NAMIBIAN NATIONAL ISSUES REPORT ON THE KEY SECTOR OF ENERGY WITH A FOCUS ON MITIGATION

For: **UNDP Environment & Energy Group**

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Detlof von Oertzen, VO Consulting, P.O. Box: 8168, Swakopmund, Namibia

voconsulting@mweb.com.na

Intended audience

This report's primary audience comprises of Government officials drawn from various Namibian ministries and government agencies. A secondary readership includes interested and affected Namibian energy sector stakeholders, such as private sector participants, researchers and students from tertiary education institutions, NGO's, and other civil society actors. A basic familiarity with contemporary topics in the global climate change debate, including issues and options for mitigation and adaptation, is assumed.

Introduction

This report was commissioned by the UNDP's Environment & Energy Group for the project "Capacity Development for Policy Makers to Address Climate Change". It seeks to inform about policy options to undertake mitigation actions in Namibia's energy sector, as well as the key issues likely to surface in international negotiations when the promotion of national policies for this sector are discussed.

As per UNDP brief, the report is structured along the following five topics:

1. why energy is a key sector for Namibia;
2. description of the Namibian energy sector;
3. proposed mitigation options for Namibia's energy sector;
4. key issues in assessing investment and financial flows to address climate change mitigation in Namibia's energy sector; and
5. proposed approach and recommendations for conducting the assessment of investment and financial flows to address climate change mitigation in Namibia's energy sector.

Conclusions finalise the report.

Why energy is a key sector for Namibia

Namibia's population of some 2 million people is spread over a land area exceeding 800,000 km². In comparison with other developing nations, the country's total annual per capita energy consumption of approximately 7.5 MWh [NamPower, 2007] (all units used

in the report are explained in the Annex) producing a gross domestic product (GDP) of some N$52 billion [UNSD, 2009], or N$26,000 per person in 2007, indicates that Namibia's economy is energy intensive [CBS, 2008]. This means that energy is not always used most productively, and other nations have higher GDP's at the same per capita energy use [WEC, 2007].

Namibia's energy intensity is attributable to: a) the dominant economic sectors such as mining and agriculture which are highly energy dependent, b) the country's low population density coupled to high domestic energy use, c) the long transport routes to the country and between the few major centres within Namibia, and d) the high reliance on imports of fuels, consumer goods and manufactured products.

All liquid and gaseous fossil fuels, including petrol, diesel, heavy fuel oil, jet fuel, liquid petroleum gas and coal are imported, mainly from South Africa. Namibia's total installed electricity generation capacity in mid-2008 is 387 MW, while the peak demand exceeds 500 MW [NamPower, 2008]. Almost 50% of the country's electricity needs are met by imports, with South Africa and Zimbabwe as the main external suppliers [NamPower, 2008]. Namibia is thus highly dependent on energy imports. In light of current energy market developments in southern Africa, this dependency is expected to remain in place for a considerable time.

The latest figures available for the country's greenhouse gas emissions are from 2000, at which time Namibia was a net carbon sink sequestering a total carbon dioxide (CO2) equivalent of some 1,400 Gg. The country's greenhouse gas emissions were mainly from the agriculture (6,700 Gg in 2000) and energy (2,200 Gg in 2000) sectors [MET, 2008]. Land-use changes and the forestry sectors on the other hand were key in removing atmospheric CO2. Here, it is interesting to note that the single largest removal agent is an increasing density of indigenous bush species, the so-called invader bush, which covers some 26 million hectares of land [de Klerk, 2004]. It is expected that considerable changes in land-use practices, the rapidly increasing use of fossil fuel-based energy, the increasing use of biomass products particularly from invader bush, and a rapidly growing need to develop local energy sources will substantially change Namibia's overall carbon balance in years to come.

Considerable carbon mitigation potentials exist in the country's energy sector, these will be discussed later. It needs to be recognised though that both local and foreign investments in mitigation options and technologies will occur more frequently if the energy market is further liberalised, currency export restrictions are eased, and tariffs increased to international levels.

Institutionally, while compact and easy to navigate and generally perceived as investor friendly, Namibia has not benefitted from significant energy or electricity generation infrastructure developments in the past decades, other than the considerable expansion of its electricity transmission and distribution systems since independence in 1990. Energy-related expenditure in international currency denominations constitute a significant and continuous burden on the country's trade balance, and have a sizeable impact on the nation's foreign currency reserves.

Namibia's technology and engineering skills base is small and generally underdeveloped. For most large-scale technology projects the country remains highly dependent on foreign expertise. Localised economic development, mainly driven by the tourism and mining sectors, currently invigorates Namibia's economic growth. This development remains closely coupled to the availability and affordability of liquid fuels and electricity. However, local fossil fuel prices are pegged to the international ones, which in turn

exposes the majority of the energy sector, and by implication the Namibian economy, to currency fluctuations and international demand and supply forces, none of which Namibia has any influence over.

It is concluded that the energy sector is a key strategic sector in Namibia's economy, and its future will to a very significant degree determine if and how the economy of the country will grow and perform.

Description of Namibia's energy sector

In 2007, Namibia consumed approximately 15 TWh of energy. Almost 60% of this was attributable to liquid and gaseous fossil fuel use, while some 25% was in the form of electrical energy. Biomass accounted for almost 15% of the total energy used, while other renewable energy sources contributed the remainder, i.e. less than 1% [MME, 2007; CBS, 2007; von Oertzen, 2009].

Presently, on the supply side, all fossil fuels are imported from regional and international sources, while almost 50% of the total electricity consumed in Namibia is imported [NamPower, 2008]. This implies that the country supplies less than one-third of its total energy requirements from internal resources.

Generation capacity in the electricity sector includes a 240 MW hydro-electric plant, a 120 MW coal-fired plant, and a heavy fuel-oil powered plant of 24 MW and 3 MW [NamPower, 2007]. The country's electricity transmission and distribution systems are considered well-developed, and span some 16,000 km [NamPower, 2008]. Existing transmission infrastructure from South Africa is currently strengthened by the Caprivi inter-connector, which will link Namibia to Zambia and Zimbabwe.

In the coming 10 years, Namibia's electricity consumption is expected to grow considerably, driven mainly by the booming demand from the mining sector. Presently, it is not clear what percentage of this growth will be satisfied by way of an increased reliance on imports from the severely supply-constrained region, or through the development of own generating capacities, or both. Long-term demand forecasts envisage annual average electricity sector growth rates exceeding 3% per annum over the next 30 years [NamPower, 2007; NamPower, 2008].

About one-third of the Namibian population has access to grid electricity, and it is estimated that more than 70% of the urban and some 15% of rural households are connected [Hamutwe, 2007]. Urban electricity consumption accounts for about one-half of the country's total electricity consumption of approximately 3.5 TWh in 2007 [NamPower, 2007]. Despite substantial rural electrification efforts initiated after independence, more than 100,000 households remain unconnected to the national electricity grid, including many informal settlers living around urban centres. Off-grid electrification by way of diesel or renewable energy technologies remains very limited, although the uptake of alternative non-grid supply technologies has experienced good growth in the past years, mainly in the tourism and commercial farming sectors.

The investment and development of future sources of energy, including fossil fuels such as coal (e.g. around Aranos), natural gas (Kudu gas field) and oil (mainly off-shore) offers real and potentially interesting opportunities in the national energy sector. Here, the quantification of potential yields of such resources, as opposed to merely indicating their presence, is required. Namibia is richly endowed with uranium resources, and is currently the world's 4th largest exporter of uranium oxide [WNA, 2009]. While new exploration for this important resource takes place in some 50 exclusive prospecting sites around the

country, many in environmentally sensitive areas, the enrichment and beneficiation of this resource is energy intensive and requires a well-developed human resource and technology backbone. Namibia would have to develop such capacities if it wishes to be more than an exporter of this strategic resource.

The renewable energy sector offers very significant and as yet untapped opportunities for investment, development and expansion. With an average daily solar radiation of 6 kWh/m², Namibia's solar regime is amongst the world's best [Meteonorm, 2009] and holds huge development potentials. In addition, on-land wind energy sites are numerous, and an installed capacity exceeding 100 MW are possible, even though some grid strengthening would have to be made if significant wind capacity is added to the national electricity supply mix [von Oertzen, 2009]. The biomass potential, specifically from invader bush, could readily boost the national capacity by 100 MW or more, while the country's hydro-electric potentials exceed 350 MW. The geothermal potential is estimated to exceed 100 MW, and tidal and wave energy potentials of more than 200 MW are considered realistic [von Oertzen, 2009]. The real resource base and potential yields however remain largely unquantified.

Despite a favourable regulatory electricity sector regime, and an established but as yet untested Independent Power Producer framework, foreign investments in Namibia's energy sector remain very limited, especially when compared to those made and planned for in neighbouring Angola and South Africa. In the electricity sector in particular, low tariffs, a lack of targeted incentives and national targets, and Namibia's small industrial/manufacturing base continue to suppress the appetite of investors.

Emissions from the country's energy sector are mainly due to those from transport fuels [MET, 2008]. The use of biomass is considered carbon neutral, and the electricity sector makes only intermittent use of its coal- and diesel-powered generation sources. At a carbon dioxide equivalent of 2,200 Gg in 2000, and a historical growth of some 50 Gg per annum in the past years [MET, 2008], the energy sector's emissions remain approximately one-third of those of the agricultural sector.

The portfolio of future technology options used in the country's energy sector will to a large extend determine how significant any additional emissions from this sector will be. These options, with an emphasis on suitable mitigation options, are discussed in the next section.

Proposed mitigation options for Namibia's energy sector

Between 1990 and 1996, the Namibian economy grew by about 5% per annum, and then declined to 3.5% per annum between 1996 and 2000, and to some 2.6% per annum in the period 2001 to 2006 [CBS, 2007]. Economists suggest that an average GDP growth of some 4% per annum seems realistic for the coming decade, but will be insufficient if Namibia is to reach its Vision 2030 goals [NEPRU, 2009].

The development of the energy sector will, to a large degree, determine whether reasonable economic growth rates can be realised. Here, the generally constrained energy situation in the southern African region, specifically in the electricity sector, will have a limiting effect on Namibia's ability to sustain its economic growth unless own capacity is quickly commissioned. Presently, domestic electricity generation is inadequate to meet the country's peak demand, and unless drastic steps are taken, unserved demand will rapidly increase. To complicate this, supply constraints in South Africa are resulting in the South

African electricity utility ESKOM not being able to meet local electricity needs, let alone those of Namibia. The cost of sourcing electricity has almost tripled in the last eight years.

Internationally, high oil and commodity prices have also had a significant effect on the price of fuel, gas and coal, leading to rapidly rising energy prices in the region. In addition, concerns about global warming, and a growing awareness of the damage done by uncontrolled growth and the use of fossil fuels, is causing an increasing pressure on countries to turn to other ways of supplying affordable clean energy.

The Namibian energy sector stands at a cross roads, and urgent and decisive action is essential if the country is to sustain its economic growth and reach its long-term development targets. Namibia's economy is sensitive to fuel price increases. Incentives to save on fuel and associated price signals generally find their way into the economy, even without Government intervention. In regard to the conceptualisation, planning, trialling and implementation of large-scale fuel switching efforts however, or the introduction of national fuel-economy standards, considerable Government input, regulation and incentivisation will be required. This is particularly true because of the scale of the Namibian economy, and its proximity to South Africa, which often seems to inhibit national action in the hope that the big southern neighbour will initiate the required steps first.

The national transport sector is wholly dependent on the import of fuels and lubricants [Namcor, 2009]. Sector experts agree that realistic mitigation options are most likely to be found in

- **enhancing the fuel efficiency of the national fleet of public and private vehicles**, for example by introducing transport sector emission reduction targets, emission standards for vehicles, tax and other incentives for low-emission vehicles including hybrid vehicles, and imposing carbon taxes
- **fuel switching**, for example from liquid fuels to gas, or from fossil fuel sources to biofuels, and
- **increasing the application of energy efficiency measures in the transport sector**, for example by way of improved logistics, road-to-rail switching, and using more cost-effective means of transporting goods and people.

Namibia has not invested in new electricity generation capacity in nearly 30 years, and local electricity tariffs are considered low when compared to most other nations. Institutional arrangements in the electricity sector in particular, which only has the Government-owned generation and transmission utility NamPower, are yet to prove whether private-sector entrants are able to infuse new expertise and much-needed dynamism into the sector. As the implementation of new and often unfamiliar technologies is generally characterised by long lead times, technology transfer is one method to advance the sector, but requires suitable and financially attractive framework conditions. The absence of large-scale energy sector investments is indicative of the absence of such a favourable investment climate.

On the back of a general electricity demand growth of more than 3% per annum, there are other and more immediate demand drivers emanating specifically from the mining sector. NamPower expects that the rapid developments in the uranium mining industry in particular will require as much as 200 MW of additional capacity, merely to satisfy the demand created by new mining and related mineral processing developments planned for between 2008 and 2010 [USEA, 2008]. A desalination plant at the coast and a cement plant in northern Namibia, and the various other mining- and agriculture-related

developments that are already in the pipeline will add to this new demand. Given these growth drivers, a forecast peak demand of at least 700 MW in 2011, and 850 MW in 2018 seem conservative [IPPR, 2009].

How can such a demand be matched by supply, while at the same time keep emissions from the electricity sector capped? Experts agree with various recent studies indicating that the following options would satisfy the country's economic growth requirements and at the same time lead to a more carbon-constrained national generation portfolio [von Oertzen, 2009]:

- **Baynes hydro-electric generation scheme:** the proposed Baynes hydro dam is located in the Kunene River and planned to have a generation capacity of some 360 MW, thus contributing about 1 TWh per annum to the national electricity mix. Options for further expansion, up to a capacity of 600 MW, exist.
- **Lower Orange River / Divundu Popa small hydro-electric generation plants:** the lower Orange and Okavango River show potential for a number of smaller-scale hydro-electric plants, and a total capacity of at least 120 MW is seen realistic in case all such potentials are developed, contributing about 0.3 TWh per annum.
- **Electricity generation from biomass:** biomass can be burned directly in boilers or gasified, and Namibia's invader bush shows considerable potential to feed such generation plant. If a current proof-of-concept project is successful, this option could readily develop into various decentralised electricity generation plants and contribute more than 100 MW to the national capacity, and some 0.5 TWh to the national energy mix.
- **Wind energy generation:** wind resources along the Namibian coast are considerable, and several on-shore wind farms of 20 to 50 MW capacity each seem possible, yielding some 0.12 TWh per annum per 50 MW installed capacity at most coastal sites. Off-shore sites may add considerably to such capacity, but would also increase the cost of such supply.
- **Natural gas-powered generation:** Namibia's Kudu gas field could supply the fuel for a combined cycle gas turbine plant, and at an installed capacity of 400 MW the source is estimated to provide a supply for some 40 years, yielding about 3 TWh per annum.
- **Integrated solar combined cycle (ISCC) plant:** these power plants are essentially based on a conventional combined cycle gas plant with an added solar-driven booster. An ISCC plant's main advantage is that the peak capacity can be increased at a lower capital cost and the solar power boost is available for daytime generation. Several plants in the range of between 50 MW and 150 MW are possible, yielding a generation output of some 0.3 TWh per annum per 50 MW unit.
- **Concentrated solar thermal plant (CSP):** Namibia's excellent solar regime could readily feed several CSPs of 50 MW each, at a yield of about 0.2 TWh per annum per 50 MW unit.
- **Solar photovoltaic (PV) plants:** the generation potential of solar PV in Namibia is not limited by the resource or space, but rather by the amount of power that the Namibian grid can accommodate, and how a PV supply curve can be matched to the demand. Under prevailing conditions, a generation output of some 0.08 TWh per annum per 50 MW installed capacity is seen as realistic.

- **Clean coal:** coal-powered plants are well-known in design and operation, and NamPower is currently investigating the establishment of such a plant of 300 to 800 MW capacity at or near Walvis Bay. Presently, Namibia does not have any domestic coal resources that have been proven to be minable. The clean coal option in modern coal-fired plants adds significant generation costs to the cost of a conventional coal-fired plant, as does the use of sea water for cooling purposes. Remaining dependent – throughout the useful life of such a plant – on international commodity prices and therefore foreign exchange fluctuations is another significant draw-back, even if the CO2 signature is significantly reduced.
- **Nuclear power:** although well-endowed, Namibia has few technology and engineering capacities, which will delay any plans to establish such plant any time soon. Here, build-own-operate arrangements could be envisaged. Strategically however, the beneficiation of uranium and/or outsourcing of a nuclear power plant could place the ownership and associated leverage under foreign control, and expose the country to uncontrollable future price escalations and potential economic blackmail.

Key stakeholders and many experts agree that the following tasks would promote investments in the Namibian energy sector and contribute to developing realistic mitigation options:

- **undertaking a strategic assessment of the energy sector's multiple "no-regrets" mitigation options and scenarios** in order to develop appropriate policy tools promoting the introduction of energy sector mitigation options
- **integrating energy as a cross-cutting theme into the national Vision 2030**, thus ensuring the compatibility and promotion of mitigation options under the national development goals, and exploring the opportunities of attaining these goals by incentivising those options that lead to carbon abatement
- **reviewing and updating Namibia's White Paper on Energy Policy** with a view to more comprehensively integrate energy policy and effectively address climate change mitigation and adaptation
- **creating a national energy regulator** to coordinate and provide the guiding framework for the country's sustained energy sector development
- **establishing a national climate change institution** that promotes and monitors carbon-reducing mitigation activities across the various economic sectors
- **increasing the public awareness of the risks of climate change** and the role and responsibility of the individual, to reduce each consumer's carbon footprint, both through mitigation and adaption
- **incentivising investments in the energy sector**, especially those using and/or beneficiating local resources such as the Namibian biomass resources, and those harnessing the country's excellent solar and wind regimes
- **practicing active demand management** across the entire electricity sector value chain. Namibia's peak demand requirements remain subject to how the national demand for electricity is planned for, and managed, which are substantially influenced by how demand management practices are applied.
- **incentivising the efficient and effective use of energy**, and in turn promoting the productive use of energy in general, and electricity in particular

- **quantifying national wave, tidal and geothermal resources**, and
- **strengthening the institutions that promote research, development and investment** across the energy sector, and specifically in the renewable energy and energy efficiency sectors.

The above list illustrates that the range of potential mitigation options is significant. In the absence of large-scale energy sector investments in Namibia, the question remains whether there is a gap between the various options identified above and the current financial and other constraints experienced in the sector. These topics will be addressed in the next two sections.

Key issues in assessing investment and financial flows to address climate change mitigation in Namibia's energy sector

Initiating carbon-reducing activities, and assessing their particular costs and benefits are new concepts in Namibia, and have historically not played a role in strategic and financial decision-making in the country's energy sector. Although of interest, projects that benefit from the international trade with carbon certificates, for example through the Clean Development Mechanism (CDM) [CDM, 2009] or the Voluntary Carbon Market (VCM), have not commenced. The associated institutional capacity and know-how of the requirements and application of the relevant procedures is generally low. In addition, energy sector players do not generally seem to have a consistent working definition of the costs and benefits accruing through the various mitigation options, and whether and how these contribute to project-specific revenues, or macro-economic benefits, or what their social and environmental implications are.

There is little evidence that any strategic planning takes place in Namibia's energy sector. A case in point is Namibia's current uncertain electricity supply future, which has been predicted for years, but has not seen any real action to avoid it [IPPR, 2009]. Also, despite known capacity constraints extending well into the future, the national electricity utility continues to enter into new supply contracts with mining and industry partners. In response to the recent explosive growth in demand, the utility has sought to resort to quick-fix supply augmentation options, such as the envisaged expansion of the Paratus diesel-powered plant, and is investigating whether to build a coal-fired power station at Walvis Bay. This is despite the fact that Namibia presently has no own heavy fuel-oil resources or minable coal fields, which implies that consumers will have to be prepared for volatile future prices driven by international commodity price fluctuations and ever-changing foreign exchange rates.

Namibia's energy sector is compact, and in most cases readily allows for the assessment of investment opportunities. In the electricity sector, and in view of the country's existing generation and transmission monopoly, and the current arrangements regarding the national utility's single buyer function (this requires that all parties contributing to the country's generation capacity or using the transmission infrastructure need to have agreements with the utility before feeding electricity into the national grid), coupled to the low electricity tariffs, large-scale investments will remain challenging. Despite these complexities it should be noted that the Electricity Control Board has received numerous applications for generation licenses, which is indicative of investor interest in the electricity sector. Investments in generation capacity however have not been forthcoming.

The country's liquid fuels sector on the other hand is served by private sector companies, as well as the parastatal Namcor. Here, investments in conventional infrastructure are

occurring regularly, and few supply shortfalls have been experienced in the past years. However, it is unclear whether any efforts have or will be made to either plan for or attract investments that would boost the transport sector's energy efficiency in general, or prepare Namibia's transport sector for large-scale fuel switching, or explore the multitude of opportunities in switching to biofuels. While such initiatives do not emanate from the established liquid and gaseous fuels sector players, there has been some interest from others, and preliminary evaluations of large-scale agricultural projects to establish oil-bearing plantations using mainly Jatropha and castor oil plants have taken place, as have preliminary assessments to use Namibia's invader bush to produce electricity and biofuels. The biofuels sector will have to be developed with care so as not to compromise the country's limited ability to produce food, and/or create additional development stresses that a competition between food and fuel can evoke. It is against this backdrop that the use of invader bush for both electricity generation and fuel production presents a unique opportunity that eliminates most concerns raised in international biofuel vis-à-vis food security debates.

Namibia has a progressive White Paper on Energy Policy, developed a few years after the country's independence [MME, 2009]. At the time, which in 2008 is viewed as an era of low energy prices, both the supply of fossil fuels and electricity was relatively unconstrained. The recent emergence of the South African electricity supply difficulties and the drastic rise of international fossil fuel prices however necessitate that this important policy document is reviewed and updated. Specifically, energy scenario models taking cognisance of the rapidly changing southern African energy supply arrangements are necessary. Recent developments and opportunities arising as a result of the application of the CDM/VCM, and the opportunities that carbon trade creates in the energy sector in particular, should be integrated as a matter of urgency. Considering that there are only some 51 African CDM projects, out of a total of 3,902 worldwide [UNEP, 2008], the potential for tapping into such development funds is considerable. Opportunities in international bi- and multi-lateral funding, often as a result of rapid technological advances in the renewable energy sector, and new funding mechanisms for mitigation options geared towards the energy sector, need to be taken into account too. An updated policy document should make it clear to all energy sector participants and potential entrants that there is an urgent need to undertake national strategic energy scenario planning, to address the barriers the sector faces before it will attract large-scale investments. These barriers and the mechanisms to address them include:

- **diversification** of the national supply of liquid and gaseous fuels
- **promoting and incentivising the productive use of energy**, for example through favourable taxes, tariffs, national targets and other measures
- **strengthening a rapidly expanding electricity market** to ensure that the economy as a whole and specifically the energy-intensive sectors such as mining are adequately provided for, and attract third-party investments and participants
- **incentivisation of energy efficiency practices** in the public and private sectors
- **implementing demand management and active demand market participation** throughout the electricity sector value chain
- **incentivising the development of indigenous carbon-neutral energy resources** through favourable tax and tariff regimes, the establishment of national renewable energy generation targets, and the financial support of research and development programmes and projects through Government

- **incentivising the establishment of decentralised Independent Power Producers**, for example through national targets, introducing favourable tariff regimes, and tax incentives/rebates.

An integration of energy as a cross-cutting topic into the national vision and development plans, specifically Vision 2030 [NPC, 2004], is essential too. Had this been done during the development of such national policy documents, many of the current energy sector bottlenecks would have been avoided or at least minimised, especially those experienced in the electricity sector. The above-mentioned integration will infuse additional realism into the country's development goals, and highlight the many investment opportunities that exist if the underpinnings of sustainable national development, including the availability and reliability of affordable energy, are comprehensively addressed.

Proposed approach and recommendations for conducting the assessment of investment and financial flows to address climate change mitigation in Namibia's energy sector

Institutional arrangements to incentivise and enhance investment flows to address climate change mitigation in Namibia's energy sector have not been streamlined, and therefore exhibit many of the same barriers and structural impediments that characterise large-scale investments in other developing countries. Namibian institutions and Government ministries that deal with large-scale investments include the Ministry of Trade and Industry (MTI), the Ministry of Finance (MoF), the National Planning Commission (NPC), and in case of energy sector investments and developments, the Ministry of Mines and Energy (MME), the national electricity utility NamPower, and the liquid fuels provider Namcor. The MME's role is that of Namibia's energy policy-level champion.

The Government's sustained political commitment to energy policy support and programme subsidies remains essential if the energy sector is to become more vibrant, diverse, and of greater interest to national or international investors. Investors generally seem to regard the MTI and the Namibian legal requirements and associated bureaucracy, as acceptable, especially when compared to those of many other developing nations. In addition, Namibia is a member of the Southern African Customs Union, and as such applies foreign exchange controls. However, investors do not seem overly perturbed by such requirements and evidence of the recent inflow of substantial investments into the mining sector and cement industry bear testimony to this. In the energy sector however, large-scale investors may well perceive a lack of direction, and will note the absence of national clean energy targets, and specific investment incentives including tax incentives and worthwhile tariffs. Others may be deterred by the existing monopoly in the country's electricity sector, which entrenches the national utility's bargaining power when negotiating Power Purchase Agreements with prospective generation sector entrants.

The fledgling renewable energy sector is particularly vulnerable [von Oertzen, 2009]. Several recent studies have pointed out that Namibia's

- **low electricity tariffs**
- **one-sided market rules** (especially the single buyer arrangement mentioned earlier)
- **limited investment opportunities**

- **absence of tax and investment incentives** to introduce new technologies and level the playing field between established and new sector participants
- **lack of national renewable energy targets** and / or other measures to incentivise the introduction of carbon-neutral generation capacity, and
- **lack of institutional support mechanisms** that investors find in other parts of the world

may well have discouraged investors in the past. In an energy hungry world, such investors have a wide choice of locations to go to, some with excellent short- and long-term incentives in addition to good resource conditions. Investors will be lost to the country if investment framework conditions seem unattractive. The above-mentioned impediments perpetuate the non-level playing field between established grid technologies and players, and keep away those new entrants that are potentially introducing energy sector mitigation options in Namibia.

Investments in climate change mitigation technologies in the energy sector will therefore benefit particularly if

- such technologies and approaches would have tangible **investment incentives**, benefits and privileges, even if only during an establishment phase, for example in the form of dedicated funds and investment subsidies to attract new energy sector investors and carbon neutral energy operators
- **national goals and targets** existed that made it a requirement on all actors to provide a percentage of supply from sources that are carbon neutral, for example defining national supply mix targets that mandate the establishment of carbon neutral technologies and supply options
- greater **private sector participation was encouraged**, for example by way of tax- and investment incentives
- the **use of indigenous resources** was specifically incentivised
- if a set of **standardised life-cycle costing methods** for energy supply options was mandatory to allow the ready comparison of costs and benefits, as well as technology in- and outputs
- energy sector **investments** had defined financial investment programme parameters **anchored in policy**, for example by way of White Paper on Energy Policy targets, and through targeted supply and generation license conditions
- a **coordinated integration of centralised and decentralised energy service provision** was taking place, and
- specific **energy sector investments incentivised the integrated rural energy service provision** as part of a wider national integrated rural development policy.

The above aspects provide an overview of which approaches would yield more investment certainties and incentives, and therefore require urgent national attention if Namibia's energy sector is to benefit from investments and financial flows to reduce the nation's future carbon footprint.

The following **ranked recommendations** – starting from the priority that the author views as the most important – are formulated to create a conducive national investment

environment that more readily attracts climate change mitigation technologies and projects to the Namibian energy sector.

It is recommended that

1. **Energy, as a cross-cutting development theme, is explicitly addressed in Namibia's Vision 2030, with a view to recognise energy as a critical ingredient in climate proofing the national development goals.** Here, the integration and linkage of the energy sector into other sectors, and quantification of the implications and requirements for the development of the energy sector are important to ensure that the envisaged growth and development pathways can be reached. Such an activity, for example in form of a cross-sectoral review, should be initiated by the NPC and coordinated by the MME, in close collaboration with all the key ministries and development stakeholders.
2. **Namibia's White Paper on Energy Policy is updated**, and special emphasis is placed on developing policy measures that take the many indigenous renewable energy options, as well as the new regional and international energy sector constraints and opportunities into account. The MME should initiate such a review.
3. **An Energy Act is prepared,** integrating the various energy sector requirements into a single overarching energy sector policy document. The MME should initiate the development of such an Act.
4. **A regulator for Namibia's entire energy sector is established**, endowed with sector-wide governance functions similar to those of the current electricity sector regulator. This is an activity that requires broad political support, and would have to be initiated by the MME.
5. **A strategic review of the roles and responsibilities of the various supply entities in Namibia's liquid fuels market is undertaken**, with an eye on incentivising this vital sector, so as to diversify the supply options and optimise future investments taking national carbon targets into account. This initiative should be initiated by the MME, and executed in close collaboration with the NPC, MME and other Government ministries.
6. **A national entity to systematically and cross-sectorally collect, analyse and communicate Namibia's greenhouse gas emissions is established**. Such an entity could be initiated and administered by the Ministry of Environment and Tourism and the NPC, and focus specifically on providing updated information to the to-be-established Designated National Authority, energy companies, and industry players in general. The entity should also initiate and guide national greenhouse gas studies and audits, including in the agricultural, energy, biomass and various industry sectors.
7. **Special energy sector investment mechanisms are established,** with a view to incentivise new energy sector investments coming from both national investment agents as well as through foreign direct investment. The MTI, in close collaboration with the MME, MoF and other Government ministries and institutions, as well as private sector entities, should initiate the establishment of such special purpose instruments and measures.
8. **The Independent Power Producer's framework is extended to specifically attract investments that introduce energy mitigation measures** into the country's electricity sector, and in this way broaden Namibia's low-carbon generation mix.

Conclusions

Namibia's energy sector has to continue to provide affordable and accessible energy services to ensure that the country's ambitious development growth targets can be realised. However, in view of international energy developments and current supply constraints, as well as the low energy prices that the region has benefitted from in past decades, the sector's reform with a view to attract investors and investments will remain a key challenge for years to come. Here, realistic policy framework conditions and directives focusing on energy sector taxes / incentives, national clean energy targets, and realistic tariffs, and the deliberate climate proofing of national development goals, are of critical importance and will to a significant degree determine whether low-carbon investments will be forthcoming.

The Namibian energy sector's low-hanging fruit are to be picked by the wide-scale introduction and application of energy efficiency practices. In the electricity sector in particular, energy efficiency measures can address short-term electricity supply constraints, while at the same time contribute to greenhouse gas abatement and the enhancement of the productive use of energy.

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 constitute a national comparative advantage that can and should be exploited more aggressively. In addition, Namibia is endowed with natural gas resources, which if used wisely, can bridge the way into a low-carbon emission energy future, specifically in the transport industry.

Namibia's uranium reserves constitute another significant national resource and should be recognised as a reserve of considerable strategic value and importance. If well managed, the phased exploitation of the mineral can significantly contribute to future national revenues.

Active and goal-oriented Government engagement, including the provision of special-purpose incentives and investment packages favouring low-carbon investments will be required to convert Namibia's natural resources, including its mineral riches, while providing sufficient energy to allow for the ongoing development of a nation that has traditionally been energy intensive. The focus of energy sector investments needs to include both mitigation as well as adaptation strategies and measures. Here, investments that tap into Namibia's rich renewable energy endowments, while promoting and incentivising greater energy efficiency throughout the economy, are essential. The time has come to develop and roll-out these options nationally.

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Annex: Abbreviations and units used in the report

billion	one thousand million, or 10^9
GDP	gross domestic product, the total market value of the goods and services produced by the country's economy during a specific time
GWh	gigawatt hour, equal to one thousand MWh
Gg	gigagrams, a unit of mass, equal to one billion grams, or one million kilograms, or 1000 tons
km²	square kilometers, the area covered by a square of 1,000 by 1,000 meters
kWh	kilowatt hour, a unit of energy, one kilowatt of power used for one hour
kWh/m²	kilowatt hour per square meter, a measure of the energy received from the sun on one square meter of surface area in a given time
MW	megawatt, a unit of electrical power, capacity and electrical demand, equal to one million Watts
MWh	megawatt hour, a unit of energy, equal to one thousand kWh
TWh	terawatt hour, a unit of energy, equal to one thousand GWh, or one billion kWh

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