimum energy imports' has the lowest BCR (2.00). It should be noted that from an economic perspective this scenario is still more desirable than the 'no new local generation' scenario because the BCR is greater than 1.

The following conclusions are drawn:

- The 'all options considered' scenario is the most desirable scenario from an economic efficiency perspective.
- This is followed by the 'price minimised' generation mix, the 'renewables maximised' scenario and the 'maximum supply diversity'.
- The least desirable scenarios are 'no new local generation' and 'minimum energy imports' in that order respectively.
- The 'all options considered' scenario remains the most desirable scenario even when testing sensitivity to the inclusion of energy efficiency; changes in economic growth rates; changes in Eskom prices; increased or decreased Eskom shortages, the value of unserved energy; and the value of carbon credits.

3. The key conclusions from an electricity price perspective are:

- The 'no new local generation' scenario has the lowest overall electricity price but the greatest price volatility and the highest risk of unserved energy.
- The 'maximum supply diversity' and 'maximum renewable' scenarios have the highest electricity prices but are less volatile than the 'no new local generation' scenarios.
- The 'all options considered' scenario results in a price level only about 5% higher than the 'price minimised' and base case scenarios.

- From a sensitivity perspective the 'all options considered' scenario has a significantly lower exposure to variations in resource costs than the base case; and has a lower sensitivity to South African import constraints than the base case.

4. As far as contribution to GDP is concerned:

- The 'renewables maximised' scenario, at NAD 14.0bn, makes the greatest contribution to GDP. This is the result of the high construction costs involved with constructing additional capacity at the Baynes hydroelectric power station (more than in any of the other scenarios), as well as requiring significant plant size from Concentrating Solar power stations.

- The next highest contribution is from the 'minimum energy imports' and the 'generation self sufficiency' scenario at NAD 13.1bn.

- The 'all options considered' scenario makes the fourth largest contribution to GDP at NAD 12bn.

- The 'no new local generation' scenario, at NAD 3.0bn makes the lowest contribution to GDP. The reason for this is the extremely low expenditure that would go into producing electricity in Namibia.

- The 'maximum supply diversity', at NAD 7.5bn has the second lowest contribution to GDP.

- Both the 'base case' and 'no new local generation' have high amounts of unserved energy which poses a significant cost to the economy.

5. From a social perspective:

Two issues are quantifiable – job creation and promotion of small, medium and micro enterprises (SMME).

For **jobs** the following conclusions are drawn:

- The number of unskilled jobs outweigh the number of skilled jobs for each generation scenario.

- The 'renewables maximised' scenario at 8 553, creates the most jobs. This is followed by the 'minimum energy imports', the 'generation self-sufficiency scenarios at 5 851 and the 'all options considered' scenario at 5 600.

- The main reason for the high job creation for these four scenarios is the implementation of the Biomass (Invader Bush) generation option. This is a labour intensive generation option, particularly at the unskilled level.

- The option with the least job creation potential is the 'no new local generation' scenario, followed by the base case scenario. The reason that these two scenarios create so few jobs is that they do not have the Biomass (Invader Bush) generation option in their mixes and they are also more heavily dependent on imports from Eskom and the Hwange power station in Zimbabwe.

The following conclusions are drawn on the degree of **SMME promotion**:

- The biomass (invader bush) generation option has the greatest potential to promote SMME development, followed by the Baynes hydroelectric scheme and then the Kudu gas field and the gas/solar hybrid generation options.
- Many of the generation options will not promote much SMME development.
- Scenarios 'generation self-sufficiency' and 'minimum energy imports' scenario score the highest as far as potential SMME development is concerned. This is largely due to the Kudu, Baynes and biomass (invader bush) generation options contribution.
- As would be expected the no new local generation scenario (mainly imports) scores the lowest, followed by the base case.

6. From a renewable energy perspective:

- At the moment nearly one half of all Namibia's electricity generation comes from renewable generators in the form of hydro power. In time the 'maximum renewable' scenario could contribute between 90% and 100% of all of Namibia's electricity needs. In contrast, and as could be expected, the 'no new local generation' scenario has the lowest renewable component.
- If one excludes hydro generation then the non hydro renewable part of the 'maximum renewable' scenario stands at 46% in 2014 to 2017 before dropping to 25% as Baynes comes into the generation mix.

7. As far as emissions are concerned:

- On average the 'maximum renewables' scenario has the lowest emissions, followed by the 'generation self-sufficiency' and 'minimum energy imports' scenarios.
- The 'all options considered' scenario has the fourth highest level of emissions but is not considerably larger than the lowest three.
- On average the 'no new local generation' scenario has the most emissions, followed by the 'base case' scenario.
- The 'maximum renewables' generation scenario continues to have the lowest levels of emissions.
- Considered over time the 'all options considered' scenario achieves the second best level of emissions in the latter part of the model horizon preceded by the "maximum renewables'" scenario.
- The 'no new local generation' scenario continues to have the highest level of emission even though these do take place in South Africa and not in Namibia.
- All scenarios that include the Baynes hydro display a sharp drop in direct emissions when that power plant comes on-line.

8. There are broader social and environmental issues that need to be taken into account:

- When comparing the 'Base Case' and the 'All Options Considered' scenarios, it is apparent that the Base Case relies more heavily on fossil fuels both within Namibia and outside its borders through Eskom imports. Although the Van Eck coal-fired power station is likely to retire after 2012, until that time the power station is likely to release high levels of air pollution into the atmosphere. Additional power could be available in South Africa after 2012 and available for import to Namibia. The lack of demand-side management and energy efficiency alternatives in the 'Base Case' scenario avoids the role that the public and private business alike should play in the effective use of electricity. Without such a programme in place the general public does not take ownership for their electricity use nor understand the relationship that the generation of electricity has in its impacts upon the environment.

- However, there are additional environmental aspects associated with the transmission of power that will need attention both in South Africa and Namibia. These include:

    - The transmission line losses and thus, ineffective use of natural resources from the generation source to the point of use,
    - The cost of operation and maintenance of land beneath the long-distance transmission lines,
    - The risks of fire under these lines, with the potential loss of power to Namibia, and
    - Wildlife and bird inter-actions of power lines and the loss of power or electricity supply interruptions to Namibia.

- Due to the mix and diversity of supply options proposed under the ‘all options considered’ scenario, the environmental and social impacts should be less than those of a larger, centralised power station. Under this scenario, the general public will take greater ownership of the electricity they use through the use of diverse renewable energy options and DSM. For Namibia, the location of the biomass will not necessarily be where the need for electricity is on the system. However, more localized, distributed power supply options could be considered to avoid the high carbon footprint and cost of transporting the biomass over great distances to a centralized power station. Also, smaller, localized systems could support communities in the area of the station by buying fuel and/or employing people from the surrounding areas. If planned properly, land for biomass-for-energy production in Namibia should not have to conflict or compete with land for food production for the country. However, this would have to be verified and is outside the scope of this study.

9. The final set of conclusions relates to a comparison of the base case to the ‘all options considered’ scenario.

- The ‘all options considered’ scenario has a cumulative contribution to GDP of NAD 12.05bn, compared to the NAD 8.98bn of the base case although the ‘all options considered’ scenario does reduce economic productivity because the electricity price is higher than that of the base case.

- At 5 600 average annual jobs the ‘all options considered’ scenario creates many more jobs than the base case at an annual average of 2 200. This is particularly the case for unskilled job because of the inclusion of the Biomass (Invader Bush) generation option in the 'all options considered' scenario.

- As far as the price of electricity is concerned the 'all options considered' scenario has a lower electricity price than the base case in the early years. However, from 2011/12 onwards the electricity price in the 'all options considered' scenario is more expensive than the base case.

- The 'all options considered' presents a lower risk profile due to less exposure to fuel price fluctuations, greater diversity in the generation profile and higher level of generation self-sufficiency compared to the base case.

- Due to the utilisation of smaller generation plant and concomitant shorter lead times the 'all options considered' scenario results in lower levels of unserved electricity than the 'base case', in particular in the short term.

THE POLICY IMPLICATIONS

This study set out with three objectives. The first was to determine the electricity outlook that Namibia faces. The second was to identify generation and demand management options within the context of the 1998 White Paper on Energy Policy. Here it was important to determine the technical feasibility and economic implications of the various options. The third was to explore the potential and role of renewable energy resources and energy efficiency measures in these generation mixes.

Namibia faces a pending electricity crisis. If Namibia continues to rely on imported electricity and does not invest in local generation capacity then unserved energy, power outages in other words, could be as high as 9.7% of total demand. Peaking in 2012/13 cumulative unserved demand could be as high as 10.8% of total demand. It has also been shown that, based on some specific assumptions that a 24 hour blackout for one day a month, the equivalent of a 3.29% drop in electricity supply, would reduce Gross Value Added by up to 3.7%. These calculations suggest that there could be some dramatic impacts on the Namibian economy because of the shortage of electricity.

The Energy White Paper of 1998 identifies a number of policy options including self-sufficiency, security of supply, inclusion of renewable energy source, sustainability and cost effectiveness and efficiency. Each of these has been explored separately in this study within the context of eight separate scenarios. What has been found is that there is no, one, single scenario that satisfies all of the policy criteria. Some of the options are economically efficient but do not maximise the use of renewable resources. Others are cheap but do not guarantee security of supply. Others, in turn, maximise the use of renewable resources but are expensive. The consequence is that there is trade off between the various options and the final decision needs to taken at the political level. What this report does is to inform on the consequences of the various policy decisions.

There is however one conclusion that is unequivocal. Demand side management measures should be introduced as a matter of urgency. They have been shown to be cost effective. They are desirable from an environmental perspective. Probably the most important short term advantage is they will help to alleviate the imminent power outages and in the long term reduce the need for generation capacity. The analysis indicates that the investment needed for demand side management breaks even at an unserved energy value between NAD2/kWh and NAD10/kWh. Both these values are substantially less than the "low" value attached to unserved energy in South Africa which has been assumed at R20/kWh in the 2004 NIRP.

There is a second conclusion that is almost as unequivocal although more muted. Generation from renewable resources is desirable. It is environmentally responsible, will create jobs, make an important contribution to the economy and ranks well from an economic efficiency perspective. However this option is not without risks and cannot be expected to supply all Namibia's electricity need, at least in the short term. The "all options considered" scenario demonstrates that, excluding hydro, it is possible to have renewable energy producing 20% of electricity needs without escalating end consumer prices more than 7% above the cost of importing electricity from South Africa. It also avoids the power outage problems having unserved energy of as little as 0.4% of total demand.

From an economic perspective the least desirable option is relying on imports from South Africa. While this option has the lowest average price it also has the highest amount of unserved energy and therefore the worst benefit cost ratio. Probably the most important observation that can be made is that such an option would continue to leave Namibia at the mercy of South African politics and policy with a similar risk exposure currently experienced in the capacity shortages in the South African electricity sector.

One policy option is that of security of supply. What has been found in this study is that it has a higher cost, because it means more diversified supply sources. It also means making use of both the cheapest supply sources as well as small amounts of alternate sources that have little or no correlated risks with the mainstream supply sources. This option has one of the worst impacts on the current account, has the second lowest benefit cost ratio and one of the highest electricity prices, indicating that security of supply as dominant policy driver

What this study has shown, and where the research moved to as the results became evident, is that a balanced approach to electricity generation and demand side management is probably the most desirable option. In this study this became known as the 'all options considered' scenario. This generation mix relies on a small coal plant, biomass and Baynes hydro as the backbone of base-load electricity supply. This is complemented by an array of diverse renewable generators, each limited in size to ensure grid stability and cost effective grid integration as well as a balance between dispatchable (firm) and intermittent generators. This scenario also implements demand side management. This option is the most efficient and desirable from an economic perspective. It makes a contribution to the economy which is little different to the top contributing scenarios. It creates a handsome number of jobs although not as many as the 'renewables maximised' scenario. It has the least power outages, low environmental emissions and average electricity price that it not that far out of line with the cheapest options. It presents a lower risk exposure to unserved demand through a higher level of generation diversification, less reliance on fossil fuels and more self-sufficiency.

Expanding the generation capacity by including small scale renewable options allows Namibia to grow generation modularly with demand growth thus reducing the size of the projects and associated risks as well as the need to sell excess capacity in the region.

Namibia stands at a cross roads and the price of not taking action could be very high indeed. We trust that the work that has been done in this study will assist policy makers in making informed decisions that will benefit all Namibians.

Is has become clear that an integrated resource plan for electricity in Namibia is needed. This needs to be developed under the leadership of the policy maker with full participation of all major stakeholders to ensure that the end result is a balanced plan drawing on the wisdom of diverse specialists and viewpoints.