Namibia's Electricity Supply

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1.1 Introduction

Namibia's economy depends on the reliable, accessible and affordable supply of electricity. Most domestic and industrial consumers take an uninterrupted supply of electricity for granted. But, how does electricity get into our businesses and homes, and what makes it so ubiquitous that users seldom even have to think about it?

To be able to use electricity, one has to generate it. Presently, Namibia has three electricity-generating power stations. The most important is Ruacana, which is a hydroelectric power station on the Kunene River with a capacity of 249 MW. Ruacana is a run-of-river station, meaning that its ability to generate electricity remains dependent on continuous water flows from Angola. In the absence of sufficient flows it cannot generate and feed electrical energy into the national electricity grid. The coal-fired van Eck power station just north of Windhoek has a capacity of 120 MW. It was commissioned in 1972, and today is expensive to operate; this implies that it is only started to bridge short-term supply gaps. The Paratus power station in Walvis Bay uses heavy fuel oil, and has a capacity of 24 MW. Similar to the van Eck power station, Paratus is mainly used to match short-term demand peaks.

Presently, the total installed electrical generation capacity and therefore the maximum that all Namibian power stations could supply if run simultaneously, is mostly insufficient to match Namibia's demand for electrical energy. For example, in 2008, the maximum demand was 533 MW, which is substantially more than the maximum internal electricity generation capacity of 393 MW that Namibia has at its disposal. To make ends meet, Namibia imports electrical energy, generated mainly in South Africa and Zimbabwe, using NamPower's extensive transmission networks. Assuming that our neighbours have sufficient capacity, these electrical interconnecting power lines to across-border suppliers had a maximum capacity of 600 MW in 2008.

Measuring electricity

A common unit to measure and quantify the energy produced or used is kilowatt-hours - kWh. Typically, a medium-income Namibian household uses between 5 and 15 kWh of electrical energy per day.

To express many thousands of kWh, one often uses a different unit, namely megawatt-hours - MWh. One MWh is equal to one thousand kWh.

Yet another unit is used if millions of MWh are used or produced, namely terawatt-hours - TWh. One TWh is equal to one million MWh. Namibia consumed some 3.6 TWh of electrical energy in 2007.

In analogy to the above, electrical capacity, i.e. the ability to generate electricity, is expressed in terms of kW, MW or TW.

Namibia has a total installed electrical generation capacity of 393 MW, while its peak demand in 2008 amounted to 533 MW.

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Presently, the so-called Caprivi link is built at a cost of N$ 3.2 billion, and will extend the Namibian transmission system using a high voltage direct current line. This new transmission line will link the Namibian system with Zambia and Zimbabwe, and will have an additional capacity of 600 MW. The line will enable NamPower to more readily trade electricity between Zambia, Zimbabwe and other neighbouring countries, and make Namibia less dependent on imports coming from and wheeled through South Africa. Also, as a risk mitigation measure, the new transmission line will reduce Namibia's exposure and dependence on the South African transmission grid and its current constraints.

In 2007, Namibia's total annual electricity consumption amounted to 3.6 TWh, which includes transmission line losses, and is equal to an average consumption of some 1,800 kWh per person for the year. In the same year, NamPower's Ruacana hydroelectric power station supplied more than 92%, or 1.56 TWh, of Namibia's locally-generated electrical energy in that year. These numbers illustrate that the country remains import-dependent to cover more than one-half of its annual electricity requirements.

The following sections explore how Namibia's policy environment supports developments in the electricity supply sector, and investigates possible development scenarios and their implications. This chapter considers both non-renewable and renewable electricity supply options, even though renewable energies are also discussed elsewhere in this paper.

1.2 Policies of Relevance to Namibia's Electricity Supply Industry

1.2.1 Vision 2030 (2004)

Namibia's Vision 2030 envisages the transformation of Namibia into an industrialised nation with a viable natural resources-based export sector, and increased size of skills-based industrial and service sectors, and market oriented production [Vision 2030, 2004]. Rapid industrialisation will place significant pressure on the Namibian electricity supply industry, and challenges its growth and ability to deliver electrical energy on demand.

The opportunity to strategically incorporate the development of the nation's energy sector in general, and its electricity sector in particular – as key economic drivers of cross-sectoral significance and importance – was missed in the preparation of Vision 2030. Yet, adequately powering the nation comes with many challenges, economic trade-offs and long-term commitments, all of which need to be taken into account if the Vision is to have a realistic chance of being accomplished.

1.2.2 White Paper on Energy Policy (1998)

Namibia's White Paper on Energy Policy of 1998 states the following broad energy policy goals: effective governance, security of supply, social upliftment, investment and growth, economic competitiveness and efficiency, and sustainability [Energy, 1998]. The Policy also recognises the importance of renewable energies, and their potential role in realising the country's energy-related goals and aspirations.

The White Paper identifies the sector's challenges – which remain as relevant today as they were more than 10 years ago – namely: high dependence on imports, a large number of supply authorities with widely differing competence and practices, a host of technical, financial and institutional problems relating to rural electricity supply, electricity prices that in many instances are not cost-reflective, and unclear institutional structures and arrangements.

1.2.3 National Development Plan III (2008)

The National Development Plan 3 – NDP III of 2008 – recognises that the "energy sub-sector plays a pivotal role in the country's economy and national development" [NDP III, 2008]. It states that "although electricity supply has improved since 2001, the vast majority of Namibian households still have no access to electricity, particularly in the Northern Regions. Fuel wood is still dominant as an energy source putting severe pressure on the natural environment. This situation requires enormous efforts to realise Vision 2030."

NDP III further states that the sub-sectors' goal is "adequate, secure and efficient supply of energy that is environment friendly and leads to a reduction in the country's reliance on energy imports." Specific energy-sector strategies put forward are:

- establish a strong body to regulate and monitor the whole energy sub-sector
- establish a commercial electricity trading centre
- enforce regionally harmonised tariffs for cost recovery that are socially acceptable
- increase local energy generation with conventional and renewable technologies
- improve the regional transmission network
- implement the Rural Electricity Distribution Master Plan and provide remote areas with off-grid renewable energy
- extend the urban electricity network and promote renewable energy in urban areas
- promote the efficient use of energy by introducing special technologies (such as compact fluorescent lights), programmes (such as demand side management) and public awareness campaigns, and
- increase local capacities, in particular on economic aspects of the energy sub-sector, on energy efficiency and renewable energy.

1.2.4 Electricity Act (2007)

In September 2007, the Namibian President signed the Electricity Act, 2007 [Electricity, 2007]. The Act establishes the Electricity Control Board (ECB) as the country's electricity sector regulator, and formulates guidelines for electricity sector governance[2] [ECB, 2009]. The ECB is responsible to control and regulate the provision, use and consumption of electricity in Namibia, to oversee the efficient functioning and development of the industry, and security of electricity provision, to ensure that a competitive environment in the electricity industry is maintained, and to promote private sector investment in the electricity

[2] The previous Electricity Act, i.e. Act No. 2 of 2000, was repealed by the promulgation of the new Act.

industry. The Act describes the requirements, conditions and obligations for obtaining licences to generate, trade in, transmit, distribute, import and export electricity. Amongst others, the ECB has developed guidelines to set cost-reflective tariffs, and implement an Independent Power Producer regime in Namibia, both of which are of importance in the discussions below.

1.2.5 Cabinet Directive (2007)

A Cabinet directive in June 2007 approved the implementation of the Off-grid Energisation Master Plan, and also directed that the hot water supply to all Government and parastatal buildings is to be met by solar water heaters only [MME, 2008]. As a demand side management measure, and potential stimulant of the solar water manufacturing industry in the country, the latter directive is significant.

The following section introduces Namibia's electricity supply industry, and reflects on the issues and challenges that the above-mentioned policies and directives have for the sector.

1.3 Namibia's Electricity Supply Industry

Namibia's Ministry of Mines and Energy (MME) is the custodian of the country's energy sector. The Electricity Supply Industry (ESI) is regulated by the Electricity Control Board [ECB, 2009]. The ESI's main role players are the MME, ECB, NamPower, the Regional Electricity Distributors (REDs), and a handful of municipalities and mines. The ECB sets the required licence conditions, and defines, oversees and manages the processes for the application and issuance of such licences. Amongst others, it assesses and makes recommendations to the Minister of Mines and Energy regarding the issue, transfer, amendment, renewal and cancellation of licences, and the approval of conditions on which electricity is provided by a licensee [Electricity, 2007].

In some cases in the past, the Minister of Mines and Energy has overturned the ECB's recommendations, for example when granting longer licence terms than those recommended by the ECB to Regional Electricity Distributors (REDs). Such non-automatic approval processes are indicative of the existing dialogue between the Ministry of Mines and Energy and ECB, and illustrate the important and to-be-expected tensions that occasionally exist between the regulator on the one hand, and the political establishment on the other.

NamPower, as the country's only electricity utility, encompasses three main ring-fenced businesses, namely generation, trading and transmission [NamPower, 2009]. NamPower also fulfils the role of system operator and trader, which includes the important function of balancing the supply of electricity to the prevailing demand. In addition, it is the contracting party for imports, primarily from Eskom in South Africa, the Zimbabwean power utility ZESA for supplies from the coal-fired Hwange power station, and from ZESCO in Zambia for supplies to the Caprivi region. As such, NamPower has to balance the availability of its own generation capacities with imports, which has important implications for the long-term cost-

effective supply of electricity to Namibia. To undertake cross-border transactions, NamPower holds licences for the import and export of electricity, which can be divided into those at trading level (for example the transactions with Eskom), and those at transmission supply level such as supplies to Angola and Botswana, and the supply from Zambia.

NamPower's transmission section is divided into two businesses, i.e. the wires and the supply business. The wires business is responsible for the transmission network. The supply business looks after transmission customers including some large mines, the REDs, Windhoek Municipality, and some supply points that remain connected to the transmission grid for historic reasons.

The Regional Electricity Distributors – REDs – are responsible for the distribution and supply of electricity to consumers within their respective areas. In June 2009, three REDs are established and fully operational. NORED was established in 2002, and serves the country's north-central regions. Both CENORED and Erongo RED were established in 2005, and serve the north-central and the Erongo region respectively. Two additional REDs, i.e. one for the central and one for the southern regions, may be established in future. Presently however, local and regional authorities, and NamPower, remain the licensed distributors in the areas not covered by REDs. There is considerable debate about the establishment of the central and southern REDs. Even in existing REDs the ECB's authority is challenged by some municipalities, local authorities, unions and members of the public. It appears that a political rather than a regulatory decision remains outstanding to ultimately resolve the matter.

1.4 Developments in the Electricity Supply Industry

This section reviews the recent and most important electricity supply sector developments, and assesses whether the goals as stated in the White Paper on Energy Policy have been achieved.

The NDP III identifies the following achievements for the second national development plan period; quoting verbatim [NDP III, 2008, p 137]:

a. off-grid electrification using renewable energy sources, with mixed results
b. promotion of renewable energy and energy efficiency in some parts of the country
c. rural electrification programme under the Rural Electricity Distribution Master Plan for Namibia (2000) that specifies the off-grid and grid electrification of rural localities in each region until 2040
d. technical assistance and training programmes to put in place the enabling laws and institutions and strengthen staff capacities, and
e. promotion of energy conservation and the culture of regular payment of electricity charges.

NDP III further states that the following challenges were encountered during the NDP II implementation period [NDP III, 2008, p 137]:

a. the reluctance of Regional Electricity Distributors (REDs) to take over the electricity billing and collection functions from the municipalities
b. the need for the tariff structure to take into account the full costs of electricity generation and distribution including depreciation and other unforeseen costs, and
c. difficulties in adapting available renewable energy technologies to fit the situation in Namibia including the lack of expertise in Namibia to design systems suitable for local conditions and their economic viability.

In terms of ESI developments, the MME's Annual Report 2007/8 observes that a total of 600 solar systems were funded within the two-year period 2006 and 2007 [MME, 2008]. The Solar Revolving Fund, that allows mainly rural inhabitants to acquire solar technologies, is said to hold a commitment of 800 backlog applications that are awaiting funding. The Report further states that renewable energy was promoted using renewable energy technologies demonstration units at regional level for all 13 regions. In particular, wooden stoves were promoted in the Hardap, Khomas and Omaheke regions. In regard to rural electrification, and in view of Government's efforts to achieve 25% access to electricity in rural areas by the year 2012, 550 villages have so far been connected to the national electricity grid, at a total cost of more than N$350 million. In 2007 alone, 43 additional villages in Omaheke, Omusati and Oshikoto were connected. The MME and NamPower, as part of the national demand side management strategy, distributed more than 600,000 compact fluorescent lights countrywide, which when fully completed is expected to reduce the country's peak demand by up to 20 MW.

When the more recent developments within the electricity supply sector are viewed through the lens of the sector objectives as stated in the White Paper on Energy Policy (1998), the following observations are made[3]:

Energy sector objectives	Features, developments and achievements
effective governance	• the ECB is firmly established, and regulates the electricity sector's licensing and tariffs • an Independent Power Producer framework is in place, but by June 2009, no IPP has established itself in Namibia • the establishment of both the central and southern REDs remain unaccomplished, and the ECB's authority in this regard is challenged by various local authorities and municipalities • NamPower remains the country's only supplier of electricity, and controls sector-wide developments through its trading and single-buyer functions
security of supply	• new supply arrangements with Zimbabwe are in place and operational – however as long as the direct connection remains incomplete all loads are wheeled through South Africa which perpetuates Namibia's dependence on a functioning South African transmission system • the country's transmission network is strengthened through the high voltage direct current (HVDC) connection to Zambia, which will reduce Namibia's reliance on South African networks

[3] Status: June 2009

	• new supply agreements have been entered into with Eskom – these have diminished the advantages that Namibia had under previous arrangements
social upliftment	• rural electrification targets are well-defined, but access to sufficient funding, systematic implementation, socio-demographic changes and developments, changing social upliftment priorities and unplanned electrification activities remain the most important challenges • a Solar Revolving Fund is in place and operational, but has a considerable backlog of applications due to financial constraints • larger-scale off-grid electrification remains largely unaccomplished • the viability of business models – underpinning the implementation of the off-grid energisation plan and rural energy shops – remains uncertain
investment and growth	• to date, investments in the electricity supply sector remain limited to those undertaken by NamPower • the HVDC connection to Zambia, at N$ 3.2 billion, represents a most significant electricity sector investment • investments in new generating capacity in Namibia remain limited to the addition of a 4th turbine at Ruacana • generation licence applications for wind parks at Lüderitz and Walvis Bay have been received by the ECB. If built, these wind parks would represent the first larger-scale investment in the country's electricity supply sector by an entity other than NamPower. • the potential for the establishment of IPPs exists • sector growth is driven by supply uncertainties and strong demand growth, especially from the mining sector and particularly those in Erongo region • despite the prevailing constraints in the southern African power sector, few new sector entrants have established themselves – this is in part due to low regional electricity tariffs and the wider investment climate in the region
economic competitiveness and efficiency	• electricity tariffs are to be cost-reflective by 2011/12 • Namibia's energy intensity is and will remain high • the considerable dependence on the constrained South African electricity supplies limits the local supply sector's independence
sustainability	• sector investments targeting transmission infrastructure are high • regional dependence, especially on supply capacity, remains high • commercial considerations and different partnership expectations continue to complicate the exploitation of the Kudu gas field • no larger-scale investments in the development of local sustainable energy sources have been made to date, although considerable potentials exist • an envisaged coal-fired power station at Walvis Bay may undermine Namibia's short- to medium-term prospects of attracting sizeable renewable energy sector investments, despite its significant resource base

The above considerations raise the following pertinent issues and questions:

1.4.1 National generation targets

Presently, national electricity supply and generation targets do not exist. Clearly articulated mandatory targets would send an unambiguous signal to investors, and would also increase the urgency by which projects of national importance, such as the development of Baynes and Kudu, would be handled. ESI stakeholders should would capitalise and be guided by such

targets, firstly to diversify their supply arrangements, and also, as a percentage of their supplies, utilise Namibia's rich endowment of renewable energy sources.

Defining national supply targets that mandate the use of indigenous resources as well as carbon neutral technologies is both essential and long overdue. The Ministry of Mines and Energy, as the custodian of the country's energy sector, is responsible for initiating the required steps to identify and – in collaboration with the ESI – set and incentivise national supply targets.

1.4.2 Electricity tariffs

In May 2009, Cabinet confirmed that NamPower will have to introduce cost-reflective tariffs by 2011/12. This additional one-year grace period was granted to allow the utility to more gradually ramp up its supply prices. A more gradual increase of electricity prices shields consumer pockets. However, electricity sector investments hinge on attractive tariffs, and tariffs are a central pivot determining the viability of any energy business. Presently, in comparison with many other developing nations, Namibia's electricity tariffs are still low, and therefore fail to attract investors. They also do not discourage the non-productive use of electrical energy.

It is concerning that Namibian electricity tariffs do not differentiate whether the electrical energy is derived from renewable or fossil fuels. Feed-in tariffs that incentivise the generation and feed-in of electricity generated from renewable energy technologies are non-existent. Now that South Africa has put such tariffs in place, few investors will be tempted to pour their monies into the Namibian electricity sector which does not offer the financial rewards and other advantages found elsewhere.

Value adding to Namibia's rich renewable energy endowment will not just happen automatically. The non-level playing field between conventional electricity and that generated from renewable energy technologies is rooted in history. But there is a way out of this situation: creating tariff structures that actively incentivise the investment and use of renewable energy technologies will foster the much-needed development of Namibia's rich diversity of indigenous renewable energy endowments [von Oertzen, 2009].

1.4.3 Taxes and tax incentives for continued ESI development

Tax breaks and tax incentives specifically promoting investments in Namibia's electricity supply sector do not exist. NamPower continues to be the generation monopoly provider, and enjoys access to government subsidies. Targeted tax breaks for new entrants are essential if Namibia is to attract new investments to the sector.

The lack of tax incentives available to the renewable energy sector is particularly concerning: such tax mechanisms could promote the higher uptake and greater penetration of renewable energy technologies in Namibia. For example, exempting imports of renewable

energy technologies from value added tax, introducing tax breaks for renewable energy enterprises, creating tax incentives such as tax-free establishment periods for new energy sector entrepreneurs, introducing carbon taxes, and creating special-purpose supply sector incentives similar to those in free-trade zones are options to enhance the sector's attractiveness for investors.

1.4.4 Rural electrification

Since Independence, Namibia has made substantial progress in bringing electricity to the furthest corner of the land. In 2009, most of the lower hanging fruit in rural electrification have been picked, yet more than 200,000 households remain without access to modern energy services [Hamutwe, 2007]. The Ministry of Mines and Energy estimates that only some 17% of Namibia's rural population have access to electricity [MME, 2008]. Economic considerations prohibit the country's complete electrification using conventional grid electricity. Here, off-grid technologies powered by renewable energies are suitable to provide decentralised energy services to people in areas far away from the existing national grid [von Oertzen, 2007]. However, such technologies require a well-resourced and planned implementation.

To date, investments in off-grid energisation[4] in Namibia have been minor, and few real and sustainable successes can be shown. The playing field between grid and off-grid technologies remains far from level [Hamutwe, 2007]. The demand for off-grid technologies in rural Namibia remains underdeveloped, despite a number of novel attempts and support mechanisms to introduce affordable financing and bring such technologies closer to consumers [REEECAP, 2008a]. Service reliability, the long-term provision of cost-effective maintenance, and the collection of fees remain major challenges in rural Namibia. High unemployment does not help either, and limits the abilities of households to secure and service loans.

Realism in terms of which rural electrification targets are achievable, and how rural energisation can be incentivised, is needed. A continued commitment by Government to systematically bring affordable energy services to rural Namibia is necessary, thereby also introducing new and decentralised livelihood, learning and business opportunities. The Off-grid Energisation Master Plan is in place, but its implementation remains a challenge.

1.4.5 Developing Namibia's comparative advantages

The abundance of Namibia's renewable energy resources, specifically those with a proven resource base including biomass, solar and wind, but also the as yet un-quantified but seemingly plentiful indigenous resources such as geothermal, wave and tidal energies

[4] Energisation refers to the provision of a range of suitable energy sources and services to meet a consumer's electrical and thermal energy needs, as well as those for liquid fuels.

constitute a national comparative advantage that can and should be exploited more aggressively [von Oertzen, 2009].

It is well-known that start-up and fledgling markets and industries are vulnerable and prone to failure. The renewable energy market in Namibia is a case in point. If Namibia's comparative advantages vis-à-vis its renewable energy potentials are to be developed more deliberately, investment and market conditions have to be made more attractive. As mentioned above, if Namibia does not at least equal the in-feed tariffs as recently introduced in South Africa, few investors will find it worth their while to invest in such technologies locally. And although Namibia's tax regime is not biased against renewable energy technologies, there are also no special tax breaks to specifically promote renewable energies in Namibia. In the absence of such incentives, and in view of the other barriers stacked against renewable energy technologies, such as high upfront costs and lacking awareness, few investors will manage to establish themselves successfully in the country's electricity supply sector.

1.4.6 Broadening the ESI's active stakeholder base

Namibia's ESI is small, and new entrants remain absent. While the transformation of an entire industry requires time, one recognises from similar experiences internationally that new supply sector entrants would invigorate old structures, and infuse a much-needed sense of urgency and competition. The reasons for an absence of new players lies, amongst others, in the issues identified above: low electricity tariffs, the lack of targeted incentives, a monopoly electricity trader, considerable leverage by NamPower as the country's generation and transmission monopoly provider, low population densities particularly in rural areas and even in most urban centres, high financial barriers, and an as yet untested IPP framework all contribute to delay the entry of new players into the sector.

International experience shows that renewable energy industries promote local job creation, lead to enhanced local value addition, and the increased use of local resources. At the same time, because of their non-polluting nature, most renewable energy sources have a limited impact on the environment [IPCC]. Investments in low- or no-carbon energy technologies are one important step in stabilising the Earth's climate, and reduce the potentially negative implications of continued global warming. It is here where Namibia's many blessings can be further developed: increasingly there are international financial instruments becoming available that promote the development of local energy sources while benefiting from carbon revenues. Namibia's electricity supply sector is well-advised to make use of such new funding opportunities while strengthening the country's security of supply. Again, however, such new endeavours will not happen overnight, and require national commitment, supportive policy and institutional framework conditions, and a pragmatic investor-friendly context that welcomes new sector entrants, even if they are seen to compete with long-established monopoly suppliers.

1.4.7 Sustainability

Namibia's continued economic development relies on a vibrant electricity supply sector that provides reliable, affordable and accessible electrical energy. The continued reliance on fossil fuels damages the environment and leads to climate change and its many undesirable effects – this is by now a well-established fact [IPCC]. Regionally, Namibia finds itself in a situation where the projected supply arrangements no longer meet the required demand. This necessitates local electricity supply sector investments that do not only address short-term supply constraints, but will also ensure that investments take regional developments and its own sustainability into account.

To this end, the development of renewable energy technologies is of particular importance. Not only are fossil fuels finite and will eventually become too expensive to be considered the backbone of a developing nation, but our national abundance of renewable energy potentials demand that we develop these national riches more deliberately. The increased use of renewable energy technologies is an important step to limit the economic implications of climate change, while at the same time allowing Namibia to become more energy autonomous and benefit from the multitude of added value that the use and beneficiation of local resources holds.

1.5 The Regional Context

This section briefly describes the regional electricity sector developments, and reflects how these will impact on Namibia's future electricity supply. Of particular importance is Namibia's trade and interactions with the Southern African Power Pool.

Presently, Namibia's only electricity generating utility, NamPower, also has the function of a single buyer and transmission trading agent. This implies that all imports and exports, and all wheeling arrangements that utilise the Namibian transmission grid are managed and controlled by NamPower. As the sole electricity trader, NamPower effectively purchases electric power from its own plants, i.e. Ruacana, van Eck and Paratus, and on-sells power to transmission customers, such as the mines, the REDs, and a number of municipalities and water pumping schemes. In addition, there are cross-border supply arrangements where NamPower supplies power at distribution or sub-transmission level to Angola, Botswana and South Africa. NamPower has supply agreements with Eskom – largely modelled on Southern African Power Pool principles – that govern the amount, tariffs and general supply arrangements with South Africa. A new contract with Eskom has just recently been negotiated, but it no longer offers firm supply, and prices are escalating rapidly due to supply shortages experienced in South Africa. NamPower also holds power supply agreements with all its transmission and distribution customers.

The restructuring of regional electricity markets is in progress. In South Africa, which is the most dominant and important regional electricity sector player, efforts have been made to separate Eskom's generation and transmission businesses, and establish regional electricity

distributors. Most southern African countries have begun to establish electricity sector regulators. In South Africa, Zambia and Namibia, the regulators are by now well-established, while Zimbabwe in the establishment process. Botswana and Angola do not yet have electricity regulators.

The Southern African Power Pool – SAPP – was created through an intergovernmental Memorandum of Understanding in August 1995, with the primary aim to provide reliable and economical electricity to SAPP members [SAPP, 2009]. As cooperation in the electricity sector has taken place for a long time, several regional utilities came together under the auspices of Southern African Development Community (SADC) to form the SAPP, and create a common market for electricity in the SADC region. Utilities participating in SAPP have equal rights and obligations, and have agreed to act in solidarity without taking advantage of one another. Members have undertaken to share information and knowledge, and, amongst others, accept wheeling on behalf of other members when this is technically feasible [SAPP, 2008].

The SAPP, and by implication the southern African region, has not seen many investments in the power sector during the last twenty years. This is surprising as power shortfalls have been predicted for a long time. Very few projects addressing the impending electricity shortfall were approved by SAPP member states, while the implementation of approved projects has been slow [SAPP, 2008]. In April 2008, the installed capacity in the region stood at 55,032 MW, while the available capacity was 47,067 MW. A total of some 1,700 MW of new capacity was commissioned in Angola, South Africa and Swaziland in 2007, against a target of 1,925 MW. In 2008, SAPP planned to commission 1,757 MW, against a planned target of 2,014 MW. It is expected that power deficits will persist in the region until at least 2012. For example, the Democratic Republic of Congo's Inga 3 project – which forms part of the Western Corridor (Westcor) power project – is expected to have an output of 3,500 MW, while the complete Westcor project is envisaged to add some 10,000 MW, which could potentially displace the region’s reliance on Eskom’s coal-fired base-load capacity. Longer-term projects to be implemented in the region until 2025 are expected to provide additional power, and capacity additions of up to 44,000 MW costing in excess of US$ 41 billion are mentioned.

The SAPP region offers significant resource potentials for future electricity generation. However, most such projects have experienced longer-than-expected delays, which continues to cause uncertainty, and also delays other investments. The sheer scale of some of the more adventurous electricity supply schemes discussed in the region is perplexing. Effective regional integration of the supply markets is desirable, but requires trust, commitment and political stability. The SAPP will require more time to address the region’s long-term power sector developments, while allowing its member states to cooperate on regional investment decisions without undermining their national development ambitions.

1.6 Independent Power Producers in Namibia

The White Paper on Energy Policy (1998) is clear about the need to create a conducive investment climate in Namibia's energy sector. As discussed in section 2.4 above, structural and institutional impediments remain in the electricity supply sector, and render Namibia's short-term investment environment less investor friendly than the ones found in some of our neighbouring countries. Also, in an energy-hungry world, prospective investors may well find that Namibian power projects lack the broad incentives found elsewhere.

On a more positive note however, the ECB's progressive pricing model which foresees the introduction of cost-reflective tariffs in the coming years is bound to lead to greater interest by potential Independent Power Producers (IPP). Also, the ECB's guidelines for IPPs have resulted in a number of prospective IPP's submitting applications for licences [ECB, 2009].

As yet, Namibia's IPP framework remains untested. Although the market is open for IPPs, and guidance for new entrants is available, a number of unresolved issues and barriers remain, and continue to delay the establishment of IPPs in the country. Of particular concern is the independence of the single buyer, and NamPower's entrenched position as a monopoly provider. For future IPPs, these two considerations alone imply that power purchase agreements, access and use of NamPower's transmission system, and trading of electricity all take place under NamPower's direct control. These realities continue to strengthen NamPower's bargaining position and sector-wide leverage, and can complicate or even delay the establishment of an IPP.

NamPower's role in relation to a prospective IPP may take different forms: as a buyer of electricity, as a potential IPP joint-venture partner, as a wheeling agent, as a direct competitor within the sector, or as an objector to an IPPs entry into the local supply market. One can only speculate, but it is likely that NamPower will – in negotiations with prospective IPP operators – always ensure that its own generating plants are optimally utilised. Only once their own capacity is no longer sufficient will additional entrants and their respective supply capacities be favourably considered. Such vested interests are unbecoming for a liberalised electricity market, and are most likely going to impede or delay the entry of new supply sector players.

Smaller IPPs may be able to enter into power purchase agreements with the REDs, provided that NamPower's transmission infrastructure is not used in the process. From this perspective, it may seem more likely that smaller-scale IPPs will be the supply market's new entrants. However, given the fact that IPPs will most likely establish themselves where the resources and connecting infrastructure is most favourable, few such opportunities exist where new IPPs can commence with their business activities without having to deal with NamPower. And it remains to be seen if the hoped-for neutrality of the single buyer can be guaranteed if a prospective IPP offers supply profiles that are in competition with those offered by NamPower.

The strategic nature of a reliable and sustainable electricity supply industry demands that the key role players, i.e. the MME, ECB and NamPower, collaborate without undermining

their own roles and mandates in the sector. To enhance transparency, the distinct roles of the ECB and NamPower should be codified. This holds particularly true for the different responsibilities that the ECB and NamPower have in respect to rendering assistance to prospective IPP operators, and negotiating power purchase agreements with them. Also, the independence of the single buyer function vis-à-vis NamPower's responsibility to ensure the availability and reliability of supplies, sector-wide cost-effectiveness, and the creation of growth opportunities, needs further clarification.

Crafting the vision for a flourishing sector, creating the associated enabling environment, and setting actionable goals and targets is the responsibility of the Ministry of Mines and Energy. In addition, a more goal-oriented collaboration between the ECB and NamPower is needed to foster a shared sense of responsibility for the sector, and its developments. The proof that Namibia's IPP framework is indeed workable and sufficient to attract newcomers still waits to be made. Creating a common understanding and formalisation of institutional processes, for example to enable middle-management of both institutions to more effectively collaborate on day-to-day issues, would have most beneficial effects on the sector in its entirety. Not addressing these issues will perpetuate the uncertainties that prospective investors face, and stifle the ambitions of new sector entrants. As stated in the Introduction to this chapter, Namibia's economy depends on the reliable, accessible and affordable supply of electricity. What the country's electricity sector needs is bold vision, and decisive action – and all stakeholders have an important contribution to make to see this happening. The next section describes how such action could look like.

1.7 Namibia's Future Electricity Supply Mix

How could Namibia's future electricity supply mix meet the various policy goals, while effectively addressing the various constraints and considerations discussed above? Namibia's domestic electricity generation capacity is inadequate to meet its current needs. The country's envisaged socio-economic development pathway and especially the ambitious targets laid down by Vision 2030 demand that considerable electricity supply sector investments have to be made in the very near future. This necessity is accentuated when viewed against the backdrop of the regional supply constraints that exist since 2007. This section will therefore ask how investments in Namibia's electricity supply capacity could yield the largest economic and social benefits, while limiting environmental degradation.

Urgent investment decisions are required to ensure that the local demand for electricity can be met in future. Such investments can take several forms:

a) relying on electricity imports mainly from South Africa and Zimbabwe, which implies that Namibia's transmission networks need to be bolstered, and/or
b) limiting local demand growth, which means that some energy-intensive projects may not be undertaken, and/or

c) building own generating capacity, taking into account that these usually have lead times of several years.

Strategically, we need to ask whether relying solely on imports can remain a realistic option for Namibia. It is noted that regional supply constraints, low investments in regional generating capacity, and much-needed economic development is at stake in every country in the region. As illustrated in 2008, particularly in South Africa's mining sector, not meeting the demand for electrical energy has had serious economic implications, and results in below-par socio-economic development. Thus, merely relying on electricity imports is economically inefficient, and is a strategic risk.

Can active demand side management (DSM)[5] be applied to cap the demand for electricity while still allowing the economy to grow efficiently? Currently, the key drivers of electricity demand in Namibia are the mining sector and the growing domestic sector. The mining sector in particular requires reliable power supply arrangements – necessary load shedding in South Africa in 2008 caused significant economic losses. In the domestic sector, load shedding is less costly, mainly because the cost per unmet unit of electricity is low. Not meeting the domestic demand however may in time cause political pressures and will have often unpredictable socio-economic repercussions and developments.

We conclude: while DSM is an effective tool to avoid temporary blackouts and increase consumer awareness in regard to the productive use of electricity, it will not be sufficient, even if rigorously applied, to ensure the continued growth of Namibia's main economic sectors. This implies that, while the importance of DSM will further increase and thereby promote the productive use of electrical energy, it is not a mechanism to ensure the long-term provision of electricity supply to power Namibia's much-needed growth.

Realising that the continued reliance on imports and a sharpened focus on demand side management activities are both insufficient to meet Namibia's future electricity supply requirements triggers the following question: does an economically efficient mix of different supply options exist that is cost effective, create jobs, and at the same time minimise the environmental degradation that characteristises many conventional electricity supply systems?

As has been alluded to in the previous sections, Namibia's comparative advantages that can be leveraged to strengthen the country's electricity supply sector lie in its abundant renewable energy resources, i.e. its excellent sunshine resource, feasible wind resources along the coast, a significant offshore gas field, and millions of hectares of bush-infested rangelands [von Oertzen, 2009]. Also, the Kunene River holds promise for additional large-scale hydropower, while the Okavango and Orange River have some hydropower potentials too. In contrast to these natural endowments, Namibia has very limited options when it comes to generating electricity using conventional technologies. The country does not have any mine-able coal reserves and therefore must import coal. It is the driest country in sub-

[5] Demand side management (DSM) activities reduce and/or shift a consumer's demand for and therefore consumption of electrical energy. In this chapter DSM includes energy efficiency measures.

Saharan Africa and only has the above-mentioned hydropower options in the perennial rivers along the country's borders. And, while nuclear energy could one day supply the nation's electricity, its current scope is considerably constrained by the country's small technical skills and supply base, and very high capital costs associated with the importation of such technologies and necessary human resources.

This section considers the following future generating options as the most promising electricity supply options for the coming decades[6]:

- the Baynes hydroelectric power station
- a natural gas-powered combined cycle power station (CCGT), possibly at Oranjemund and/or Walvis Bay
- integrated solar combined-cycle power plant, to be fed with gas from Kudu
- wind energy power generation along the coast
- electricity generation from invader bush
- concentrating solar-thermal power plant(s)
- solar photovoltaic power plant(s)
- a coal-fired power station, possibly at Walvis Bay
- a nuclear power plant, and
- a host of demand side management options including
    - applied energy efficiency whenever cost-effective (e.g. the use of compact fluorescent lamps, and the large-scale application of energy efficient appliances and practises including the concerted roll-out of solar water heaters), and
    - demand side management practises such as ripple control systems (mainly to control domestic electric water heaters, and time of use tariffs).

Figure 1.1 below illustrates how soon the above supply options could be rolled out. The implementation timeline shown below takes typical lead times for the different technology options into account, noting however that the timescale used is relative and merely indicates when supply options could become available relative to one another. Investment decisions are to be based on the expected medium- to long-term demand, as well as the ever-changing regional supply situation. Because of their relatively short lead times, wind, biomass and concentrating solar power could be available most rapidly, while gas and/or integrated solar combined-cycle power plants could make substantial supply mix contributions within a few years. Once the envisaged CCGT plant fed from Kudu and Baynes become available, the southern African regional supply and demand profiles will have changed considerably too. All investment decisions will have to take regional developments into account to determine in how far additional Namibian-based generation capacity is and

[6] This section relies extensively on the assessment and findings presented in [REEECAP, 2008b]

will remain feasible. The scenario below assumes that demand side management practices would be applied whenever cost effective.

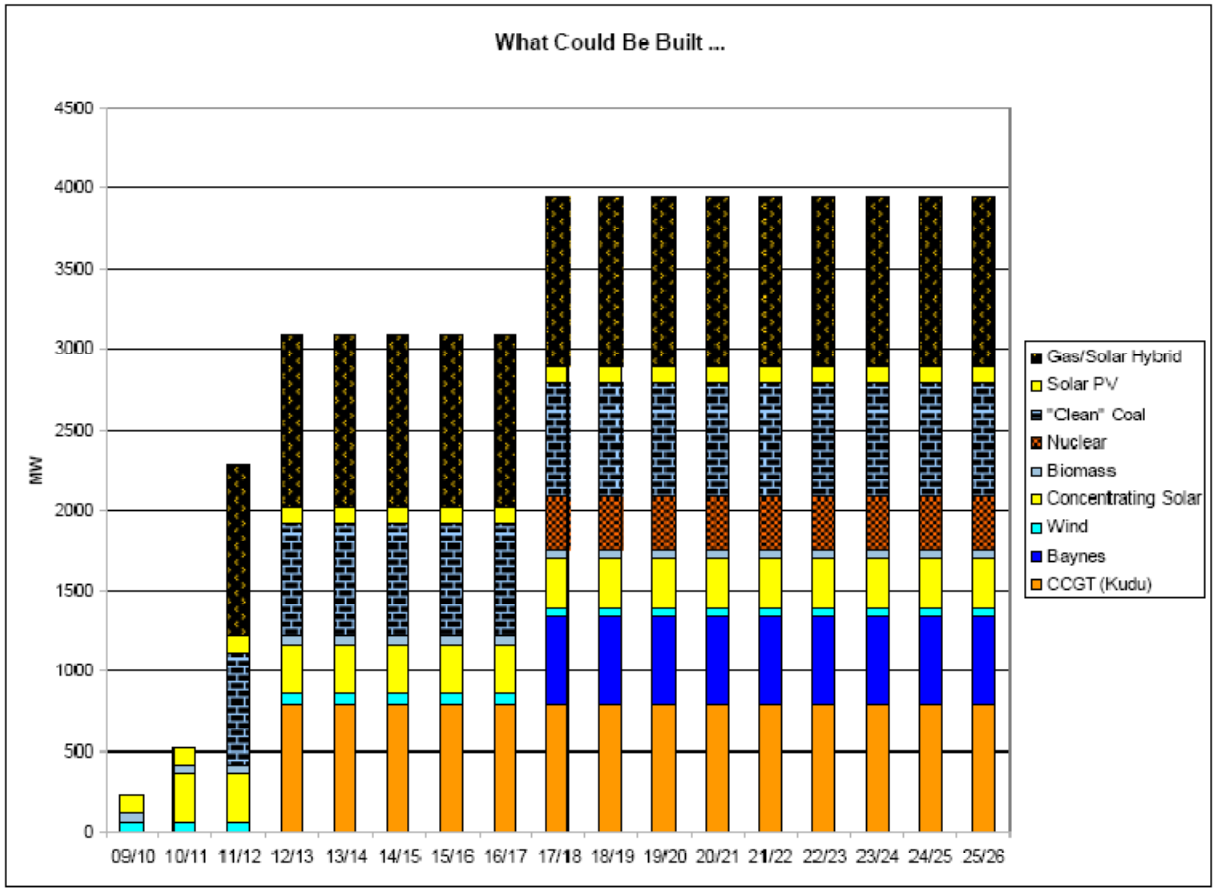

Figure 1.1: Timeline to roll out various electricity supply options [REEECAP, 2008b]

The White Paper on Energy Policy (1998) identifies self-sufficiency, security of supply, inclusion of renewable energy sources, sustainability and cost effectiveness and efficiency as the main energy-sector policy objectives. This chapter deliberately narrows down on these policy criteria, and only considers three distinct evaluation perspectives, i.e. the economic perspective, the social perspective, and the environmental perspective. Here we ask how the different potential supply options introduced above stack up, and what their main advantages and disadvantages are.

To inform the **economic perspective**, cost-benefit analyses and macro-economic analyses are requisite tools [REEECAP, 2008b]. Cost-benefit analysis is a means of quantifying all the direct costs and all the direct benefits of a proposed undertaking and presenting these as a ratio of costs to benefits. Macro-economic analysis in turn focuses on the overall contribution of the proposed action to the national economy, and reports on contributions to the gross domestic product (GDP), job creation, tax generation, and others. In the Namibian context it is found that the generation option with the lowest capital cost is a

combined-cycle gas plant, followed by wind, biomass and coal power plants. The most capital-intensive option is concentrating solar, followed by the Baynes hydroelectric power, nuclear power and solar photovoltaics. From an economic efficiency perspective it is found that a future supply that relies on a mix of the above generating options is the most desirable. Furthermore, a supply mix that maximises the use of renewable energies makes the highest contribution to GDP, resulting from the considerable construction costs associated with the Baynes power station and the significant plant size required for a concentrating solar power station.

To formulate a **social perspective** on any new electricity supply option demands an understanding of how it will impact on jobs, livelihoods, prices and perceived desirability [REEECAP, 2008b]. The following broad conclusions are made: irrespective of which supply option is chosen from the above list, the number of unskilled jobs created will outweigh the number of skilled jobs. More specifically, those supply options that maximise the use of Namibia's renewable energy potentials create the most local jobs – this is also confirmed by international experience. As can be expected, supply options depending on future fuel imports create the least number of local jobs. In regard to the promotion of small and medium enterprises (SME), electricity generation from invader bush has the greatest potential to promote SME development, followed by the Baynes hydroelectric plant, the development of the Kudu gas field, and the implementation of an integrated solar combined-cycle hybrid power station.

From an **environmental perspective,** one needs to take into account that presently, more than one-half of the electricity consumed comes from South Africa, while in 2007, more than 92% of the electricity generated locally was from hydropower [NamPower, 2007]. A generation mix that maximises the renewable energy component of the future supply portfolio could contribute more than 90% of all of Namibia's electricity needs [REEECAP, 2008b]. Such a supply mix will, on average, have the lowest emissions. On the other hand, a broad mix of the above-mentioned supply options achieves the second lowest emissions.

A few additional observations include [REEECAP, 2008b]:

- a supply mix that maximises the diversity of supply produces smaller adverse environmental and social impacts than those found when larger centralised power stations are used
- consumers are likely to take greater ownership of the electricity they use if involved in the implementation of demand side management
- Biomass suitable for electricity generation is not always where the need for electricity is. However, distributed power supplies using Namibian biomass would avoid the high carbon footprint and cost of transporting the fuel to more centralised power stations. Smaller, localised systems can also support communities living in the area of the power station by buying fuel and/or employing people from the surrounds. If

planned properly, land for biomass-for-electricity production in Namibia should not have to conflict or compete with land for food production for the country.

What do the above scenarios suggest in terms of Namibia's future electricity supply mix? In summary:

a) If Namibia continues to rely on imported electricity and does not invest in local generation capacity, future power outages could be as high as 10% of total demand. Peaking in 2012/13, cumulative unserved demand could be almost 11% of total demand. For one 24-hour blackout occurring every month – which is the equivalent of a decrease in electricity supply of only 3% – Namibia's gross domestic product is reduced by almost 4%. This suggests that the Namibian economy would suffer dramatic consequences in case future electricity supply shortages occur.

b) The Namibian electricity supply system requires base-load power that is relatively independent of the season and time of day. Although energy storage systems can be used to smooth out the supply of those renewable energy technologies that have a daily or season-dependent variable output, such storage systems are currently developed and substantially increase the cost of many renewable energy systems.

c) Demand side management measures have a very low cost-to-benefit ratio and should therefore be a principal ingredient of any future supply mix. DSM measures have short-term advantages in that they alleviate imminent power requirements and therefore reduce system outages, while in the longer-term they reduce the need for generation capacity. Enhanced DSM is also desirable from a social perspective in that they allow people to control their electricity consumption behaviours, which is also advantageous from an environmental perspective. However, DSM alone is not economically efficient.

d) Developing future electricity supplies using Namibia's plentiful renewable resources is most desirable. The development of local renewable energy resources creates local jobs, makes an important contribution to the local economy, and ranks well from an economic efficiency perspective. It is also environmentally responsible and limits the emissions of greenhouse gases. However, in view of the base-load requirements that Namibia's future electricity supply mix has to satisfy, relying solely on variable-output technologies introduces considerable supply risks and costs.

The above scenarios, which are underpinned by detailed assessments, show that a balanced mix of generation options, incorporating both conventional and renewable energy technologies for electricity generation, and applied demand side management, constitutes the most desirable long-term future electricity supply choice for Namibia [REEECAP, 2008b]. Such a supply mix relies on the increased use of biomass from Namibia's plentiful invader bush, the development of the Baynes hydropower station, and a gas-fired power station to guarantee the availability of base-load electricity supplies. The supply portfolio is to be

complemented by an array of diverse renewable generators – each limited in size – to ensure grid stability and cost effective grid integration. A strategic balance between base-load power and the more intermittent generators is essential. An optimum mix also includes a range of demand side management measures, which fosters the productive use of electricity, while maximally involving consumers in their personal electricity consumption decisions. Figure below displays the individual cost build-up per supply and demand side management option.

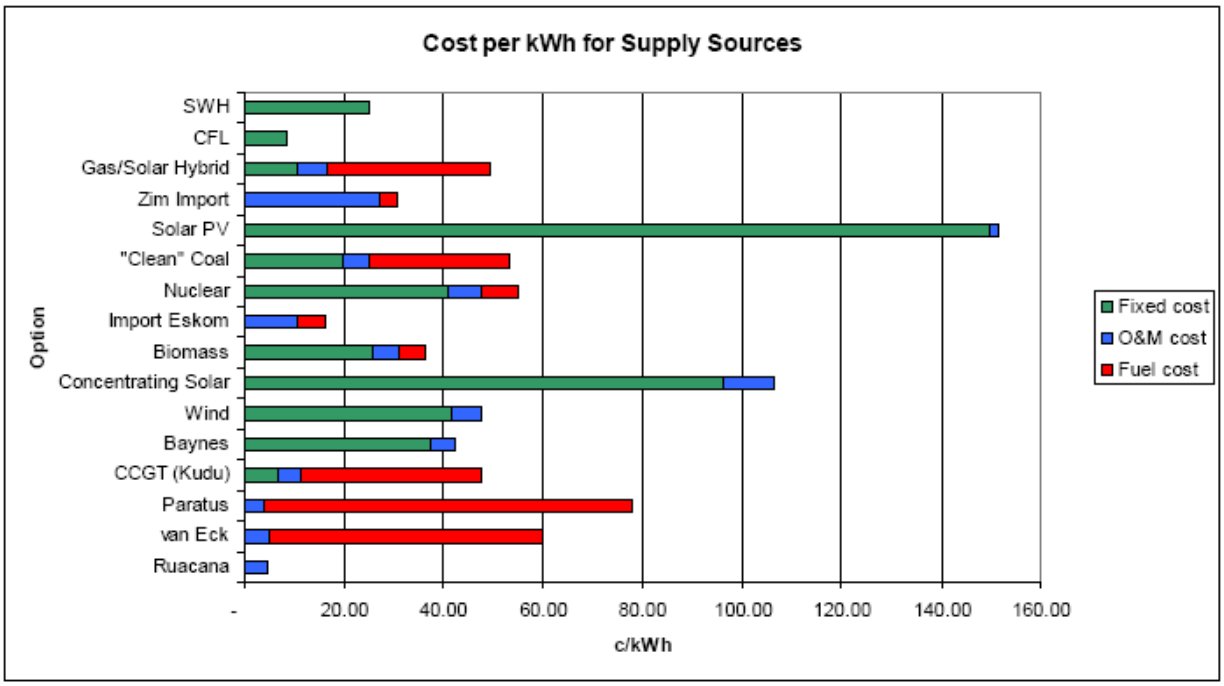

Figure 1.2: Estimated base tariffs for the different potential electricity supply options [REEECAP, 2008b]

The balanced supply mix described above is also the most efficient and desirable from a broad economic perspective: it creates a sizeable number of jobs, it promises to have the least power outages, it ensures low environmental emissions, and foreshadows only average future electricity price increases. It implies a lowered risk of unserved demand, achieved by way of diversification of supply. It reduces the reliance on fossil fuels, and builds increased self-sufficiency. By enhancing the use of renewable energies, Namibia's future electricity supply mix capitalises on local comparative advantages, ensures local value addition, creates local jobs and reduces future price risks for imported fuels by lowering resource dependencies. Expanding the generation capacity through smaller-scale renewable energy technologies allows Namibia to increase its supply capacity in a modular manner, in tune with increasing local demand as well as the ever-changing availability of regional supplies. Such a strategy reduces the risk of the overall supply portfolio while benefiting from cost-competitive electricity imports as and when they are again available in the region.

We conclude that there is no single supply option that optimally and simultaneously satisfies the ideal economic, social and environmental ambitions. Individually, some supply options are economically efficient, but do not maximise the use of indigenous resources. Other options have immediate capital cost advantages, but do not guarantee the security of supply, and/or have considerable long-term operating and maintenance costs, and/or introduce risky foreign exchange dependencies. Yet others maximise the use of renewable resources, but are expensive and risky because the availability of base-load power is not guaranteed. We recognise that there are multiple trade-offs between the various supply options. The optimal timing of each supply option presents its own challenges, particularly because of regional electricity infrastructure developments that could radically change Namibia's import or export position.

Combining the above supply options into a balanced generation portfolio offers the greatest cumulative advantages. To this end, we recommend to evolve an electricity sector strategy that

1. is guided by clear policies and well-defined policy goals and targets (e.g. as part of an Energy Act and its Regulations)
2. incentivises investments in the country's electricity infrastructure
3. encourages the use of Namibia's abundant renewable and non-renewable energy resources
4. promotes energy efficiency in all public and private endeavours
5. minimises long-term foreign exchange dependencies
6. further promotes strong regional partnerships and reliable electricity trading arrangements, and
7. focuses on creating local opportunities for energy entrepreneurs and new energy-related industries, thereby promoting local job creation in the sector and its affiliated industries.

Kudu Gas

The Kudu gas field is located some 170 km south-west of Oranjemund, in the south western corner of Namibia's maritime border with South Africa. The field was discovered by Chevron/Soekor in 1974. In 1987/88 two more successful drillings confirmed the field's commercial potential. Proven plus probable recoverable reserves are estimated to exceed 3.3 trillion cubic feet. The reserves are located below some 170 m of water at a depth of 4.5 km, which presents a considerable challenge for their future exploitation. However, Kudu has proven reserves that could fuel an 800 MW combined-cycle gas power station for more than 20 years, and represents the single most important hydro-carbon reserve that Namibia has to offer to date.

Following Namibia's Independence, exploration licenses were granted to Shell Exploration and Production Namibia (SEPN) and Energy Africa in 1993. In 1996, the Kudu Power Project was initiated by SEPN, NamPower and Eskom, and a year later a Memorandum of Understanding (MoU) was signed to promote an 800 MW power station sited at Uubvlei, some 25 km north of Oranjemund. In 1998 the MoU lapsed as Eskom remained unconvinced about the commercial viability of the project. Alternative plans to use the gas, for example by piping it to the Western Cape, were made. Plans to establish a 400 MW generation facility at Oranjemund, and another of 1,600 MW capacity located in the Western Cape, were made. Such plans however did not lead to any firm investment decisions. Further investigations were launched to establish the feasibility of a 400 MW power plant, combined with a floating liquefied natural gas facility. However, when the results of drillings at Kudu-6 and Kudu-7 were released, both SEPN and Chevron Texaco withdrew from the concession.

In 2000, a pre-feasibility study was undertaken, and then updated in 2003. In 2004, a joint development agreement as well as a MoU regarding power purchases was signed between NamPower and Eskom. By the time, the new partners in the Kudu Power Project were NamPower, Energy Africa, and the National Petroleum Corporation of Namibia (Namcor). In July 2005 a feasibility study was launched, to assess the viability of an 800 MW closed-cycle gas turbine power station near Oranjemund. During 2005, a full environmental impact assessment was conducted and approved by the partner organisations, and a production license was granted. During 2006, Energy Africa was purchased by Irish Tullow Oil Plc, and in April 2007 the Japanese oil company Itochu joined the project team by acquiring a 20% share.

In 2008, NamPower stated that it was keen to sell the gas in US$, while Tullow and Eskom wanted to buy the gas in South African Rand. Neither of the parties seemed willing to accept the foreign exchange risks [New Era, 2008]. In February 2009, Tullow announced that efforts to develop the Kudu gas project were hampered by the "failure to reach commercial agreements with gas buyers" [Namibian, 2009]. In March 2009, Tullow was reported to consider alternative commercial options for the Kudu gas field, including marine compressed natural gas (CNG) exports to Namibia and South Africa [IHS, 2009]. This development is said to have arisen because of recent developments in power generation priorities in the region, and the emerging potential for supplying gas to industrial and transport markets as a replacement for diesel. CNG would be transported to shore in purpose-built shuttle tankers, rather than by conventional pipeline. This would provide the flexibility for gas to be delivered to more than one destination, and would also allow Walvis Bay to be considered as a new delivery location where gas can be used for power generation and by industrial and transport users. Pursuing the CNG option would also provide a means of delivering gas to more than one regional market [Tullow, 2009].

Tullow states that the commercial analysis of the various development options for the gas field are progressing. The company has indicated that it has the intention of presenting a proposal to the Government of Namibia in 2009, in advance of entering into more detailed negotiations with potential gas buyers. At the same time, Tullow is said to be committed to proving and commercialising the potentially significant reserves within the greater production license area, and current exploratory appraisal efforts are focused on locating extensions of the Kudu main field reservoir within the production license area.

Baynes Hydropower

At the turn of the 19th century, the Kunene River's hydropower potential was recognised by the colonial powers. Since then, various dams and weirs have been constructed along the river, including the Gove Dam in Angola, the Calueque Water Scheme, and the Ruacana hydropower station on the border between Angola and Namibia. The Ruacana power station was commissioned in 1975 and completed in 1978, and has a total installed capacity of 249 MW. The absence of one or several reliable storage dams to regulate the flow of water is Ruacana's key drawback. The Kunene River's main basin is located in the highlands of southern Angola, where the rainy season only lasts between November of one year to February in the next year. The availability of water in the river has a direct influence on the quantity of electrical energy that Ruacana can generate at any given time.

In 1991, the Governments of Angola and Namibia ratified the Kunene River Agreement, accepting the Master Plan of 1969 as the official guideline for the further development of the Kunene River [NamAng, 1998 a]. In the past, political changes and instability had hindered efforts to develop additional hydropower projects in the Kunene, but with peace arriving in Angola, hopes were raised that joint development projects could now commence. A major feasibility study presented in 1993 found that "the most promising sites (for hydro power stations) are located in the lower Kunene ... from the existing Ruacana scheme to the sea level" [Norpower, 1993]. The report concluded that the Epupa site would be the most feasible. Between 1995 and 1998, NamAng conducted a full feasibility study and environmental assessment for the Epupa Project [NamAng, 1998]. During the study, all potential hydropower sites along the Kunene River downstream of Ruacana were investigated. The Epupa and Baynes sites were eventually selected as the most viable sites. The feasibility study concluded that a dam at Epupa would have the greatest storage capacity, while the Baynes site would result in a smaller social and ecological footprint. However, opposition to build a hydropower station at Epupa and critical voices from within and beyond the borders of Namibia resulted in the shelving of the project.

Presently, in view of the rapidly changing regional and national electricity generation circumstances, the Governments of Namibia and Angola through the Permanent Joint Technical Commission (PJTC) are again considering the option of building a hydropower plant on the Kunene River. The PJTC appointed the Kunene Consortium, consisting of four Brazilian engineering companies, to revise the feasibility study prepared in 1998. In addition, the PJTC appointed Environmental Resources Management to conduct an environmental and social impact assessment (ESIA). The ESIA and techno-economic teams are independent of each other, but are expected to collaborate closely to ensure that their respective studies are coherent and consistent. The main aims of the technical study, which commenced in June 2008 and is expected to be finalised in March 2010, are to consider three alternative dam locations, all within a few kilometres of the original Baynes site, and assess the feasibility of a hydropower station at the most preferred site. This final assessment will also consider the optimal dam height and associated water storage capacity, the structural and engineering requirements, and the implications for the construction and operation of the hydropower plant.

At the same time, the ESIA will gather information on the social and environmental aspects required to understand the implications of the development of Baynes. The ESIA is to provide decision-makers and stakeholders with a comprehensive evaluation of the impacts of the project. The process takes place by way of scientific studies and stakeholder consultations, and is expected to include extensive public participation [ERM, 2009]. The first public stakeholder interactions have taken place in June 2009, and should allow all interested and affected stakeholders to voice their concerns, opinions and ideas with respect to the envisaged project.

A hydropower station at Baynes could have a generating capacity of some 360 MW, and because of its envisaged storage dam, could contribute some 1 TWh per annum to the national electricity mix. Such a development would provide much-needed base-load power and power on demand, provided the dam holds sufficient water. For Namibia and Angola, the addition of a hydropower plant to the countries' supply mix would be most valuable, and reduce the reliance on electricity imports from the region. Time will tell whether the considerable obstacles that need to be overcome to build and successfully operate a hydropower plant at Baynes will be overcome this time. For the region in general, and specifically for Namibia and Angola, getting this project off the ground would signal the start of new collaborative efforts to address the many remaining regional challenges.

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