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SA Future Economy

ENERGY FUTURES IN SOUTH AFRICA

Hany Besada, PhD

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List of acronyms			
AREI	African Renewable Energy Initiative	NGOs	Non-governmental organisations
CCS	Carbon capture and storage	O&M	Operations and maintenance
CSP	Concentrated solar power	PV	Photovoltaic
DOE	Department of Energy	RE	Renewable energy
ECOWAS	Economic Community of West African States	REFIT	Renewable energy feed-in tariff
EEU	Eurasian Economic Union	REFSO	Renewable Energy Finance and Subsidy Office
FIT	Feed-in tariffs	REPS	Renewable electricity portfolio standard
GVCs	Global value chains	RO	Renewables obligation
IPPs	Independent power producers	ROCs	
IRENA	International Renewable Energy Agency	RVCs	Renewables obligation certificates
IRP	Integrated resource plan	SADC	Regional value chains
JET	Just Energy Transition	SMEs	Southern African Development Community
LCOE	Levelised cost of electricity	SWHs	Small and medium enterprises
NDP	National Development Plan	UNECE	Solar water heaters
NERSA	National Energy Regulator of South Africa		United Nations Economic Commission for Europe

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1. Introduction

Africa is rich in energy resources but poor in its ability to exploit and use them. Many African countries face an energy crisis. Power is inaccessible, unaffordable and unreliable for most people, trapping them in poverty. Also, Covid-19 has increased the triple challenges of unemployment, poverty and inequality. The central argument of this paper is that the problem of poverty, unemployment and inequality in South Africa can be solved partly by a transition to renewable energy (RE). It claims that RE policy has been ineffective and makes seven sets of recommendations: investing in energy infrastructure; technology transfers; improving access to electricity on a large scale; boosting cross-border power trade; improving the performance of existing utility companies; creating regional energy value chains; and helping countries chart low-carbon growth paths. Understanding where the opportunities for tapping this wealth exist and where shortages occur is fundamental to developing these solutions but, until now, this kind of information has not been exploited (UNEP 2017). In addition, access to sustainable and affordable energy services is a crucial factor in reducing poverty in developing countries (Terrapon-Pfaffn et al. 2014). Several studies also indicate that the creation of regional energy value chains fosters development, since they contribute to job-creation and poverty-reduction benefits. Winkler (2005) notes that investment in renewable energy (RE) and energy efficiency is important to reduce the negative economic, social and environmental effects of energy production and consumption in South Africa.

Currently, renewable energy contributes relatively little to primary energy, and even less to the consumption of commercial energy. The purpose of this paper is to provide an analysis of the available literature and data on the development of renewable energy in South Africa and to suggest policy options for achieving the objectives. The paper is organised as follows: Section two examines South Africa's energy sector. Section three discusses the drivers and opportunities for renewable energy deployment in South Africa. Section four identifies the challenges of RE deployment in South Africa. This section is followed by a discussion of strategies and policies for RE deployment in South Africa (section five). Section six covers the policy proposals for RE in South Africa, followed by a discussion on the creation of regional energy value chains as a strategy for RE development (section seven). Section eight discusses the steps and measures being taken by South Africa to support green coal policies. Section nine discusses the role of gas in renewable energy transition. This section is followed by section ten, which explores Southern countries' experiences in transiting to renewable energy, and section eleven provides some concluding recommendations.

2. An Examination of South Africa's Energy Sector

The 1998 White Paper on Energy Policy for the Republic of South Africa (WPEP '98) was already quite specific: Government policy on renewable energy is concerned with ensuring that an equitable level of national resources is invested in renewable technologies and with addressing constraints on the development of the renewable energy industry (Worldwide Fund [WWF] 1986). In line with the 1998 White Paper, the Campaign for a Just Energy Future was launched by civil society representatives in 2016 to promote access to clean, affordable, reliable and safe energy in South Africa (International Energy Agency [IEA] 2020c). The campaign helped to stop the nuclear deal in 2017 and organised two community Indabas in 2018 and 2019 to discuss ways of shaping and challenging energy policy and decisions, as well as ways of contributing to the Just Energy Transition (JET) debate in South Africa (Halsey and Overy 2019). More can be said about the 'just transition' in South Africa. However, the issue of just transition is beyond the scope of this paper and more work will need to be done in this area. This paper is focused on policy options to develop the renewable energy sector in South Africa.

According to South Africa's Department of Energy (DOE), Eskom supplies roughly 95% of South

Africa's electricity and the remainder comes from independent power producers (IPPs) and imports. Eskom buys electricity from and sells electricity to countries in the region. However, South Africa plans to diversify its electricity-generation mix. Currently, about 90% of South Africa's generation capacity is from coal-fired power stations, about 5% from one nuclear power plant, and 5% from hydroelectric plants, with a small amount from a wind station, according to the DOE. South Africa has one nuclear power plant, Koeberg, with installed capacity of 1 940 MW. The country plans to expand nuclear power generation by 9 600 MW by 2030. South Africa's renewable energy industry is small, but the country plans to expand renewable electricity capacity to 18 200 MW by 2030. Efforts need to be directed towards achieving this sustainable energy target (Mokveld and Von Eije 2018). Reforming and restructuring ESKOM would strengthen the reliably of the power system, support increased industrialisation and help efforts to diversify the energy mix.

South Africa is richly endowed with fossil-based and renewable energy sources. However, a continued reliance on oil and gas, along with traditional biomass combustion for energy, will bring considerable social, economic and environmental challenges such as environmental degradation and climate change (IEA 2020b). Tackling today's energy challenge therefore requires a firm commitment to the accelerated use of modern, renewable energy sources. This is in line with Africa 2030, the International Renewable Energy Agency's (IRENA) comprehensive roadmap for the continent's energy transition, which sets out a viable path to prosperity through renewable energy development (IRENA 2015). Renewable energy is driven by a number of opportunities in South Africa, to which we now turn.

3. Drivers and Opportunities for Renewable Energy Deployment in South Africa

Modern renewables eliminate power shortages, bring electricity and development opportunities to rural villages that have never enjoyed those benefits, spur industrial growth, create entrepreneurs, and support increased prosperity across the country. Modern renewables can also facilitate a cost-effective transformation to a cleaner and more secure power sector (IEA 2020c). Some technology solutions are relatively easy to implement but require an enabling environment, with appropriate policies, regulation, governance and access to financial markets. However, successful scaling up of renewables requires the adoption of support policies, the promotion of investment and regional collaboration (IRENA 2015).

These commitments are aligned with the energy objectives outlined in the National Development Plan (NDP) 2030, which outlines a future vision for South Africa's energy sector. In terms of the NDP document, the sector intends to promote, among other things, economic growth and development through adequate investment in energy infrastructure and the provision of quality energy services that are competitively priced, reliable and efficient, as well as environmental sustainability through efforts to reduce pollution and mitigate the effects of climate change (Republic of South Africa [RSA], 2015). Research conducted by the CSIR shows that 'South Africa has the unique opportunity to decarbonize its electricity sector without pain' by dramatically increasing the percentage of renewables in its energy mix. Wind and solar power are now demonstrably the cheapest sources of power in the world and, through smart investments in electric vehicles and transport, the possibility exists to move away completely from the fossil-fuel heavy development paradigm that is destroying the world (WWF 2017).

In terms of the NDP 2030, South Africa will need clear long-term development strategies to address the challenges of poverty, unemployment and inequality while managing natural endowments in a sustainable manner. The government of South Africa is prioritising the issue of climate change and has set up a Presidential Climate Change Coordinating Commission, which is chaired by the

President. The Commission comprises representatives from government departments and state entities, business organisations, labour, academia, civil society, research institutions and traditional leadership. The Commission was formed to coordinate and oversee a just transition towards a low-carbon, inclusive, climate change-resilient economy and society. The Commission is tasked with advising on South Africa's climate change response. This includes mitigation and adaptation to climate change and its associated effects. It will furthermore provide independent monitoring and review of South Africa's progress in meeting its emissions reduction and adaptation goals (Seale, 2021; Gradl, & Jenkins, 2008).

The Integrated Resource Plan (Republic of South Africa 2019) outlines South Africa's plan for the procurement of generation capacity to 2030. It is an electricity infrastructure development plan based on the least-cost electricity supply-and-demand balance. It supports a diverse energy mix and sets out the following policy decisions that should be implemented to ensure the security of South Africa's electricity supply:

1. *Adopt a least-cost plan with the retention of annual build limits (1 000 MW for PV and 1 600 MW for wind) for the period up to 2030. This provides for the smooth roll-out of RE, which will help sustain the industry.*
2. *Make provision for 1 000 MW of coal-to-power in 2023 to 2024, based on two already procured projects. Jobs created from the projects will go a long way towards minimising the effect of job losses resulting from the decommissioning of Eskom coal power plants and will ensure the continued utilisation of skills developed for the Medupi and Kusile projects.*
3. *Make provision for 2 500 MW of hydro power in 2030 to facilitate the RSA-DRC treaty on the Inga Hydro Power Project in line with South Africa's commitments contained in the NDP Update to partner with regional neighbours. The Project has the potential to unlock regional industrialisation.*
4. *Adopt a position that all new technologies identified and endorsed for localisation and promotion will be enabled through Ministerial Determinations utilising existing allocations in the IRP Update. This approach is supported by existing electricity regulations. The Electricity Regulations on New Generation Capacity enable the Minister of Energy to undertake or commission feasibility studies in respect of new generation capacity, taking into account new generation capacity as provided for in the IRP Update. Such feasibility studies are expected, among others, to consider the cost of new capacity, risks (technical, financial and operational) and value for money (economic benefits).*
5. *Adopt a position that makes annual allocations of 200 MW for new generation for own use of 1 MW to 10 MW, starting in 2018. These allocations will not be discounted off the capacity allocations in the IRP Update initially, but will be discounted during the issuing of determinations, taking into account generation for own use filed with the National Energy Regulator of South Africa; alternatively, the Regulator (NERSA) (RSA 2019).*

The policy-adjusted scenario will result in a higher tariff of about 5% by the year 2030 compared to the least-cost scenario. This is the result of the smoothing-out RE rollout plan, which commissions plants earlier than they are actually required by the system, as well as the introduction of coal and hydro power. It should be noted this financial analysis does not take into account the economic benefits of a consistent and predictable RE rollout, the likely regional economic benefits of Inga hydropower, as well as the economic benefits of continued beneficiation from coal (RSA 2019).

South Africa has significant potential in renewables. Its biomass, geothermal, hydropower, solar and wind resources are among the best in the world. The abundance and high quality of renewable energy resources render renewables economically competitive, in particular as the costs of renewable technologies are decreasing rapidly. IRENA (2015) further observed that the renewable energy project deals concluded in Africa will deliver power at some of the lowest costs worldwide.

Modern renewables also offer great potential to empower local communities. These resources can be harnessed locally on a small scale, contributing to rural development and electrification without the cost of extending national grids to remote places. Local projects also offer economic opportunities to local communities.

The rewards accruing to South Africa to meet the challenge will be immense. Modern renewables can eliminate power shortages, bring electricity and development opportunities to rural villages, spur industrial growth, create entrepreneurs, and support the ongoing lifestyle changes across the continent. At the same time, leveraging renewables would facilitate a cost-effective transformation to a more secure and sustainable power sector (IRENA 2020). IRENA, through a number of cooperation instruments, works with African countries to support their efforts to appraise the full potential of modern renewable energies and their benefits (IRENA 2015).

The need for renewable energy stems from an input to discussions during the Leaders' Declaration issued at the G7 Summit held in Elmau, Germany on 7 and 8 June 2015. It was agreed to accelerate access to renewable energy in Africa and developing countries in other regions. It was noted accelerating the deployment of renewable energy would contribute to reducing energy poverty and mobilizing substantial financial resources from private investors, development finance institutions and multilateral development banks by 2020. Improving sustainable energy access in Africa by 2030 can be built on existing networks and initiatives (G7 Summit., 2015). Capacity additions are therefore expected to focus on wind energy, hydro power and solar PV (Roehrkasten, Thielges & Quitzow, 2016).

Renewables offer multiple benefits and opportunities in the African context. Firstly, they are domestically available. Net energy importers can reduce import bills by deploying renewables, whereas energy-exporting countries can increase revenues from fossil fuel exports and improve current account balances. In addition, renewables are cost-competitive. Recent data on renewable energy projects in Africa reveal that the levelised cost of electricity (LCOE) from solar PV and wind is significantly below the LCOE of oil-based power plants and, in some cases, even below the LCOE of new coal-fired power plants. Integrating renewables in diesel-based microgrids offers important cost savings (IEA 2020d). In addition, renewables can be deployed much faster than fossil fuel-based power plants. Renewables can also trigger additional economic benefits, such as job creation and socioeconomic development, in particular in rural areas. Finally, renewables are core components for any low-carbon strategy and offer important environmental co-benefits, such as improved local air quality and water security (Quitzow and Roehrkasten, 2016). However, accomplishing this requires clear policy signals, an enabling framework of laws, regulations and institutional setup, as well as viable business schemes to ensure the accelerated deployment of renewables. The challenges facing renewable energy also abound.

4. Challenges facing Renewable Energy Deployment in South Africa

The poor financial health of public utilities or SOEs is a major challenge for investment in South Africa's energy sector as a whole. This is further compounded by the high upfront investment costs of renewable energy projects. In addition, even though South Africa has established policies for the promotion of renewable energy sources in the past decade, the legal and regulatory frameworks often remain patchy and inconsistent. Technical challenges include the availability of resource data, operations and maintenance (O&M) skills at the local level, including repair and replacement, and system integration of fluctuating power from renewable energy sources (Quitzow and Roehrkasten 2016).

There also are attempts to entrench Eskom's monopoly in the energy sector (WWF 2017). Eskom is a vertically integrated utility that controls the transmission infrastructure and is by far the largest

electricity generator in the country. The independent power producers (IPPs) are wholly dependent on Eskom for the transmission of the electricity that they generate, and can also only sell to Eskom as the sole off-taker. Increasingly, concerns are being raised that Eskom is abusing its position to favour its own investment in new power plants, thereby in essence opposing the government's energy policy (Montmasson-Clair 2017; SAWEA 2017). Many would argue that Eskom is being disingenuous when it argues that renewable energy will be more expensive than the proposed 9.6 GW new nuclear build programme, with a projected cost of $50 billion (about R776 billion). Irrespective of how the financing is structured, an amount of this magnitude raises the spectre of crippling principal debt and interest payments that can lead to the reallocation of public budgets away from critical state spending (Scholtz and Fakir, 2017).

A number of important steps are needed to harness renewable energy in South Africa. Thus far, many African leaders have seen the opportunity that renewables present for their nations, and have announced national energy plans and targets that reflect this vision. The major role that government can play in promoting renewable energy in the electricity sector is to set a target. The key idea is a requirement that a small but growing percentage of South Africa's electricity supply should come from renewable resources. The South African government is already talking about such a target, and the draft White Paper on Renewable Energy suggests that an additional 10 000 GWh of renewable energy contribution should be achieved over ten years (United Nations [UN] 2020b). As power sectors and institutional frameworks mature, regulatory policies such as auctions and net metering are likely to be introduced. Policies are needed to entice private capital, which includes public-private partnerships, to share costs and risks, and to build capacity in local financial sectors to increase access to loans and other forms of financing (UN 2020a).

Regional cooperation is a mechanism that needs improvement: It is crucial to bring about efficiencies and economies of scale by deploying renewable energy technologies in a coordinated manner. Therefore, regional Southern African Development Community (SADC) cooperation and integration in the area of RE can build capacity to build regional value chains, using a business ecosystems approach under conditions of economic crisis, pandemics (Ebola, Covid-19), democratic reversals, natural disasters, and corruption and political conflict. A business ecosystem approach is particularly effective in the large-scale deployment of shared renewable resources for power generation. Adopting an integrated approach to trans-boundary issues such as trade, regulatory frameworks and policies, regional infrastructure and other cross-border issues allows countries to benefit from accessing regional renewable resources at affordable prices (IEA 2020d). Creating an overall enabling environment for renewables in Africa requires finding the right mix of policies and incentives, along with multi-stakeholder collaboration at the country and regional levels. A number of things need improvement: firstly, the current infrastructure requires maintenance and new infrastructure needs to be rolled out. The infrastructure has fallen behind what is required for the South African population, creating an opportunity to leapfrog and immediately introduce smart technologies in new infrastructure rollout. Secondly, the right kinds of incentives should be introduced to ensure that the economy can develop more effectively, with less corruption and less preferential treatment. Thirdly, policy support is necessary in implementation to provide explicit compensation, and a clear regulatory framework is required for the curtailment of undelivered power. This can be seen in the most recent rounds of the renewable energy independent power producers (IPP) programme in South Africa, which was launched a few years ago and has proven to be quite successful (Muzondo, Bridle, Geddes, Mostafa, Kühl, 2021).

South Africa can foster the transfer of successful business models to its own businesses, such as the small-scale off-grid renewable energy systems in Malawi, and support the private sector in adapting to the local context. The success of off-grid energy solutions, however, will depend largely on the extent to which they meet the energy needs of the underserved rural population, as well as their ability to pay (Danish Energy Management and Esbensen 2017). In particular, small-scale and

community-based renewable energy projects are recognised as important forms of development assistance for reaching the energy poor. However, to date there are only a few empirical evaluations that analyse and compare the effects of these projects on local living conditions and their sustainability ex-post implementation. Regional networks, partnerships and South–South cooperation should be intensified, because projects run by organisations with extensive established network connections and good links to the region and beneficiaries have higher success rates. Sustainable energy projects have positive effects on sustainable development (IEA 2020b). However, energy projects, even if only on a small scale, require continuous involvement and support (as opposed to one-off support) (Terrapon-Pfaffn et al. 2014). Renewable energy technologies, such as solar water heaters (SWH) and electricity generated from wind farms, concentrated solar power (CSP) and large-scale (more than 1 MW) solar photovoltaic (PV) systems, can be promoted further. These four technologies can make an extensive contribution to the renewable energy supply of South Africa, in addition to off-grid renewable energy systems (Edkins, Marquard, and Winkler 2010).

Renewable energy solutions are seen as contributors to creating a Smart City. South Africa has only recently started with Smart City initiatives. Current thinking has been to replicate international Smart City experiences in South Africa. However, it is questioned whether this is an optimal strategy, as differences in context might affect the delivery of services (Coetzee et al. 2015). Furthermore, although the implementation of renewable energy policies requires large initial capital investments, they are crucial to ensure both universal modern energy access and emissions reductions (IRENA 2020). Besides, low-carbon growth strategies offer important direct and indirect benefits. Sound energy-efficiency policies across all sectors will lead to significant net savings (Indo-German Centre for Sustainability [IGCS] 2014). Also, renewable energy promotion will provide economic, social and environmental co-benefits. These include reduced health impacts from greenhouse gas emissions and improved livelihoods from services associated with renewable energy industries, as well as decreases in the imports of fossil fuels. Small-scale manufacturing associated with renewable energy industries will also benefit from renewables development (Ouedraogo 2017).

In a related sense, setting targets connected to renewable energy can help put South Africa on the map by signalling that there is opportunity and potential for investments in similar projects. A target can be an important way to help draw attention to tap into foreign direct investment and potentially attract finance to some of those investments. Targets also provide a clear signal that there is political commitment, that there is a strategy in place and that renewables are going to be part of the national development agenda. Depending on how credible that commitment is, it can actually play an important role, particularly for lenders who are looking at the long-term viability of different infrastructure investments in a given market (Muzondo, et al., 2021). Energy master plans and regional initiatives that provide or include some form of renewable energy targets are useful. For example, in the Economic Community of West African States (ECOWAS) region, there has been success in creating regional templates for renewable energy targets across the region. The Sustainable Energy (SE) for All initiative enabled countries from across Africa to adopt concrete agendas and to start implementing the kinds of policies and regulations necessary to scale up SE (Muzondo, et al., 2021). South Africa's renewable energy policy to date has largely been driven by a 10 000 Gigawatt hours (GWh) target by 2013, and renewable energy project subsidies offered through the Renewable Energy Finance and Subsidy Office (REFSO). Nonetheless, under existing renewable energy policy, few renewable energy projects for electricity generation have been deployed. Solar water heaters (SWHs) saw some market growth through 2009, largely facilitated by an SWH subsidy and increased energy awareness due to nationwide electricity blackouts (Edkins et al. 2010).

5. Strategies and Policies for Renewable Energy Deployment in South Africa

In this section we suggest strategies and policies for enhancing renewable energy in South Africa. Most of the suggested action plans and strategies are practical, considering South Africa's capacity constraints. However, it is necessary that the strategies are well coordinated and supported by the State through clear policy and legal frameworks. Institutional arrangements should be put in place to support dialogue, provide oversight, coordinate implementation, and enable collaborative work. Policies should be clear, aligned with each other, and linked to timelines. Additionally, there should be legal tools to make such policies enforceable (Halsey and Overy 2019). South Africa already supports grid-connected renewables via feed-in tariffs, auctions, net metering and investment incentives. The South African auction programme has been especially successful in deploying renewables. While most renewable energy deployment was grid-connected in the past two decades, policies for decentralised approaches for rural electrification based on renewable energy need to be adopted. Regional power pools and renewable energy transmission corridors are important building blocks for the future expansion of renewable energy (Quitzow et al. 2016; Kumar and Majid 2020).

South Africa is already experiencing an energy transition. However, the big challenge is to ensure that this transition will indeed be fair and just. This will require a paradigm shift among all critical players to ensure that a transition indeed addresses many of the socio-economic challenges in the country. In this regard, there are a number of challenges that need addressing to ensure that the energy transition is fair and just. First, in the area of governance and decision-making, much work needs to be done to ensure that the governance structures and approaches are truly inclusive and transparent. Participatory democratic decision-making is a fundamental factor underpinning any transition (Quitzow, Röhrkasten, & Jänicke, 2016). All social partners, and especially affected communities, should be at the table when plans and decisions are made. Second, in the areas of policy and the regulatory environment, a massive review of existing policies and regulations governing the energy system in the country is required to ensure that the benefits of renewable energy are maximised in a transition (IRENA 2020). In addition, social policies would also need to be reviewed, especially to ensure the social protection of the most vulnerable.

Third, regarding capacity building, training and skills development, a scaled-up and targeted programme for building knowledge and skills within communities and the country as a whole is needed to unlock all the potential benefits in a transition. Fourth, regarding financing and investment, both public and private investment in renewable energy and its value chains should be scaled up (IRENA 2020). In addition, new financing models should be explored to ensure the funding and revenue-generation opportunities for decentralised socially owned energy systems. To date, there has been no nationally driven process for planning a 'just transition'. There are many initiatives and discussions on the issue, especially among non-state actors. However, there is a need for an inclusive process that involves all social partners in developing an overarching socio-economic transition plan for the country, which can help to inform and guide any sector or localised transition planning for South Africa's future (WWF 2017). The transition plan needs to consider the current economic crisis and the desperate need to secure a feasible post-Covid-19 economic recovery through turning to RE (Kuzemko et al. 2020).

Adopting a broad multi-scalar and multi-actor approach to the analysis of energy system change post-Covid-19 is necessary. Four key themes shape the politics of sustainable energy transitions:

1. *the short-, medium- and long-term temporalities of energy system change*
2. *practices of investment in clean-tech and divestment from fossil fuels*
3. *structures and scales of energy governance*

4. *social practices relating to mobility, work and public service. While the effects of the pandemic continue to unfold, some of its sectoral and geographically differentiated effects are already emerging. The politics of sustainable energy transitions is now at a critical juncture, in which the form and direction of state support for post-pandemic economic recovery taking advantage of renewable energy adoption will be key (Kuzemko et al. 2020).*

This means that South Africa should maximise the percentage of renewable energy in the country's electricity mix to bring about an energy future that is both least cost and most influential from a climate-mitigation perspective. The development of off-grid value chains should represent a particular priority (Quitzow et al. 2016). In addition, there should be maximisation and complementarity of the country's solar and wind resources, and an avoidance of investment in climate-unfriendly fossil fuels and expensive nuclear energy to provide base load. It is imperative to enable cities and municipalities to plan their own electricity-provision systems, allowing them the opportunity to both procure and build their own renewable energy plants, which is essential to ensure future sustainability. Policies on both the national and sub-national level should support private sector investment in renewable energy technologies through incentives, loans, etc. Pressure would need to be exerted on Eskom to ensure that the utility complies with its contractual obligation to sign the outstanding off-take agreements. Furthermore, any transition from fossil fuels to renewables should take place within the context of a 'just transition' that thoughtfully handles pressing socio-economic challenges, namely poverty and inequality (WWF 2017; Fattouh, Marquard, and Winkler 2019).

There is a need to strengthen the Renewable Energy Feed-In Tariff (REFIT), which was established in South Africa on the grounds that it has proved to be the most effective policy instrument to deploy renewables, as experienced in the German and Spanish examples of using of a feed-in policy. The benefits of a feed-in tariff include that the premium risk for investors can be minimised by establishing long-term assurance for their electricity sales at a set tariff. This allows for improved access to finance by developers, as well as market assurance, which is thought to drive renewable energy technology development and learning, resulting in lower costs of electricity generation from renewable sources in the long run. Furthermore, the deployment of a number of different technologies can be encouraged with a REFIT, resulting in a more diversified electricity supply (Edkins et al. 2010). Zhang, Feng, and Chen (2011) add that, in the power-generation sector, the best policies to reduce greenhouse gas emissions include the modification of existing oil and coal plants so they will run on natural gas, and the promotion of local renewable energy sources. This strategy allows for fuel diversification in power generation, which will increase energy security and reduces green gas emissions (Ouedraogo 2013). Diversifying energy supply away from coal would have many benefits, including a reduction in the number of premature deaths from pollution, but the social implications of changes would need careful management (UN 2020b).

In addition, investment-promotion measures are needed to attract both domestic and foreign investors, as well as encourage public-private partnerships to share investment costs, risks and benefits (IRENA 2020). In parallel, there is a need to raise awareness among local financial institutions about the grid-connected and off-grid renewable energy market. Regional cooperation should facilitate large-scale renewable energy deployment. By working together, African countries have the opportunity to become energy champions and innovators. However, the actual cooperation mechanisms, such as the African Renewable Energy Initiative (AREI), for example, should be used in a constructive and effective way, with commitments, governance rules and participation from the entire energy sector on the continent (such as civil society, private sector and academia, amongst others). Even with the large-scale implementation of renewables, off-grid renewable energy solutions are also highly important to improve access to modern energy services and contribute to poverty reduction. This would require dedicated policy and regulatory frameworks in order to boost potential investments (Pouget 2019). The following section examines the policy options for RE in South Africa and makes some recommendations for action.

6. Policy Proposals for Renewable Energy in South Africa

In this section, we explore the options for government to promote renewable electricity on a larger scale.

Fixing energy prices and targets

The major role that government can play in promoting renewable energy in the electricity sector is to set a target. However, to facilitate a 'just transition', the cost of transition should not be borne by vulnerable groups. In addition, Halsey and Overy (2019) suggest that there is a need to shield low-income households from electricity or energy prices via a social policy that includes differential pricing or subsidies. Such a target is a key mechanism for levelling the playing field for renewables in a context where their environmental and social benefits are not given a value by the market. In line with this, the draft White Paper on Renewable Energy suggested that an additional 10 000 GWh of renewable energy contribution should be achieved over ten years, i.e. 1 000 GWh/y, to be produced mainly from biomass, wind, solar and small-scale hydro (Winkler, 2005). Renewable energy targets should be revised periodically. They have to be specific, measurable, achievable, realistic, and time bound. There are two possible points of intervention for government policy: regulating the quantity of renewable electricity (for example, by setting targets for renewable electricity), and fixing prices through regulating tariffs (UN 2020a).

Fixing targets for renewable capacity cannot be done in isolation. There are several factors that need to work in sync when one is aiming for such a quantum jump in capacity. The first is whether we have enough standby capacity in the form of hydro or gas that can be put to use immediately should there be a drop in generation from renewable sources due to a sudden fall in wind velocity or unexpected cloud cover. There is also the question of availability of adequate transmission links to evacuate that power. For renewable generation, the transmission links have to be more dispersed and go well into the interior. The difference in gestation lag of renewable generation projects vis-à-vis transmission lines is a factor that has to be borne in mind. In fact, this is one of the major reasons why investments in renewable capacity have gone down (Dasgupta 2020).

Policy scenarios

The three scenarios discussed below demonstrate what could be done to achieve renewable energy for all.

Option 1: Electricity feed-in tariffs (FIT)

An electricity feed-in tariff (FIT) uses price as the policy instrument. Government sets a price for renewable electricity, usually differentiating tariffs between different technologies. Tariffs are set by an electricity feed-in law and are guaranteed for a specific period of time (Menanteau et al. 2003). The electricity feed-in law also requires distributors to buy all renewable electricity in their area. Germany's electricity feed-in law, for example, requires distributors to buy all electricity from renewable independent power producers (IPPs), but does not specify a percentage of renewable electricity to be achieved. Nonetheless, experience in Europe has been that this policy instrument has resulted in the greatest increases in capacity (Meyer 2003). The promise of good returns on investment due to relatively high, guaranteed prices is a major factor. In economic terms, the policy favours producer surplus. Proponents argue that a grid-feeder law in South Africa would require less bureaucracy than a government-set target and allow more flexibility for small producers. It would provide greater security for developers of renewable electricity plants by guaranteeing a market and a price (Contejean and Verin, 2017).

The FIT is likely to promote investment, given the security of guaranteed prices that power producers would enjoy. The renewable energy industry tends to favour this option. While FITs have resulted in large quantities of renewable electricity in Europe, it is not self-evident that this would be true in South Africa. However, for developing countries with severe budget constraints, the key limitation will be government's ability to pay for relatively high tariffs. FITs guarantee prices for developers, but would not provide certainty for the amount of renewable electricity that such a tariff would deliver under South African conditions. Given that the marginal costs of local renewable electricity production are not well known, the quantity produced by the change in price is not certain (Winkler 2005; Overland 2021).

Option 2: Renewable electricity portfolio standards

The policy instrument that most directly sets the quantity of renewable electricity is a portfolio standard. In this policy option, government sets a target through a renewable electricity portfolio standard (REPS), while electricity distributors have flexibility in how to meet the requirement. International experience with REPS is greatest in some US states (Rader and Hempling 2001), where laws setting targets for the renewable share of generation capacity have been passed in Arizona, Connecticut, Maine, Massachusetts, Nevada, New Mexico, New Jersey, Pennsylvania, Texas (2 000 MW under Governor Bush) and Wisconsin (Wiser et al. 2002). An REPS entails the following:

1. *A purchase requirement: Government sets targets for the share of electricity distributed as a percentage of sales for each distributor.*
2. *Resource eligibility: Eligible renewable electricity technologies would include solar thermal, wind, small hydro (10 MW), solar PV, landfill gas for power generation, biomass, wave, tidal.*
3. *Trading of credits: Economic instruments can be used to allow distributors to achieve the target at least cost, increasing the flexibility of the policy. As the industry is restructured into several regional distributors, individual distributors can be required to either achieve this percentage individually, or to buy credits from others who achieve more than their target. An REPS would be particularly important once the restructuring process in the electricity industry extends to wholesale competition to create an incentive for individual private generators to invest in renewables in a competitive market.*

Portfolio standards are generally envisioned as market-based policies in the sense that they use financial incentives rather than prohibitions to achieve policy goals. Several key concepts in portfolio standards are common to other market-based policies. Credits are an accounting mechanism used for compliance and are tracked in electronic databases, sometimes called registries. Lawmakers can choose the degree of flexibility regarding credit use in a portfolio standard, with potential effects on overall policy costs and benefits. Procedures to monitor, report and verify credits can help portfolio standards achieve their policy goals and reduce the risk of fraud.

A national portfolio standard might also have environmental effects compared to a business-as-usual scenario, depending on design choices such as source eligibility and the change from business as usual. Potential eligible sources vary in their greenhouse gas and air pollutant emissions, as well as other attributes such as water consumption and power density (which can affect land requirements). Implementation could affect environmental outcomes too. For example, deploying small-scale distributed eligible sources might have different effects than deploying large-scale eligible sources. Another policy consideration is potential interaction with state energy policies such as existing portfolio standards, electricity infrastructure siting and the use of competitive markets to influence electricity investment decisions (IRENA 2020).

Such interactions may generate debate regarding pre-emption and highlight potential regional concerns. The overall effect of a national portfolio standard on the South African economy would be

influenced by multiple factors. However, increased electricity costs could reduce economic activity, depending on the price response throughout the economy. Potential price responses are reduced electricity consumption, increased investment in efficiency measures, or reduced spending on other goods or services. Some price responses might have a minimal effect on overall economic activity, for example if consumers shifted spending from electricity consumption to energy-efficiency improvements (Lawson 2020). Strengthening efficiency throughout the economy would reduce the demand for both materials and energy, while the implementation of minimum energy performance standards for electric motors in the industry and mining sectors would be an important first step towards unlocking further efficiency gains

Option 3: Renewables obligation

Another way of fixing the quantity of electricity generated is a renewables obligation. The obligation 'sets aside' a quantity of electricity generation, which is put to tender. Competition focuses on the price per kWh, so that a price is determined through bidding. The renewables obligation (RO) is a mechanism designed to support large-scale renewable electricity generation. Through the RO, the Government places an obligation on all licenced electricity suppliers to source a proportion of the electricity they supply to customers from renewable energy sources. The renewables obligation is met by purchasing renewables obligation certificates (ROCs), either from renewable generators or from the ROCs market (Menanteau et al. 2003).

This differs, however, from the FIT, where government sets the price upfront. The price is guaranteed for the contract period once the tender process is completed. The additional costs are finally borne by green customers or taxpayers. For instance, the UK introduced a non-fossil fuel obligation (NFFO) programme in 1990 to promote renewable energy technologies and to pay the costs of nuclear stranded assets. In 2000, this was reframed as a renewables obligation (United Kingdom [UK] 2001). In this mechanism, the renewables capacity would be secured through contracts with renewables generators at premium rates (Nedergaard 2002). In this policy option, the regional utilities are obliged to purchase power from NFFO-awarded generators at a premium price. The difference between the premium price and the average monthly power pool purchasing price is subsidised through the Fossil Fuel Levy, as administered by the Non-Fossil Purchasing Agency. To help build a sustainable energy future, there is a need to invest in and support power plants that can generate renewable energy in order to hit ambitious Government climate reduction targets (UK., 2001).

Comparing policy options

Policymakers in South Africa will need to choose between the options and combine the elements most suitable for local conditions. Local issues that need to be taken into account in applying policy instruments from other countries include the goal of universal access to commercial energy services, constraints on government budgets and the relatively low price of electricity. However, the South African context differs significantly from the contexts in which most policy options for renewable electricity have been developed, viz. those of industrialised countries. Relevant differences include the fact that, despite a major electrification drive, about a third of the population remains without access to electricity (National Electricity Regulator [NER] 2001).

The three options outlined above each have both advantages and drawbacks. Some of the factors that might influence the choice of policy instrument are summarised in Table 1.

Table 1: Comparison of Policy Options to Promote Renewable Electricity			
	Option 1: Feed-in tariffs (REFIT)	**Option 2: Renewable electricity portfolio (REPS)**	**Option 3: Renewables obligation**
1. Ensures quantity of renewable energy and diversity of supply	No	Yes	Yes
2. Promotes investment by guaranteeing prices	Yes	No	Yes
3. Does not require government to pick a winner	If price is differentiated by technology	Depends on whether target is differentiated	Yes
4 Requires government investment	Yes	No	Yes

Source: Winkler (2005)

Given the significant demands on the government budget for other social expenditure, approaches that do not require direct government expenditure have an advantage. This would suggest that a REPS (option 2) would be an appropriate choice, while the renewables obligation (option 3) represents something of a compromise in that it sets a quantity but allows competitive bidding to set the prices. The key constraint is probably institutional capacity; if the government can build the capacity to administer such a process, this may become an option. A critical challenge for such an approach would be to prevent collusion between suppliers to drive prices up. Neither setting quantities nor regulating prices, however, would be sufficient on their own. To implement a policy option, government needs to create enabling conditions for the development of renewable electricity (Robert et al. 2020).

The three options outlined above each have advantages as well as drawbacks. Some of the factors that might influence the choice of policy instrument are summarised in Table 1. The renewable energy policy roadmap 3, with an electricity supply from renewable sources, is identified as the most favoured strategy for South Africa. Winkler (2005) observes that the strategy would create the most possible employment, well above a 100% change from the baseline of 2015, and would stabilise GHG emissions from the electricity sector. A mixture of wind (30%) and concentrated solar power (70%) would be the largest contributors to achieving this target by 2030, supported by the renewable energy feed-in tariff (REFIT). REFIT (option 1) will support the deployment until the technologies become cost competitive. From completing sensitivity analyses on roadmap 3, it can be seen that photovoltaic can play a more important role if higher technology-learning rates are encouraged by an effective REFIT with sensible tariff degression. If government guarantees a price through an FIT, it will be asked by utilities companies to compensate them for any additional costs. If government simply sets targets, industry has to find the least-cost way of meeting these, but is likely to pass on increased costs to consumers. Given the current government budget constraints, the government will be hard pressed to agree to large expenditure on guaranteeing renewable electricity tariffs. Getting the prices right, as would be required for government to determine the FIT, would be difficult – since there are few renewables, there is virtually no information on their marginal cost curve locally (Winkler 2005).

Furthermore, higher reductions in GHG emissions can be achieved at a lower cost compared to renewable energy sources by encouraging nuclear energy to supply the additional electricity demand from 2020. The price of electricity under projection is also below that of policy options 1, 2 and 3. Option 3 is the most economical strategy based on the assumption that the cost of nuclear

energy will not increase in the future. This shows that renewable energy policies aimed at substantial renewable energy targets, in particular the REFIT, can encourage GHG savings and employment without requiring too much additional private and public investment over and above the baseline projection (Edkins et al. 2010). The following section examines the creation of regional value chains as an approach to develop renewable energy in South Africa and the broader African region.

7. Creation of Regional Energy Value Chains as a Strategy for Renewable Energy Development

As South Africa embarks on a transition to sustainable energy, and the role of IPPs is expanded to make up for the supply shortfall, localisation must be prioritised through proactive policy informed by widespread stakeholder engagement. Similarly, Pasquali, Shane, and Nadvi (2020) observe that regional value chains (RVCs) are increasingly considered key features of 21st-century globalisation. In this regard, the creation of regional energy value chains is useful in fostering development. Energy value chains can have significant job-creation and poverty-reduction benefits. For instance, the International Renewable Energy Agency (IRENA) estimated that, by 2017, 76 000 jobs were created across African countries in renewable energy value chains, from manufacturing to operation and maintenance. The energy value chain includes all activities necessary for the production, distribution and consumption of electrical energy. There are five major segments: fuel procurement, electricity generation, transmission, distribution and the end-market or service location (Power Futures SA 2019).

In addition, regional value chains and cooperative partnerships can help Africa industrialise – and avoid the many uncertainties of fierce global competition. These regional variants of global value chains can be viewed as production systems from input provision to commercialisation, spread beyond national borders to exploit existing complementary activities within a region. These complementarities could include differentiated labour costs and productive capabilities, natural resources or geopolitical features such as maritime access, and trade agreements with extra-regional partners (World Economic Forum 2021).

Broadly speaking, South Africa can pursue two models of regional value chains; first, it can be outward looking and supply global markets or, second, it can be inward looking, with development intended for regional consumption markets. Import-substitution regional value chains consider products that are both produced and consumed within the same region, creating potential complementarities and merging production capabilities with consumption potential. This type of regional value chain has the advantage of being intraregional and, as such, does not face barriers to entry (Weigert and El Dahsha 2019). However, local capabilities need to be enhanced across the renewable energy value chain. Capacity building is a central priority in South Africa. IRENA pays particular attention to energy value chains. For example, in recognition of the essential role of the reliable data provided by IRENA, energy statisticians across Africa have been trained in the collection, processing and dissemination of renewable energy data, as well as in the construction of national renewable energy balances. There is an urgent need for increased co-operation between energy sectors at all levels, from strategy and planning to policies, budgeting, procurement and implementation. There is a particularly strong need for innovation in delivery and financing models, and dedicated financing schemes by banks and financing institutions. Innovation should also be encouraged and promoted in the design of suitable and efficient devices appropriate for rural areas. Implementing the right ecosystem for accelerating off-grid renewable energy deployment requires efforts to develop the necessary human capital by building capacity across the off-grid value chain and supporting local entrepreneurship (IRENA 2019).

The regional value chains (RVCs) enable the end product (finished product) to be exported, either

globally or regionally, by a country in the region. RVCs therefore offer opportunities to the countries in the region to climb up the value chains by using the region to boost their competitiveness and produce and export higher value-added products. Well-established RVCs in South Africa can also provide an opportunity to the countries in the region to link gainfully to global value chains and to increase their bargaining power with the lead firms. If these issues are not addressed systematically, then local businesses will struggle to integrate into the large international supply chains that provide goods and services for infrastructure manufacturing and assembly, installation, operation and maintenance. In terms of local content policies, South Africa is among several developing countries that require local and international renewable energy investments to bring local businesses into their supply chains (IRENA 2020).

The level of localisation that is necessary in the renewable energy value chain is linked to the extent to which the different aspects of this value chain can be carried out, operated, owned or financed by local employees, businesses or financial institutions and investors. The independent power producers are mandated to drive localisation in South Africa as part of local economic development requirements. If renewable energy value chains are not localised effectively in developing countries, then much of the business and economic value of these investments is lost to foreign economies. The manufacturing of components and construction of infrastructure generate significant economic value. However, there are challenges to localisation – renewable energy value chains may promise potential jobs, but without appropriate skilling or reskilling of workers (in the case of workers in the coal industry), this potential is significantly limited. Therefore, there is a need for adequate, long-term planning and investment for appropriate education and training to meet the needs of the renewable energy sector. In addition, countries may get stuck at the bottom of the value chain, unable to move up it, and may continue exporting low-end and low value-added inputs, with lower gains in terms of domestic value addition and diversification (UNCTAD 2018).

The academic literature shows that there is consensus amongst observers that, for businesses to effectively integrate poor people into value chains through access to finance, markets and other resources, companies need a supportive ecosystem (Gradl and Jenkins 2011). For example, many small and medium enterprises (SMEs) in South Africa require financial and technical support to start and scale up their innovative solutions. Similarly, large multinationals require the local knowledge of non-governmental organisations (NGOs) or local small and medium enterprises to access low-income markets. It is noted that many of the challenges facing businesses in Africa also apply to inclusive businesses operating on the continent: unclear regulatory and policy environments, a lack of infrastructure, high levels of illiteracy, and a lack of knowledge and skills. Therefore, regulatory reform and government support are crucial for enabling low-income people to participate in the formal economy and to be integrated into value chains, as many of them do not have legal documentation for their informal businesses. Similarly, improving market infrastructure for low-income producers makes it easier for them to access markets beyond the local level by ensuring price transparency and reducing transaction costs. Despite its improved quality and increased sophistication, significant gaps in the financial landscape continue to create barriers to inclusive business and value chain development. Research is essential for advancing insight into and know-how relating to inclusive businesses and value chain development, which are relatively new approaches to energy business and development (Nielsen et al. 2021).

Further, an ecosystems approach should be considered for inclusive business and value chain development. Gradl and Jenkins (2011) define a business ecosystem as an economic community supported by a foundation of interacting organizations and individuals – the organisms of the business world. Gradl and Jenkins (2011) argue that inclusive businesses are functionally equivalent in that they are communities or networks of interconnected, independent players whose actions determine whether or not a company's inclusive business model can succeed. These ecosystems play an important role in the development of inclusive value chains. This means that, through the

active role of NGOs and other social-purpose organisations, socio-economic issues are integrated into the design stage of business models (Drayton, & Budinich, 2010).

An inclusive business ecosystem includes actors such as individuals (as consumers and suppliers); companies; governments, business associations and other intermediaries; NGOs, private and public finance providers; academic and research institutions; and media and other trendsetters. These players can fulfil critical roles in tackling barriers to inclusive business models and value chain development (Drayton and Budinich 2010). Each actor within the ecosystem will utilise its capabilities and incentives to contribute to the success of the inclusive business. An ecosystem can involve actors with the following capabilities: companies that are engaged in research and development, and commercialised new products and services, companies that purchase from and sell to other companies, provide financing solutions, and invest in new operations and infrastructure, and companies that create standards and compete against other companies. Government actors adopt new policies and regulations, adjust tax and improve public services such as health care, education and the provision of energy. Business associations, cooperatives, unions, standards bodies and other intermediaries provide their members with services such as information on or access to markets and represent their members' interests. NGOs raise consumer awareness and build trust, set environmental and social standards, change social and cultural norms, inform government policy reform and create training facilities. Public and private donors build the capacities for producers, provide catalytic financing to companies and entrepreneurs, and advise governments on how to improve market environments. Academic and other research institutions undertake basic research that ultimately benefits all players in a market, and analyse what works and what does not in the business and policy spheres. The media and other trendsetters raise awareness, influence social and cultural norms, provide information and create momentum for change (IRENA 2020).

8. Steps and Measures to be Considered by South Africa for Green Coal Policies

South Africa need to take some steps to consider its green coal policies. Coal, although marginal in the final energy mix, still retains its role in the mid-term. In the long term, it will be replaced by sources with lower CO2 emissions, such as natural gas and electricity, unless coal with carbon capture and storage (CCS) is implemented. This trend is expected in Belarus and Ukraine in Central Europe; driven by Poland in Eastern Europe (EEU); and led by Kazakhstan in Central Asia (CAS). Many communities in these countries depend heavily on the coal sector. However, any accelerated phase-out needs to be supported by policies that address socio-economic concerns and facilitate a structural and 'just transition'. Further, retrofitted coal and gas with CCS may slowly be introduced from 2030 and may increasingly gain traction through to 2050. Whilst conventional coal is expected to be phased out slowly, some coal-fired power generation with CCS is expected to retain the role of coal in the power generation mix. Gas and coal with CCS have great potential in the region and, if accelerated, can serve as an immediate solution to limit CO2 emissions from the energy sector. In many regions, such as that served by the United Nations Economic Commission for Europe (UNECE), gas is progressively substituting retired coal, oil and nuclear capacities in the market (UN 2020a).

Gas can play a major role in addressing climate change. The most important contribution that gas can make will be in the form of 'green' or 'blue' gas that has been largely or totally decarbonised, rather than as natural gas used for power generation or as feedstock for petrochemical products (AU., 2012). Such development requires significant advances in the technologies and costs of carbon capture and storage (CCS), as well as in the development or adaption of infrastructure to cope with new fuels, notably hydrogen. However, the biggest problem faced by the natural gas industry is that there is very little appetite amongst politicians to address the practical aspects of tackling the

climate emergency, decarbonisation, sustainable energy provision and air quality. Likewise, there is an increasing need to educate the public about these issues (UN 2019).

9. The Role of Gas in Renewable Energy Transition

South Africa's current gas production is limited, although the Karoo basin has potential for shale gas reserves, with initial estimates of 13 Trillions of standard cubic feet of gas (tcf). However, these reserves have not reached commercial extraction. Also, gas demand could be sizeable in South Africa and Mozambique. Mozambique's focus on creating new gas-based industries is to drive increased demand. The country holds most of the region's new industrial demand potential. Beyond the power sector, there will be a demand for gas in other sectors. Shell plans to build a 38 000 barrel per day gas-to-liquids (GTL) plant, and Norway's Yara aims to construct a 1.3 million tonne per annum (mtpa) fertiliser plant. Both will be located near Mozambique's Rovuma gas sources in Cabo Delgado. Potential demand from the transport sector, if fuel switching is to take place, would be concentrated mostly in South Africa because of the sheer size of its industrial economy and its relatively more advanced transport sector. Mozambique and South Africa could address their local imbalances by trading as an integrated system while exploiting the SADC.

A case for trade that could exist between the two countries could become even more relevant in the context of the current developments in the global gas markets. Gas trading is more cost-effective and versatile than power trading, given the distances involved. However, there is a need for advancements in the regulatory environment to enable the development and use of natural gas. It therefore can be noted that the region has some potential for gas-to-power development and even regional gas trade. Not only could this unlock a further supply of (cleaner) energy, the development of natural gas resources can bring real benefits to the economies of four countries (Botswana, Mozambique, Namibia and South Africa) (IEA 2020c). It can generate employment, increase GDP, and raise foreign direct investments. The value chain associated with extracting natural gas can create substantial, permanent employment opportunities (direct and indirect). In addition, using natural gas locally supports industrialisation (e.g. creating fertiliser and petrochemical industries), which also has positive effects on employment and GDP (USAID 2021).

10. Experiences in Transiting to Renewable Energy

Some examples from the African region provide insights into what can be done to ensure the transition to renewable energy, as well as the costs, lessons learned and impact. Morocco has rapidly become a renewable energy champion in Africa and the world: it set targets to increase the share of electricity-generating capacity from renewables to 42% by 2020 and 52% by 2030, as well as reducing energy consumption by 12% by 2020 and 15% by 2030 through enhanced energy efficiency. Morocco quickly implemented its immense solar and wind projects. It was able to produce 400 GWh from solar thermal technologies, 1 662 GWh from solar energy and 3 000 GWh from wind in 2016. The most well-known renewable energy project in Morocco is called Noor, and its three components make up the biggest concentrated solar power plant in the world. The power plants are distributed between Ouarzazate (south of the country) and Midelt (north-central). The Morocco solar power plant has been in operation since October 2018. The project was supported by investments from the World Bank, as well as from the European Union and the African Development Bank, and bilateral finance from countries such as Germany and France. The workers hired on the sites were mostly Moroccans, and the three plants are planned to produce 500 MW at the conclusion of the project. Therefore, Morocco's energy transition is inspiring and can serve as a path to follow. However, the country is facing challenges in the implementation phase: several energy projects are behind schedule, and a real participatory strategy and decentralised approach to the energy transition still needs to be established (Pouget 2019).

Many African governments already have implemented green economy policies across key sectors. In Ghana, green public procurement has supported the development of emerging markets in areas of sustainably produced renewable energy and energy efficiency. Sound fiscal reforms are being implemented in Ghana and Mauritius to introduce environmental taxes, remove environmentally harmful subsidies and reallocate budget expenditure to green sectors. Further, capacity-building programmes and institutions, such as the Kenya National Cleaner Production Centre and the Rwanda Resource Efficient and Cleaner Production Centre, have been created to develop skills and support access to new green job opportunities (UNEP 2015).

Lessons learned from Morocco's experience confirm the need for government leadership; for adequate planning based on precise analyses of the situation; and for clear the allocation of responsibilities at the national and local levels. Progress was realised through ambitious and well-designed public programmes and driven by the extension of national grid networks. Regarding isolated or dispersed areas, access to electricity was provided by solar home systems based on a fee-for-service model. In Morocco, more than 90% of the population cooked with LPG in 2018 as a result of LPG use being subsidised by the government. Similarly, a comprehensive strategy for rural development, integrating health and education services enabled Tunisia to achieve progress in rural electrification (IEA 2020a, 2020b). In South Africa, improved cook stoves and LPG would help to eliminate the use of traditional biomass, reducing household premature deaths by 80% by 2030 (IEA 2019; Rai 2017).

Renewables offer multiple benefits and opportunities in the African context. Firstly, they are domestically available. Net energy importers can reduce import bills by deploying renewables, whereas energy-exporting countries can increase revenues from fossil fuel exports and improve current account balances. Secondly, renewables are cost-competitive. Recent data on renewable energy projects in Africa reveal that the levelled cost of electricity (LCOE) of solar PV and wind is significantly below the LCOE of oil-based power plants and, in some cases. even below the LCOE of new coal-fired power plants. Integrating renewables in diesel-based microgrids offers important cost savings. In addition, renewables can be deployed much faster than fossil fuel-based power plants. Renewables can also trigger additional economic benefits, such as job creation and socioeconomic development, in particular in rural areas. Finally, renewables are core components for any low carbon strategy and offer important environmental co-benefits, such as improved local air quality and water security. While most renewable energy deployment was grid connected in the past two decades, a number of countries have adopted policies for decentralised approaches to rural electrification based on renewable energy. Finally, the establishment of regional power pools and renewable energy transmission corridors is an important building block for the future expansion of renewable energy (Quitzow et al. 2016).

11. Concluding Remarks

This paper has discussed the necessity of turning to renewable energy in South Africa. Opportunities, strategies and policy proposals in energy deployment were examined. Based on the literature reviewed in this study, it was shown how renewable energy and policy on it can result in higher employment and savings, often at very little additional investment. Different renewable policy options were analysed, along with the effects they can have in South Africa. Given the different policy options available, it is recommended that South Africa should support the rollout of renewable energy technologies. Considering the substantial demand on the government budget for other social expenditure, approaches that do not require direct government expenditure have an advantage. This would suggest that an REPS (option 2) would be an appropriate choice. Feed-in tariffs guarantee prices for developers, but lack certainty on the amount of renewable electricity such laws would deliver under local conditions. Portfolio standards set a fixed quantity, which would guarantee diversity of supply. A renewables obligation combines the setting of a target with

a tendering process but may be too complex to administer. This paper recommends that, ideally, a renewable energy feed-in tariff (REFIT) should be coupled with a renewable electricity target that is well above that of the present 10 000 GWh target (Edkins et al. 2010).

Thus far, renewable energy policy in South Africa has been ineffective. Renewable energy currently contributes relatively little to primary energy, and even less to the consumption of commercial energy. Investment in renewable energy is important to reduce the negative economic, social and environmental impacts of energy production and consumption in South Africa. There is a need to invest in renewable energy production and to its full utilisation by the population (Winkler 2005). However, neither setting targets nor regulating prices alone can be a sufficient independent policy option. Power purchase agreements, access to the grid and creating markets for green electricity are some supporting activities that should be considered. Funding is necessary because renewable electricity technologies have to compete with relatively low electricity tariffs. Therefore, different possible sources, both locally and internationally, can be explored. The extent to which mechanisms can be utilised determines the future mix of renewable energy in South Africa. This study has presented the relevance of the country transitioning to renewable energy.

Regional energy value chains help to bring poor communities on board. In addition, including poor communities in value chains could unleash an enormous reservoir of human potential and result in more sustainable economic growth in South Africa. However, inclusive businesses and value chain development also face numerous challenges, amongst which are scaling up the viability of products and services, securing financing and gaining the trust of low-income consumers. To overcome these challenges and maximise South Africa's opportunities, inclusive businesses can rely on certain enablers that tend to be created and provided by actors from other sectors: government and the public sector, civil society and academia. These actors can assist inclusive businesses in various activities, including communicating about and marketing products for income; providing resources to low-income entrepreneurs to enable them to become integrated into higher value chains; and capacity building. This means that inclusive businesses can reach their full potential by integrating the poor as consumers, suppliers and intermediaries, and by building on the capabilities of actors within their ecosystem, such as the public sector and civil society (Gradl & Jenkins, 2008).

The future of renewable energy in South Africa will involve technology development, environmental impact reduction and market infrastructure improvement, among others. Specific recommendations have been limited to those judged to be most likely to accelerate the pace of deployment, increase cost-competitiveness, and shape the future market for renewable energy. The recommendations presented here are also pragmatic and achievable. Further studies should make 8additional assessments of renewable energy policy in South Africa to incorporate a more detailed analysis of possible energy-efficient policy and targets, as these will have a notable influence on the electricity demand in the country.

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