Konrad Adenauer Stiftung

ECONOMIC IMPACTS OF THE DEPLOYMENT OF RENEWABLE ENERGY TECHNOLOGIES IN NAMIBIA

Detlof von Oertzen

May 2018

ECONOMIC IMPACTS OF THE DEPLOYMENT OF RENEWABLE ENERGY TECHNOLOGIES IN NAMIBIA

May 2018

PAPER BY:

Dr Detlof von Oertzen
PO Box 8168
Swakopmund, Namibia
Tel: +264 64 402 966
Mob: +264 81 314 9664
Email: Detlof@voconsulting.net

Economic Impacts of the Deployment of Renewable Energy Technologies in Namibia

Author: Dr Detlof von Oertzen
KAS coordinator: Anna Wasserfall
Design and layout: Injomoka Studio

Acknowledgements
The author most gratefully acknowledges the support of the Konrad-Adenauer-Stiftung (KAS), and wishes to thank Thomas Keller, the Resident Representative of the KAS in Namibia, Anna Wasserfall (Programme Manager of the KAS), and Harald Schütt (Amusha) for their enthusiastic support.

Published by Konrad-Adenauer-Stiftung and printed by John Meinert Printing (JMP), Windhoek, Republic of Namibia.

This is a free copy and not for sale.

ISBN number 978-99916-39-21-5

TABLE OF CONTENTS

FOREWORD

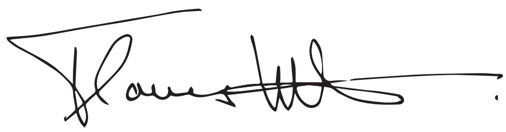
Dear cherished reader,

Coming across this publication, the question of why a political foundation such as Konrad Adenauer Stiftung (KAS) takes interest in the topics of renewable energies and climate change is likely to arise sooner or later. At first glance, these issues don't seem to have an immediate link to the initial mission of KAS, which, in its essence, deals with the fostering of Democracy and Social Market Economy values, the strengthening of the Rule of Law, Human Rights and Gender Equality and the creation of an International Political Dialogue, through the means of civic education and the offering of platforms of different scales. However, closer inspection proves that renewable energies and climate change are inseparably connected to most of the above-mentioned topics and directly interact and influence them on numerous levels. This becomes obvious when looking at some exemplary links between renewable energies, climate change and

- Social Market Economy: Global warming and the increasing occurrence of extreme weather events such as droughts or floods already threaten uncountable livelihoods and equitable economic participation all over the world. Renewable energy technologies, on the other hand, hold an immense potential to create new decentralized employment opportunities and enable access to electricity as an important foundation of sustainable socio-economic development.
- Human Rights: The access to clean water, electricity and food security is a basic human need and a fundamental right, which will (continue to) be severely threatened by the effects of climate change. Against this backdrop, renewable energies will play a crucial part in respective mitigation strategies and approaches.
- Democracy: Democracy depends on political participation in order to be and act as a true representative of its people. This includes the access to information, communication with elected representatives and the opportunity of expressing political opinions freely – processes which, in our digital age, are only possible if access to electricity and the internet is guaranteed.
- International Dialogue and Cooperation: Climate change is a global challenge; therefore, the approach of addressing and mitigating climate change also needs to take place on a global scale. In the light of the common threat of the very basis of our existence, international cooperation and mutual efforts gain more significance than ever before.

With this in mind, we consider the dissemination of relevant information through public platforms and publications such as the one at hand as an important contribution to awareness-raising, strategic planning and sustainable policy making. This book is part of a triumvirate of publications which deal with the subjects of "Smart Grids and their potential in Namibia's electricity sector", "Economic Impacts of the deployment of renewable energy technologies in Namibia" and "Energy Storage systems and their applications in Namibia's electricity sector", which look at the status-quo of renewable energy technologies, their potential and current applications in Namibia. Against this backdrop, I would like to express my gratitude to author Dr. Detlof von Oertzen and implementation partner Mr. Harald Schütt; without their invaluable expertise and input, these publications would not have been possible.

Sincerely,



Thomas W. Keller
Resident Representative
KAS Namibia-Angola

1 PURPOSE AND LIMITATIONS

This paper reflects on the economic impacts likely to be associated with the upscaling of renewable energy technology deployment in Namibia's electricity sector.
The discussion presented is neither comprehensive, nor definitive. Most aspects raised in this paper are qualitative and aimed to provide a high-level perspective rather than offer a detailed view. An in-depth quantitative analysis would be required to allow for more definite and tangible conclusions to be reached.

Despite these limitations, this paper identifies several important economic indicators, which allow for a first assessment of the likely economic repercussions resulting from an accelerated uptake and use of renewable energy technologies in Namibia.

2 BACKGROUND

Energy is the foundation of many of the most important economic activities. It is also a prerequisite for national development. Most energy consumption data shows that a steady increase of energy supplies is necessary to sustain growing populations and secure our lifestyles.

The investment decisions we make in today's energy sector determine – to a considerable degree – which energies will be used in the next decades, how much these will cost, and what their impacts will be. Large-scale investments lock in the costs and benefits of today's choices, often over many decades, irrespective of whether these are agreeable or not. The effectiveness of the future energy sector, and its ability to power our economy, is therefore shaped by decisions taken in the past, as well as those we must take today. Such choices depend on how well decisions are made, who they will principally benefit, and what their costs and benefits are. It is therefore critically important to reflect on the energy choices we make, and their repercussions and legacies.

Worldwide, the growth of our energy use has manifested itself in a variety of ways. The negative impacts associated with our ever-increasing consumption and voracious appetite for energy are evident.

Abundant fossil fuels have powered an era of unprecedented global growth and economic development. On the other hand, there is an increasing realisation that the negative impacts resulting from the exploitation of finite energy resources leads to the degradation of ecosystems. The services derived from intact land, water and air resources, and the energy sector's overall footprint on the global environment, are both noticeable, and not sustainable.

The scale and resource intensity associated with the global energy industry's activities negatively affect the availability of arable land, potable water, and fresh air, and their long-term productive potentials. Fossil fuels in particular create a multitude of negative environmental impacts, including those associated with particulate and gaseous emissions, environmental resource degradation, and many others.

National economies depend on a multitude of inputs and conditions to retain their ability to effectively deliver the goods and services needed for growth and development. As stated before, the energy sector is an important pillar of most economies and can significantly shape a country's development prospects. The driving forces exerted by the energy sector are particularly evident when the sector underdelivers, or is reshaped by political, regulatory, financial, and/or technological changes. Therefore, national energy supplies must be resilient to withstand external shocks, and be designed to securely, reliably, and cost-effectively power economic development.

Today, contemporary energy markets face several potentially disruptive forces resulting from the introduction of renewable energy technologies. Not only have some renewable energy technologies witnessed unprecedented cost reductions over the past decade, but technologies such as wind and solar photovoltaics are increasingly outcompeting well-entrenched energies.

The arenas where the greatest changes are likely to occur include well-established centrally supplied markets, such as those that characterise the electricity industry. Change is also likely in activities that have never-before been of interest to commercial investors, such as rural energisation. Because some renewable technologies can be deployed in a decentralised manner, these have the potential to unlock vast and as yet untapped markets.

In this way, clean energy could reach communities that have yet to taste their benefits.

In a world in which environmental criteria are of increasing importance, the limited negative impacts associated with renewable energy technologies are an advantage. And, as discussed in this paper, the economic benefits associated with renewable energy technologies, are another key determinant propelling their uptake and use.

Several recent studies have focused on the potentials and contributions that renewable energy technologies make on national economies, such as for example the pioneering assessments undertaken by the International Renewable Energy Agency, IRENA. In 2015, IRENA estimated that the global renewable energy sector employed almost 10 million people [1].

IRENA also developed a conceptual framework to analyse the environmental, social, and economic value brought about by the large-scale uptake of renewable energy technologies [1]. Their assessment approach focuses on quantifying the socio- and macro-economic impacts associated with renewable energy technologies. It shows that renewable energy deployment has a predominantly positive impact on many national economies. Country-specific resource endowments, policies, and regulatory regimes play a cardinal role in determining their net benefits. In countries with supportive frameworks, upscaling renewable energy technologies bolstered the gross domestic product, created new jobs, and cost-effectively delivered clean energy services to un- or underserved areas. This paper investigates these aspects in further detail, focusing on Namibia's electricity sector.

3 SCOPE

This paper provides a qualitative perspective on the likely economic impacts brought about by the increased deployment and use of renewable energy technologies in Namibia's electricity sector.

While presenting a small part of the total national energy sector, today's electricity sector is most imminently faced with the changes introduced by various emerging renewable energy technologies.

The remainder of this paper covers the following topics:

- Section 4 introduces the conceptual approach used in this paper;
- Section 5 illustrates the potential development pathways for Namibia's electricity sector, using two contrasting scenarios of the country's electricity future;
- Section 6 identifies and discusses the potential economic impacts of the two electricity future scenarios used in this paper;
- Section 7 presents some conclusions; and
- a reference section lists the bibliographic sources used in this paper.

4 CONCEPTUAL APPROACH

This paper focuses on some economic indicators to qualitatively identify, assess, and discuss the likely impacts associated with the deployment of renewable energy technologies in Namibia's electricity sector.
The following economic indicators are addressed in further detail:

- the creation of new and permanent jobs resulting from the upscaled deployment of renewable energy technologies;
- the impacts on human welfare resulting from such a deployment and use; and
- the impact that the addition of renewable energy technologies is likely to have on Namibia's gross domestic product.

The impacts on the economic factors identified above are described in the context of two contrasting future energy scenarios, namely

1. a business-as-usual electricity future, which assumes that the country will continue to meet its electricity supplies in ways that resemble the practices used in the recent past; and
2. a so-called REEE-powered electricity future, which assumes that a large-scale uptake, deployment and use of renewable energy and energy efficient technologies is to take place and is accompanied by the introduction of suitable decentralised energy storage options whenever these are viable.

5 SCENARIOS FOR NAMIBIA'S ELECTRICITY FUTURE

This section describes two future energy scenarios to illustrate the potential development pathways for Namibia's electricity sector. These scenarios are then used to assess and illustrate their high-level economic implications and impacts.

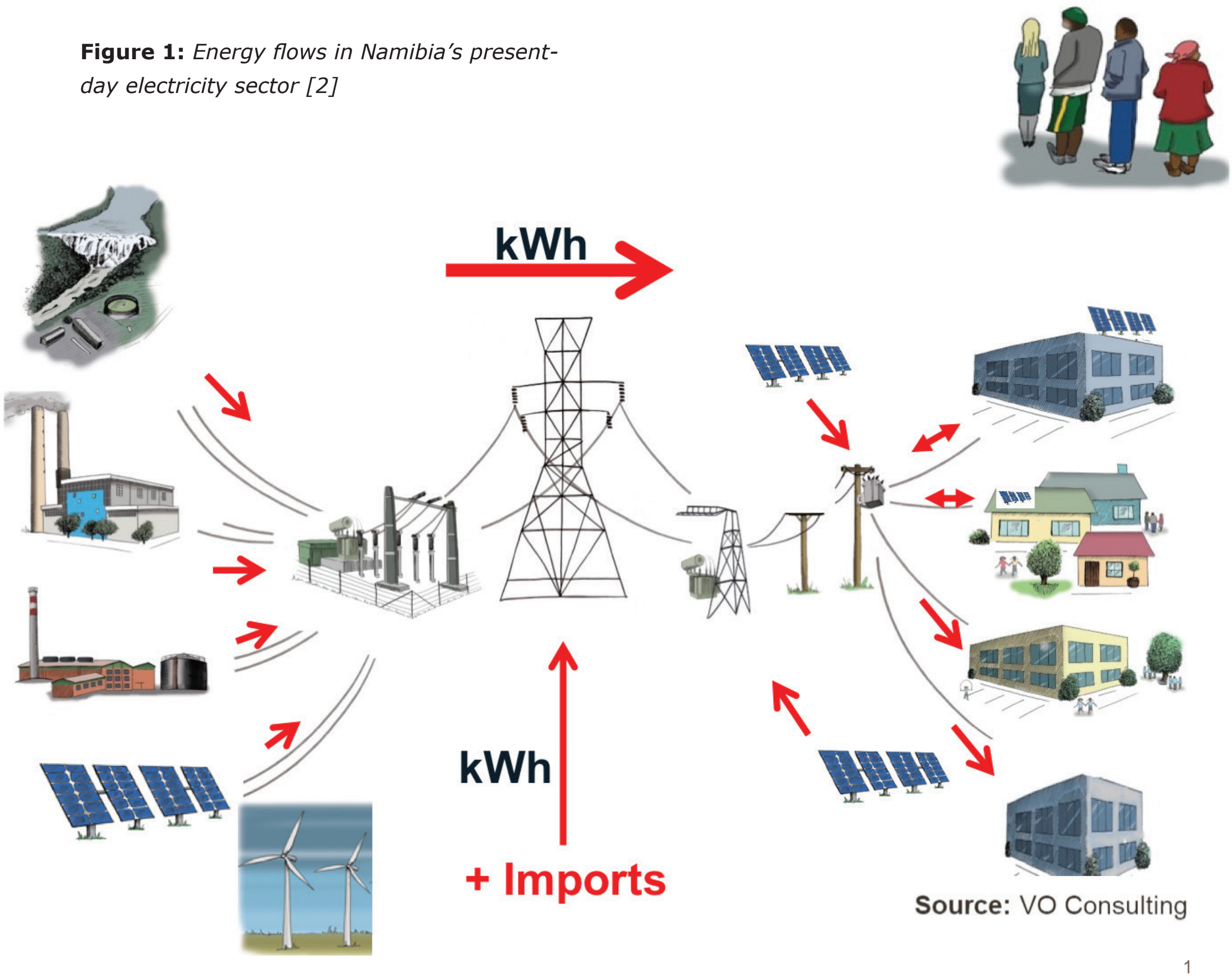
5.1 The Business-as-Usual Electricity Scenario

Namibia's present-day electricity supply system is designed around a handful of generating assets, and an electricity transmission and distribution network that supplies end-users via long, unidirectional grid connections, as is shown in Figure 1.

Namibia's present-day electricity supply infrastructure has been vital in supporting the country's development. For this to continue, and for additional positive economic stimuli, considerable changes are required. These include adapting the current market structure, embracing new technologies, and applying transparent price signals to incentivise investments and the efficient use of supplies. However, the current architecture of the country's electricity grid only provides for simple one-way energy transfers to those who are connected to the grid and can afford such services.

However, and as demonstrated by our high reliance on imported electricity supplies, Namibia's current electricity supply system no longer meets local needs. In addition, the prevailing business models applied by industry

Figure 1: *Energy flows in Namibia's present-day electricity sector [2]*

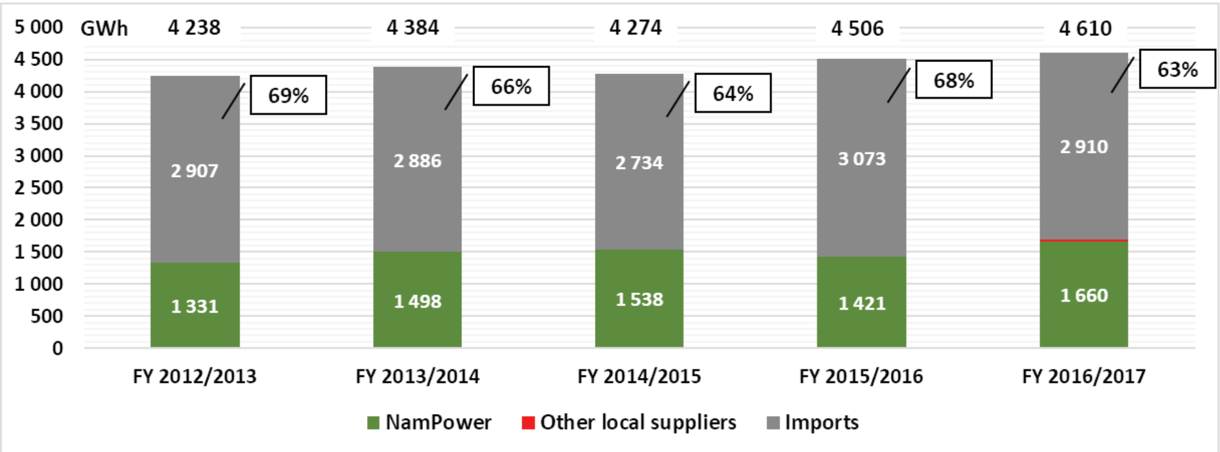


face rapid obsolescence. Today, competitive pressures are reshaping the electricity market, and decentralised supplies, energy efficient technologies, and to a lesser extent electricity storage options, make their presence felt.

One of the supply sector's challenges is Namibia's high import dependency, as illustrated in Figure 2, which is the result of insufficient national generation capacities. In addition, substantial year-on-year increases of end-user tariffs, and the slow pace of rural electrification, and many other factors, increasingly constrain the capacity for further economic growth, and thereby limit national development.

For the business-as-usual electricity future, it is assumed that the country's import dependence remains high, that investments in local generation capacity remain limited to NamPower and a few Independent Power Producers, that few additional electrification efforts are undertaken, and that annual increases of end-user tariffs remain above the average inflation rate. For the purposes of this paper, this scenario defines the baseline conditions that shape the country's economy. From the context in which this scenario is used in this paper it is evident that a business-as-usual scenario is considered unlikely, since it is unable to meet the needs of the country's present-day economy and is certainly unfit to power Namibia's economy in future.

Figure 2: *Electrical energy contributions between 2012/2013 and 2016/2017, in GWh [3]*



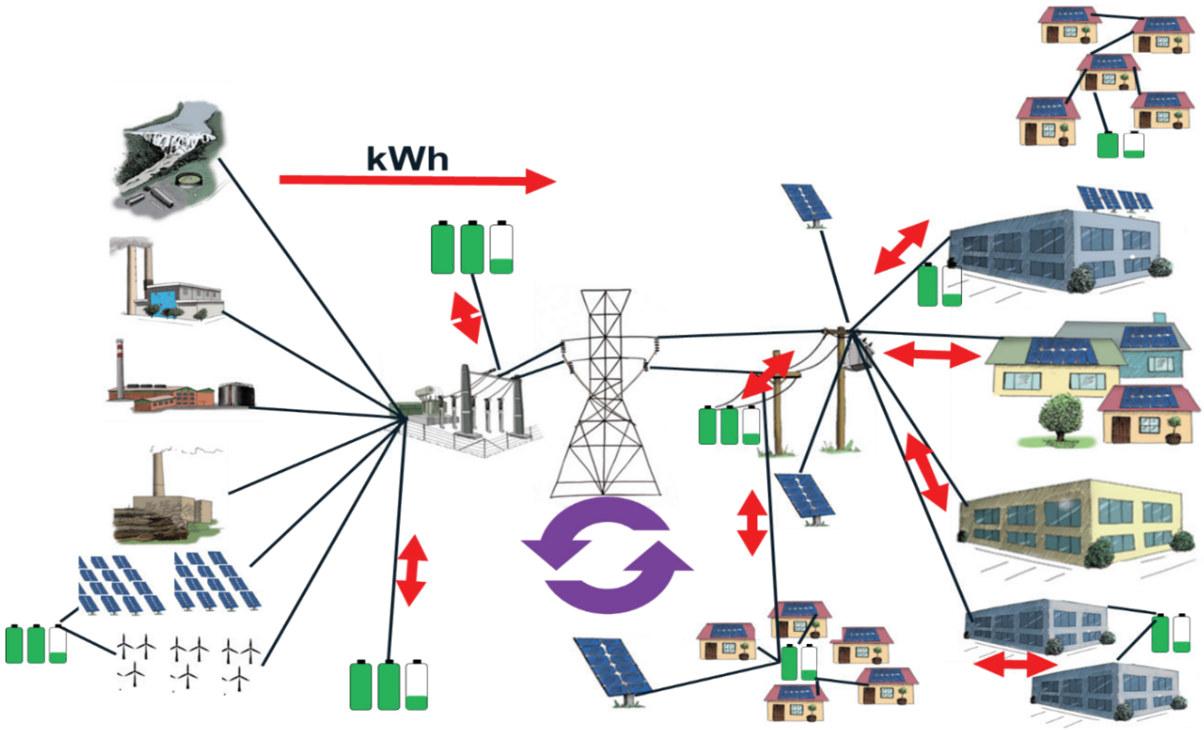
5.2 The REEE-Powered Electricity Scenario

REEE-powering is understood to mean the deliberate uptake and integration of renewable energy, energy efficient and energy storage technologies, to purposefully and deliberately create local value and thereby drive Namibia's development [4].

There are several reasons why tomorrow's electricity industry will be markedly different from what it is today: numerous decentralised renewable energy technologies are finding their way into today's and the future's electricity market. These will significantly reshape the supply side of the country's electricity industry.

In addition, contemporary energy efficient technologies, as well as energy storage options allow end-users an unprecedented control over how and when they will generate and consume electrical energy. And, because of the decentralised nature in which many modern renewable energy technologies, energy efficient and energy storage options can be deployed, new and cost-effective ways will allow end-users who have remained decoupled from grid services to gain access to basic levels of electricity supplies without having to join the grid.

Figure 3: *Namibia's REEE-powered electricity future scenario [5]*



Namibia's REEE-powered electricity future scenario, as schematically depicted in Figure 3, is envisioned to create integrated electricity supplies that render the country's electricity grid stable, secure, and cost-effective, and benefits from multiple decentralised and indigenous generation supplies. Such a future scenario is to ensure that electricity is available to consumers, as and when demanded, at a cost-reflective price that economically active consumers consider affordable.

Investments in the sector are incentivised and geared to maximally benefit from Namibia's sustainable energy resources, especially the country's abundant solar, wind and biomass energy resources.

On the electricity demand side, regulatory clarity and tariffs have triggered numerous private investments in electricity generation, energy efficiency and demand side measures, as well as energy storage. Most electricity consumers are aware of the benefits of investing in self-generation, energy storage and energy efficient appliances, and actively participate in demand side management measures, which in turn ensure that the national electricity network remains stable, and financially viable.

Electricity consumers recognise and value the benefit of service-oriented electricity utilities, which avail a suite of client-specific services. Electricity tariffs have successfully been capped, thereby benefitting the economy as a whole. Off-grid programs provide most households with access to modern energy services, albeit elementary in some cases.

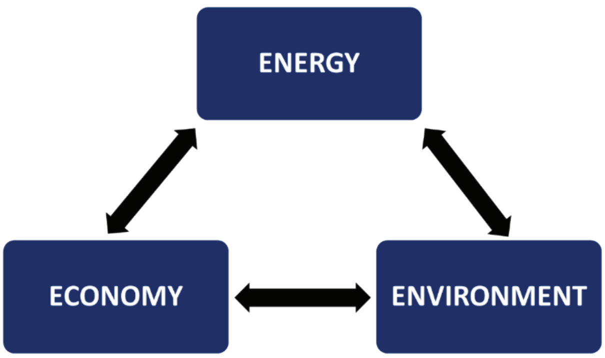
Future-oriented utility business models have been implemented, enabling clients to benefit from their own investments in renewable energy technologies, storage, and energy efficient equipment, as well as their active participation in demand side management measures. A commitment to service excellence and the provision of value characterises the country's electricity utilities, and has, in its wake, accelerated the development of the electricity sector, and energised the national economy.

6 ASSESSING THE POTENTIAL ECONOMIC IMPACTS

All modern economies rely on electricity to provide a part of the overall energy needs. Direct supplies are those that are either generated locally or are imported. Indirect electricity supplies are those embedded in imported goods and services. This paper focuses on direct electricity supplies only, and therefore only considers locally generated and imported electricity.

As an essential element of many contemporary economic activities, electricity supplies influence a country's gross domestic product (GDP), contribute to create jobs or lead to job losses, and are an important human welfare driver. Most economies also rely on multiple products and services derived from the environment. Here, mining, processing, and manufacturing are prominent examples where natural resources are used and converted. Such activities necessitate access and use of resources, such as minerals, water, and air (and many others), which are examples of environmental services which many of the key economic processes rely on. In this way, energy and environmental factors exert an influence on a country's economy, as is schematically depicted in Figure 4.

Figure 4: *Interrelationships between energy, the environment and a country's economy [6]*



Extractive processes that rely on the presence of intact environmental services can power an economy until such resources become exhausted or are replaced. These have created the foundations of most modern economies. However, as most environmental services are finite, they may not be available to meet all requirements in future. This realisation has spurred the creation of the so-called 'green growth initiatives', which aim to optimise the productivity of resources while minimising their environmental footprint.

The emergence of environmentally benign and cost-effective renewable energy technologies is one of the prime drivers with the potential to steadily divorce the trade-off between a country's economic growth on the one hand, and the preservation of natural resources on the other.

A transition to an energy system that is predominantly based on renewable energy resources therefore creates unique opportunities to balance a country's divergent economic, energy and environmental imperatives. This is especially important when considering the enormous additional requirements to energise populations that have remained without adequate access to energy, as is relevant across the African continent, including in Namibia.

A direct challenge, when shaping the energy supply systems of the future, is therefore how to optimally balance the demand for the energy required for economic growth and development, while limiting the negative environmental impacts associated with an ever-increasing energy use.

This paper focuses on the linkages and relationships between Namibia's electricity sector, and the country's economy and environment, and focuses on

- how new and permanent jobs are created when the electricity supply upscales the deployment of local renewable energy technologies;
- the impacts that such changes would have on human welfare; and
- the associated impact on Namibia's gross domestic product.

The above factors are separately discussed in the sections below.

6.1 Impact on Jobs

An economy must create jobs for national development to take place. Jobs imply wages, which spur demand for products and services, reduce poverty, improve personal satisfaction, and create a notion of a secure future for people. New and permanent jobs also create other societal benefits, which are of key importance for an economy. Specifically, paid jobs increase household consumption, and positively contribute to aggregate demand, which may in turn create additional jobs, resulting in a positive feedback loop.

IRENA estimates that the international renewable energy sector supported some 9.8 million direct and indirect jobs in 2016, including direct jobs in large hydropower plant [1]. In China alone, the renewable energy sector employs more than 3.4 million people, with the solar PV industry accounting for 1.6 million jobs, some 80% of which are in manufacturing [1]. In Brazil, about one million people are employed in the renewable energy sector, mostly in liquid biofuels, given the considerable labour requirements associated with a continuous feedstock production. In the United States, the solar, wind and bioenergy sectors offer some 0.7 million jobs, and 0.5 million people are employed in India's renewable energy sector.

Overall, employment varies significantly across renewable energy technologies. Solar photovoltaics (PV) is the single largest renewable energy technology employer, accounting for some 2.5 million jobs in 2014 [1]. Such employment figures are the result of a rapidly increasing global production of solar PV panels, and the associated reduction of costs, which further accelerates their global deployment and uptake.

Of note is the role of distributed solar PV, especially in Africa, which has seen the creation of innovative business models to enhance affordable access to clean energy services. Even in countries without a manufacturing base, the distribution, installation and after-sales services associated with solar PV applications create long-term local employment, often in areas that have traditionally witnessed little or no investments and prospects for jobs.

Internationally, employment figures in a business-as-usual scenario would see some 13.5 million jobs in the renewable energy sector by 2030, which equates to an average increase of some 2% per annum, out of a total of almost 51 million jobs across all energy sectors. A doubling of the share of renewables in the global energy mix by 2030 is projected to increase direct and indirect employment in the sector to 24.4 million, which represents an annual growth rate of 6% until 2030 [7]. The largest beneficiaries of these employment trends are countries that have clear policy and infrastructure commitments in renewable energy, and particularly those with a strong deployment and manufacturing base.

While jobs are instrumental in growing a country's GDP, and contributing to a nation's overall welfare, this section focuses only on the immediate job-creation potentials associated with the deployment of renewable energy technologies in Namibia's electricity sector. In early 2018, an estimated 700 persons are directly and indirectly active in the country's renewable energy sector, not including those employed in government, the national utility, and regulatory authority. Of these, an estimated 40% joined the sector since the country's first commercial Independent Power Producer (IPP) became active in 2015.

Since the commencement of the Interim Renewable Energy Feed-in Tariff (REFIT) Programme in 2015 [8], and several embedded IPPs becoming operational in the supply areas served by Regional Electricity Distributors, and the introduction of net metering, the country's total installed renewable energy electricity generation capacity has increased by more than 100 MW, noting that the total capacity of roof-mounted solar PV installations can only be estimated, and excluding the generation capacity of NamPower's Ruacana hydropower plant.

6.1.1 Solar Photovoltaics (PV)

In a business-as-usual electricity future, and once the 14 Interim REFIT installations of 5 MW capacity each, the 37 MW Hardap solar PV plant, and the 20 MW GreeNam solar PV plants are operational, the annual growth of solar PV capacity is assumed to be capped by the rate of access allowed by the electricity distribution entities. This is expected to result in an addition of an estimated 15 to 25 MW per year for roof-mounted solar PV plant, if the economy maintains a growth rate exceeding 2% per annum.

In contrast, in a country that embraces the value of REEE-powering, and based on Namibia's energy policy [9] and renewable energy policy aspirations [10], and its international commitments including the Intended Nationally Determined Contributions [11], annual additions of solar PV installations ranging between 30 and 50 MW capacity are considered likely. Here it is noted that a continued increase of the average annual electricity demand of 4% implies a capacity increase of some 25 MW per year.

The long-term job creation potential associated with the solar PV industry is estimated to amount to between 20 and 25 persons per installed MW of generating capacity, not including the short-term increase in jobs during construction.

Based on these estimates, annual new local jobs created in the solar PV industry alone therefore range between 250 and some 400 jobs for the business-as-usual scenario. The corresponding increase in a REEE-powered future, from solar PV only, could exceed 750 jobs per year.

Considering that other renewable energy technologies are likely to be added in coming years, for example in the wind energy and bush-to-electricity sectors, as well as in energy efficiency and energy storage, the job creation potentials are considerable.

6.1.2 Wind Energy

In early 2018, Namibia has a single wind farm, i.e. Ombepo south of Lüderitz, with a generation capacity of 5 MW. Unlike the solar PV sector, Namibia's wind energy sector is infantile, and little practical experience and know-how exists other than with the operators of Ombepo. It is for this reason that the impacts discussed below are more speculative than in the case for solar PV, and that some skills are likely to remain unavailable locally.

The wind energy sector's job creation potential is estimated to amount to between 2 and 4 persons per installed MW of generating capacity, again not taking short-term construction increases into account.
The business-as-usual scenario assumes that the 44 MW Diaz wind farm commences operations. A REEE-powered electricity sector could result in the unlocking of several hundred MW of wind capacity, notably in Namibia's south-western coastal regions. This would however necessitate considerable investments in additional transmission and energy management infrastructure, as well as a change in the current market structure.

Based on the qualitative estimates above, local jobs created in the wind energy industry depend on the scale of to-be-undertaken projects. The business-as-usual scenario is expected to add more than 80 permanent jobs, but this estimate depends on which skills sets can sustain themselves in the sector if the number of future projects remains small. A REEE-powered electricity future, on the other hand, could see the creation of several hundred direct and indirect jobs, if several large-scale wind farms are established. This however seems speculative at present as the business case of large-scale wind farms is yet to be made.

6.1.3 Bush-to-Electricity

Bush-to-electricity initiatives hold considerable potential to create new and permanent local jobs. The fledgling biomass value chain is currently not geared to permanently supply one or several power stations with biomass fuel. This necessitates that all supply elements are strengthened. However, the upscaling potential across the value chain is considered good, and local industry initiatives are likely to meet future supply requirements once an anchor client or more with long-term supply needs are establishing themselves.

The entire fuel supply chain needs to be upscaled to reliably provide biomass for a continuous end-user. This includes biomass harvesting and processing, as well as transport, storage, handling, and processing prior to its use in a power station. There are several different approaches in which the value chain elements can be strengthened, each implying their own job-creation potentials. For this reason, the job creation estimates provided in this section remain speculative.

The value chain required to continuously feed a 20 MW bush-to-electricity power plant necessitates an up-stream direct and indirect workforce of between 200 and 600 persons, excluding the jobs created at the power station itself. This implies that an estimated 12 to 36 permanent jobs are created per MW of bush-to-electricity generation capacity added, including power station staff. If 100+ MW capacity is deployed in a REEE-powered future, up to 3 000 permanent jobs could be created, most of which in rural areas, where job-creation conditions are challenging.

6.1.4 Enhancing Access to Electricity

Reflections about the job-creation potential of renewable energy technologies are incomplete if the potentials associated with creating access to new electricity services are not considered. As such potentials are especially relevant for rural Namibia, this section only reflects on jobs created through rural energisation efforts.

In 2018, most practitioners agree that conventional electrification efforts, resulting in the connection of end-users to the electricity distribution grid, are too expensive and yield insufficient returns to justify them. This implies that it is unlikely that significant in-roads will be made in grid-connecting large numbers of additional rural households.

However, not expanding access to clean energy services in rural Namibia has many undesirable repercussions too. These include low rural productivity, rural poverty, and rural-to-urban migration, to name but a few. This is as much a political challenge as it is an economic one, i.e. how can finite resources be most optimally used to create access to energy services in rural Namibia.
The capacity of the rural distribution grid is limited.

Also, costs associated with the establishment of new connections in sparsely populated areas are considerable. This implies that large-scale access to basic electricity services is often more effective when using decentralised generation options powered by renewable energy technologies, including by stand-alone systems, micro- as well as mini-grids. Such approaches create numerous new jobs in installation, marketing, and servicing, many of which close-by where customers live. Evidence-based employment creation figures are not available, but estimates indicate that at least one permanent new job would likely be created per 30 to 40 new decentralised household connections.
Considering that more than 200 000 rural households remain without reliable access to clean energy [12], a new emphasis on rural energisation holds considerable job creation potentials, which would likely add several thousand jobs in rural areas. Their potential could be further strengthened if such access to electricity is at least partially used for productive purposes, thereby establishing new rural revenue generating opportunities, with a positive impact on other sectors across the economy. In this way, investments in access to rural electricity supplies may create jobs other than those related to the distribution and servicing of newly connected households, and specifically include jobs associated with the introduction of new services in rural areas. Productive end-use opportunities, in agriculture, production and value addition to locally produced goods must therefore be a key consideration when energising rural areas in future.

Without an assessment of the type of businesses that could be established as a result of increasing access to clean energy services in rural Namibia, it is futile to speculate on the number of persons that will find employment. However, based on the above estimate that at least one person is likely to be employed per 30 to 40 households supplied with basic decentralised electricity services in rural Namibia, at least twice as many people are expected to create new businesses and thus find employment if such services become available. This implies that the energisation of 100 000 rural households could add an estimated 2 500 local jobs required for installation, maintenance, and service provision, and an additional 5 000 jobs from new businesses benefitting from the new energy services. It is beyond the scope of this paper to quantify the net economy-wide employment impacts resulting from creating a rural energisation drive, but the above estimates provide a first order-of-magnitude estimate of the possible rural implications of such a venture.

It is concluded that the large-scale deployment of renewable energy technologies to provide access to basic energy services in rural Namibia holds important and significant economic benefits and is expected to exert an economy-wide positive flow-on effect, including the creation of additional employment.

6.1.5 Sector-wide Job Potentials

The above discussion focused on direct and indirect jobs needed to realise electricity generation and supply projects. In addition, it is important to realise that the increased deployment of renewable energy technologies creates numerous indirect 'spin-off' jobs, to serve those that have found employment in new local endeavours. While beyond the scope of this paper, the creation of indirect jobs, especially for non-specialised and unskilled services, could readily exceed all direct jobs created.

One aspect relates to the provision of training, and the upskilling of the workforce to meet new requirements. Such activities in turn create both direct and indirect employment, as new skills and workforce capabilities are added through the strengthening of local value chain elements. A high-level estimate suggests that additional job requirements for training will add between 1/10th and 1/5th of the actual number of persons who find work in newly established value chains.

If the uptake of renewable energy technologies were to displace fossil-fuelled plant, one would expect that job reductions could result across these sectors as renewable energy technologies gain ground. However, in 2018, far less than 1% of locally supplied electricity is generated by fossil-fuelled plant, while Namibia continues to import more than 60% of its electricity requirements. This implies that it is not considered likely that job losses in the local fossil fuel sector would result from an accelerated uptake of renewable energy technologies. This paper will therefore not attempt to quantify such losses.

6.2 Impact on Human Welfare

Good policies create lasting social benefits. They include aspects such as improved employment, advancement of health and education outcomes, and an overall net increase in human well-being. Strengthening overall societal benefits directly addresses and reduces poverty.

Indicators such as health and welfare are important yardsticks to show whether social benefits are achieved, and whether these improve in time. This section therefore asks whether health and welfare outcomes are strengthened by the increased deployment and use of renewable energy technologies. Here, the indicator of societal health is understood to measure the absence of sickness and preventable malaise, while the welfare indicator expresses how well the economy creates social benefits given Namibia's finite human, environmental and financial resources.

Conventional economic measures, such as a nation's GDP, only provide a limited view on progress indicators such as socio-economic advancement and human welfare. Therefore, this paper uses welfare as an aggregate indicator to reflect on health, education and environmental impacts attributable to economic activities.

A recent study found that the global impact of renewable energy deployment is positive, increasing GDP by up to 3.7% [1]. The study suggests that "*the benefits of renewable energy go beyond the traditional and limited measurements of economic performance…(and) improve human welfare in a much broader manner and in a way that allows for future long-term growth and positive socio-economic development*" [1].
To reflect on the welfare impacts associated with an increased deployment of renewable energy technologies, this paper discusses three pillars which serve as proxies for human wellbeing. They include social, environmental, and financial measures, i.e.

- investment and growth of human capital through health and education;
- productive use of natural resources by the economy; and
- sustainable investment, consumption and use of financial resources underpinning such a transformation.

6.2.1 Impact on Health and Education

This paper uses a social metric to assess whether and how the deployment of renewable energy technologies could lead to improvements in national health and education outcomes. It is noted that the most important health impact associated with renewable energy technologies is the reduction of pollution. This is of special importance where coal- and diesel-fired power stations are replaced with clean electricity generation technologies. In addition, when households use polluting cooking facilities, and candles and paraffin lamps for lighting, and these are replaced by clean renewable energy technologies, the positive impact on the health outcomes of households has been shown to be substantial.

Education outcomes, particularly in un-electrified areas, are often cited to improve with the arrival of electrification options, irrespective of how such electricity is generated.

The difference between conventional grid electrification and decentralised rural energisation using renewable energy technologies primarily come about because of the potentially much larger scale of applications of the latter. As mentioned before, grid electrification of rural areas is often more expensive than using renewable energy technologies. The same amount of funding therefore ensures that a greater number of people benefit from access to energy using renewable technologies. Of note is that the revenues from electricity delivered via conventional grid lines is seldom sufficient to render such infrastructure economically viable, in contrast to new delivery models using decentralised renewable energy technologies.

6.2.2 Impacts on Access to Energy

Access to energy is critical to improve human welfare. Specifically, access to reliable, cost-effective, and environmentally benign energy sources is considered an important driver of national development, especially in view of potentially improved health outcomes, job creation potentials, improvement of access to water and food, and the positive impulses from poverty alleviation measures.

When including initiatives to improve the productive use of energy, especially in rural settings, additional sources of household income and employment are created, and distribution, installation and supply activities have additional positive repercussions on the total supply chain associated with such energy generation options.

6.2.3 Environmental Impacts

Environmental impacts associated with energy use in general, and the electricity industry, are manifold. The increased deployment of renewable energy technologies will reduce environmental pollution, for example as a result of renewable energy technologies displacing fossil-fuelled power stations. Such switching holds positive environmental benefits.

However, the materials required to create renewable energy technologies necessitate large-scale mining, processing, and manufacturing. It can therefore not be concluded that the resource impacts and those on the natural environment which are associated with the large-scale uptake and use of renewable energy technologies are necessarily benign. In fact, the increased consumption of finite raw materials, as needed to increase the share of renewable energy technologies, is a cause of concern, and the environmental degradation associated with the expansion of the sector is therefore likely to be sizeable.

6.2.4 Impacts on Investments

As for the investment, consumption and use of financial resources associated with the up-scaled deployment of renewables, it is evident that new investments, including by entities other than electricity utilities, must increase. In view of stricter investment requirements and investment selection criteria, for example those associated with triple bottom-line investments, there is likely to be a greater emphasis on investments in renewables. In addition, and in tandem with such developments, is the broadening of entities wishing to participate in such investments, including the insurance industry, and others.

6.2.5 Conclusions

Based on the above reflections, the Namibian human welfare metric is expected to be positively affected by providing large-scale access to clean electricity, which is associated with an improvement of health and education outcomes. Also, air quality is likely to be improved, on a household level, nationally, and internationally. On the other hand, additional mining, processing, and manufacturing processes are likely to increase the environmental burden, associated with the increased use of environmental services used by such activities.

Investments in new productive assets, such as renewable energy plant and equipment, are expected to have a positive impact on the welfare metric defined in this section.

It remains speculative whether direct investments in health or education create a larger overall societal benefit than comparative investments in renewable energy technologies, even though it is considered likely. However, despite Namibia's limited investment volumes, the health and energy sectors, or the education and energy sectors, are not directly competing for the same funds despite all of them being part of a single national budget.

It is concluded that the large-scale deployment of renewable energy technologies is expected to have a net positive impact on air quality, access to basic electricity services, and positively affect health and education outcomes. Therefore, and provided that negative environmental impacts associated with an increased use of natural resources is minimised, the above factors will jointly exert a positive impact on human welfare and its development in Namibia.

6.3 Impact on Namibia's GDP

This section considers the economic impact that the upscaled use of renewable energies may have on Namibia's gross domestic product (GDP). A country's GDP is the total value of all final goods and services produced in given a period. An increased GDP therefore implies an improvement of production capabilities.

6.3.1 International Perspective

Internationally it was shown that a doubling of the share of renewables in the overall global energy mix increases the global GDP by between 0.6% and 1.1% in 2030, when compared to a business-as-usual energy future [1]. Such an increase would imply a global increase of GDP valued between USD 700 billion and USD 1.3 trillion [1].

Most positive impacts on GDP are explained by the investments required to deploy renewable energy technologies, which stimulate the economy. Here it must be noted that investments in general have an invigorating impact on a country's GDP.

6.3.2 Energy Investment Requirements

New investments influence the growth of GDP the most. This is important, as the capital-intensive nature of renewable energy technologies necessitates considerable new upfront investment flows, also when compared to other electricity generation alternatives. In other words, new capital infusions are necessary to create new physical assets. For renewables, most of the total cost of such energy plant is required in form of capital investments.

Renewable energy technologies mostly necessitate upfront capital, while having small operating costs. An exception are biomass-powered electricity generation plant, which have an ongoing fuel requirements, and which therefore imply that their capital and operational requirements are similar to fossil-fuelled generation plant. In case of the latter, these are often characterised by moderate initial capital requirements, but necessitate recurrent fuel expenditure over the life of the asset. Such long-term cost usually become a most appreciable expenditure when viewed in proportion of the total lifetime cost. In contrast, solar and wind plant do not incur fuel costs. This keeps their operational expenditure much-below those technologies that rely on fuel costs which are linked to the exchange rates of foreign currencies.

Economic growth is a key indicator of a healthy economy. A critical impact of economic growth is the positive impact on employment, which generates national income and integrates people into the mainstream economy. When personal and national income increases, the standard of living increases. As the wealth of a country's population increases, government benefits from higher taxes, which in turn can be spent to further develop the economy. When corruption and mismanagement siphon off such national income, funding to create new opportunities is lost.

As an economy grows, and as long-term assets degrade, recurring investments in additional energy infrastructure are essential. These are most viable when their upfront plus long-term capital flows required to create and operate such energy supply systems are as small as possible, while ensuring that the environmental services required to provide such services are not irreversibly degraded over the life of such assets.

6.3.3 Productive Resource Use

A key driving factor of new economic growth is the unlocking and productive use of resources. While Namibia's solar, wind and biomass resources are not new, a critical external factor that can further unlock these resources is rapidly changing in their favour. In particular, the arrival of cost-competitive technologies that allow for the increased uptake and use of renewable resources is a critical game changer. This implies that technological advancement has created a resource which can now be utilised to grow GDP. This aspect has profound implications, especially for a country as well-endowed with renewable energy resources as Namibia.

In addition to technological advancement and progress, there is an increasing global realisation that investments in electricity supplies powered by renewable energy resources is financially and economically attractive and yields competitive long-term returns.

In the past decade, this has created a vast portfolio of new investment finances, specifically aiming to create physical infrastructure, including in developing countries. This is an important development with significant repercussions for Namibia: increased investments in energy infrastructure created economies of scale, both in manufacturing as well as in installation capacity. These factors contributed to lower electricity costs, thereby being a positive stimulus for economic growth and development. Cheaper electricity implies that the cost of productive and consumptive assets can be lowered, and therefore become accessible to more people. When the cost of goods falls, or a consumer has more disposable income to invest in additional goods and services, the impact on the GDP is positive. The fact that electricity from locally employed renewable energy generation plant provide long-term price stability, and predictability, often over decades, implies that such generation options remain protected from exchange rate fluctuations and unpredictable commodity price developments. This represents another significant factor favouring investments in renewable energy technologies, rather than alternative options.

Therefore, provided that new electricity assets are competitively procured, and the legal and regulatory framework conditions do not change unpredictably, increases of Namibia's GDP as a result of investments in the upscaled deployment of renewable energy technologies are most likely.

In this context, high guaranteed feed-in tariffs, as offered under Namibia's Interim REFIT programme, are attractive for investors, but keep electricity prices higher than a competitive market would supply. While such tariffs are important to kick-start an industry, they prevent advancements in generation technologies to benefit electricity end-users. This delays the arrival of broad-based value that can lead to a society-wide upliftment and advancement. Similarly, political interference in markets, e.g. by way of quota systems, increases the overall risk of investments, increases output costs, reduces investor appetite, and dries up much-needed investments, none of which are good for a country's economy.

6.3.4 Impact of Investments on GDP

Investments boost the GDP. Therefore, as substantial investments are needed to strengthen Namibia's electricity sector, to wean the country off imports, and cater for much-needed economic growth, these factors can contribute to a growth in the country's GDP. To meet the national electricity demand using local sources, the economy must attract investments. If these are realised, they create local jobs, improve energy security, enhance access to energy and create environmental benefits. As has already been noted above, this does not address the question whether investments in renewable energies yield better societal returns than those in other important areas, such as education or health. But seeing that investments in all these sectors are needed to create a robust economy, investments in the advancement of local renewable energies is seen as one of the core areas and not the only one that is of national importance.

The positive impact of investments in renewable energy technologies is particularly evident as local small- and medium-scale enterprises can readily become engaged across the sector's value chain. In contrast, a monopolised electricity supply sector offers few if any commercial niches to third-party providers. It is for this reason that the reform of Namibia's single buyer market is important. And there are numerous other opportunities that must be addressed too: rural electrification is one such example, where the more decentralised provision of electricity would create opportunities for innovative supply concepts, as are already taking place in other countries.

An important ingredient of positive impacts on the GDP resulting from renewables relates to the creation of new business models, as required to supply services in a non-centralised manner. In rural Namibia in particular, these may lead to the establishment of new installation and service companies, which creates local employment and spreads investments to beyond a handful of utilities or Independent Power Producers.

Decentralised jobs are well-suited to spread income-generating opportunities across rural areas, where development opportunities, access to services and employment opportunities are often in short supply. Strengthening decentralised electricity supplies is therefore also expected to create positive ripples throughout the economy. Creating jobs and strengthening livelihoods through the targeted introduction of productive activities in agriculture, small-scale manufacturing, and services, infuses new cash and positive momentum into rural economies. These in turn strengthen fledgling supply chains, thereby invigorating local growth and spreading economic benefits.

6.3.5 Creating Virtuous Investments

The education, health and service sectors would particularly benefit from having more reliable access to energy, particularly in rural Namibia. While electricity is a prerequisite to provide education and health services, and establish rural service offerings, such services will stimulate additional investments in strengthening their supply chains. In this way, virtuous investments which create local value contribute positively to the provision of rural services, which fosters national development.

Such a virtuous cycle is illustrated in the following example: a Regional Electricity Distributor decides that it can provide electricity services to a greater number of households in its area of responsibility, specifically by inviting service companies to introduce energy supply services to provide decentralised off-grid electricity. By strengthening the focus on the productive use of electricity by end-users and delivering electricity services that exceed those that people would traditionally have access to, household income is increased while allowing for positive health and education impacts to be realised. Such services create the jobs that are needed to supply the services in the first place, while an increase in the disposable income of households triggers further economic activities, which in turn daw in new service providers to meet such needs. This broadens the income base of electricity off-takers, while invigorating the economic activities of end-users, especially in areas that have little or no prospect to be grid-electrified.

The above illustrates a positive feedback loop that is powered by virtuous investments. Such reinforcing feedback loops are set in motion by creating access to clean energy services and promoting initiatives to encourage the productive use of energy. In this way, end-users are no longer mere service recipients, but have the means to create value from energy services. This can facilitate the improvement of health and education outcomes, while increasing the disposable incomes of households, from savings on other energy expenditure, and by creating local value and monetising it. And it is the recirculation of financial resources, in contrast to the export of local earnings, through the economy that benefits consumers, enhances local capacities and value addition, and stimulates positive national economic development.

7 CONCLUSIONS

Namibia's future electricity supply is at an important juncture: the sector could oppose the progressive developments envisioned in recent policy and regulatory efforts, to perpetuate the business-as-usual approach that relies on substantial electricity imports and implies a permanent and considerable annual export of capital, to the detriment of the country's economy.

Alternatively, new generation projects could be initiated, resulting in the displacement of imports. However, if such new generation assets use resources priced in foreign currencies, local electricity consumers pay for such exposure throughout the life of such assets. A third option, namely REEE-powering Namibia, envisions that electricity imports are displaced by locally generated supplies powered by renewable resources, without remaining perpetually dependant on electricity imports and foreign exchange developments.

The performance of Namibia's electricity sector in delivering power to spur national development has many facets. On the one hand, Namibia has benefitted from near-continuous electricity supplies, unlike most other regional economies. The reliability of these supplies has been exemplary and must inspire the goals by which the sector's performance is measured in future.

However, in perspective, the performance of the country's electricity sector remains sub-optimal. Amongst the challenges are high end-user tariffs, a sluggish pace of investments in much-needed electricity infrastructure including generating plant, a high rate of customers which remain without access to electrical energy, and the strategic risk of remaining dependant on foreign supplies.

It must be noted that high end-user tariffs are the result of Namibia's efforts to introduce cost-reflective tariffs across the electricity supply sector. The absence of ongoing state subsidies to keep electricity costs below the true cost of supplies is an important factor that differentiates Namibia's supply realities from those of other countries in the region, and such tariffs bode well for new investments and longer-term electricity price stability. Support tariffs were recently introduced, to shield the most vulnerable consumers from annual double-digit tariff escalations. However, the effectiveness of tariff subsidies is limited, and will not sustainably invigorate the country's economy.

Most recent investments in electricity sector assets were made by Independent Power Producers (IPPs). The ones active in the solar PV and wind sectors benefit from high feed-in tariffs. These are good to earn above-normal returns on investment but provide only a limited stimulus to fire up the economy. Investments in generation assets by the national utility NamPower have time and again been delayed, despite its strong credit rating, and exclusive status as the country's single buyer of electricity. In future, while it is important that the pace of investments in Namibia's electricity sector is accelerated, it must be ensured that electrical energy is procured at rates that remain attractive to investors, while limiting the negative impacts on end-user tariffs and the economy. The procurement of capacity must allow competitive market forces to work in tandem with regulations to cap the cost of future supplies.

At some 71%, Namibia's urban electrification rate is considered reasonable when compared to regional access rates, except those in South Africa. Considerable rural-to-urban migration places a substantial burden on Regional Electricity Distributors and other electricity distributing entities, which implies that the creation of new connections providing access to electricity in urban areas is much lower than the steady inflow of new arrivals. In contrast, rural Namibians are dramatically underserved when it comes to access to electricity: with less than 20% of rural households having access to electricity, the need and potential for future investments is huge. It is here where innovative supply concepts must find their application, and where new investment approaches going beyond those described in the country's Rural Electrification Master Plan are needed most. From an economic perspective it is important to realise that the provision of access to clean energy will not automatically translate into additional economic benefit or national development. It is therefore imperative that electrification efforts, both by way of the extension of the current electricity distribution grid and by using new rural energisation approaches, include the introduction of productive activities that create revenues when new connections are made.

Lastly, Namibia's electricity sector has been a steady exporter of capital. While purchases for electricity generated in the region have secured local supplies, the ongoing outflow of capital is a cause of concern. Local and national development cannot be expected to take place if vast amounts of capital leave the country every year. Namibia's dependence on electricity imports is a legacy that remains largely hinged on the use of an outdated market model, the single buyer model, and a lack of investments in new generation facilities by NamPower. The latest National Integrated Resource Plan, completed in 2016, describes several scenarios to illustrate how least-cost investments are to be made when constrained by different policy approaches. Cabinet endorsed both the National Energy Policy and the National Renewable Energy Policy in 2017. Hampered investments are therefore not merely a question that policies are absent, or unclear. Rather, as is evident across the Namibian economy, it is the lack of dedicated implementation of policy that delays progress. This aspect remains the prerogative of the Namibian line ministry responsible for energy, i.e. the Ministry of Mines and Energy (MME). It is the MME that must identify and empower those that are to implement policy. And it is this juncture that must be strengthened for Namibia to benefit from investments in the country's electricity sector. Implementation includes how goods and services are procured. This hinges on how the Public Procurement Act and Public Private Partnership (PPP) Act are applied to create value that translates into economic development and broad-based benefits.

Regarding investments in renewable energy technologies to power national development, this paper emphasises the need for a future-oriented market framework to incentivise investments and attract least-cost supply options. In view of the current budget constraints faced by Government, it is imperative that the private sector's appetite for investments is translated into actual projects. Merely indicating an intention to realise a project is insufficient.

New investments, for example by IPPs and as PPPs, are well-suited to produce tangible local investments, provided that current hurdles can be addressed. In line with Namibia's policy pronouncements, and its international undertaking as a signatory of the Paris Climate Accord, considerable inroads can be made by focusing on renewable energy technologies that benefit from the country's vast endowments in solar, wind and biomass resources. Investments that add value to local resources can readily provide much-needed local electricity supplies, without having to bet the development of the economy on the whims of imported electricity supplies or foreign exchange developments.

8 REFERENCES [1]

1. IRENA, 2016, Renewable Energy Benefits: Measuring the Economics, http://www.irena.org/documentdownloads/publications/irena_measuring-the-economics_2016.pdf
2. Detlof von Oertzen, 2012, Namibia's Energy Future – A Case for Renewables, http://www.voconsulting.net/pdf/energy/Namibias%20Energy%20Future%20-%20A%20Case%20for%20Renewables%20-%20lores.pdf
3. Based on data from NamPower's Annual Reports, refer to http://www.nampower.com.na/Media.aspx?m=Annual+Reports
4. Detlof von Oertzen, 2015, REEE-powering Namibia – Energising National Development, http://www.voconsulting.net/pdf/REEE-powering%20Namibia.pdf
5. Detlof von Oertzen, 2017, Energy Storage Systems and their Potentials in Namibia's Electricity Sector, http://www.kas.de/wf/doc/kas_49900-1522-2-30.pdf?170825134027
6. VO Consulting, www.voconsulting.net
7. IRENA, 2015, Renewable Energy Integration in Power Grids, http://www.irena.org/DocumentDownloads/Publications/IRENA-ETSAP_Tech_Brief_Power_Grid_Integration_2015.pdf
8. Electricity Control Board, www.ecb.org.na
9. Namibia's National Energy Policy, http://www.mme.gov.na/files/publications/fd8_National%20Energy%20Policy%20-%20July%202017.pdf
10. Namibia's National Renewable Energy Policy, http://www.mme.gov.na/files/publications/03f_National%20Renewable%20Energy%20Policy%20-%20July%202017.pdf
11. Namibia's Intended Nationally Determined Contributions, http://www4.unfccc.int/ndcregistry/PublishedDocuments/Namibia%20First/INDC%20of%20Namibia%20Final%20pdf.pdf
12. Uli von Seydlitz & Detlof von Oertzen, 2017, Scoping Study - Towards a 50% Electrification Rate in Namibia, on behalf of the Namibia Energy Institute for the Ministry of Mines and Energy.

1 *Internet addresses provided in this section were verified on 12 March 2018.*

Konrad
Adenauer
Stiftung