COBENEFITS POLICY REPORT

December 2020

Making the Paris Agreement a success for the planet and the people of South Africa

Unlocking the co-benefits of decarbonising South Africa's power sector

CSIR our future through science

IASS POTSDAM

UfU Independent Institute for Environmental Issues

IET International Energy Transition

COBENEFITS

Imprint

This COBENEFITS Policy Report has been realised in the context of the project "Mobilising the Co-Benefits of Climate Change Mitigation through Capacity Building among Public Policy Institutions" (COBENEFITS).

This project is part of the International Climate Initiative (IKI). The Federal Ministry for the Environment, Nature Conservation, and Nuclear Safety (BMU) supports this initiative on the basis of a decision adopted by the German Bundestag. The COBENEFITS project is coordinated by the Institute for Advanced Sustainability Studies (IASS, lead) in partnership with the Renewables Academy (RENAC), the Independent Institute for Environmental Issues (UfU), International Energy Transition GmbH (IET), and in South Africa the Council for Scientific and Industrial Research (CSIR).

December 2020

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We express our gratitude for the valuable expertise and inputs of thought leaders in South Africa's climate and energy policy, including Tasneem Essop, Commissioner of the National Planning Commission, the South African Local Government Association, and the Centre for Environmental Rights.

We also acknowledge the members of the organisational consortium comprising the Institute for Advanced Sustainability Studies (IASS, lead), the Renewables Academy AG (RENAC), the Independent Institute for Environmental Issues (UfU), and IET – International Energy Transition GmbH (IET). This COBENEFITS study was facilitated through financial support from the International Climate Initiative (IKI) of Germany.

Supported by:

Federal Ministry for the Environment, Nature Conservation and Nuclear Safety

based on a decision of the German Bundestag

INTERNATIONAL CLIMATE INITIATIVE (IKI)

Reviving South Africa's economy & health system and facilitating a just transition following the COVID-19 pandemic

Foreword in light of recent events

At the time this report is being published, South Africa along with many economies around the world has been hit severely by the spread and impacts of the global COVID-19 pandemic. The national health system and the national economy, along with thousands of businesses, workers, and employees, have been shaken to the core. Similarly to many countries worldwide, substantial political efforts will be needed to rebuild national and local economies and job markets, as well as restoring and strengthening the resilience of the health system.

Recovering from the economic shocks of the COVID-19 pandemic and avoiding running into severe future shocks triggered through the climate crisis do not represent conflicting interests but rather a mutually reinforcing coping strategy. This report and the recent studies that it builds on suggest that the new energy world of renewables and the decarbonisation of South Africa's energy sector should play a strong role in reviving the economy by boosting employment, fostering prosperity among previously marginalised communities as a foundation of local value creation, and – importantly – unburdening national health systems by reducing cases of respiratory disease.

By providing an enabling policy environment to unlock these co-benefits, the South African Government can provide important stimuli to recover from the impacts of the COVID-19 pandemic and revive both the health system and the national economy. The Paris Climate Agreement and the United Nations 2030 Agenda for Sustainable Development offer important, internationally agreed frameworks to ensure economic recovery in the shorter term and to build resilient economies and health systems in the long run.

The Council for Scientific and Industrial Research (CSIR), as the South Africa Focal Point, together with the Institute for Advanced Sustainability Studies (IASS), invited ministries and government agencies, such as the Department of Environment, Forestry and Fisheries (formerly Department of Environmental Affairs), the Department of Mineral Resources and Energy (formerly Department of Energy), Department of Trade, Industry, and Competition, and the Independent Power Producer Office (IPP Office) to join the COBENEFITS Council South Africa, to provide their guidance to the COBENEFITS Assessment studies along with the COBENEFITS Training Programme and Enabling Policies Round-tables. Since its constitution in November 2017, the COBENEFITS Council South Africa has guided the programme in framing its assessment topics for South Africa and ensuring their direct connection to the current political deliberations and policy frameworks of their respective ministries.

South Africa, among 189 parties to date, has ratified the Paris Agreement, to combat climate change and provide current and future generations with opportunities to flourish. With this COBENEFITS policy report, we seek to contribute to the success of this global endeavour by offering a scientific basis for harnessing the social and economic co-benefits of building a low-carbon, renewable energy system while facilitating a just transition, thereby *making the Paris Agreement a success for the planet and the people of South Africa.*

We wish the reader inspiration for the important debate on a green recovery under a just and sustainable energy future for South Africa!

Ruan Fourie
CSIR, South Africa
COBENEFITS
Focal Point Coordinator

Sebastian Helgenberger
IASS Potsdam, Germany
COBENEFITS
Project Director

Executive Summary

Making the Paris Agreement a success for the planet and the people of South Africa

Unlocking the co-benefits of decarbonising South Africa's power sector to enable a just transition

South Africa has an abundance of renewable energy resources which, under an enabling political environment, can become a central source of social and economic prosperity for communities, families, and businesses in South Africa. In light of the COVID-19 crisis substantial political efforts will be needed to rebuild national and local economies and job markets, as well as restoring and strengthening the resilience of the health system. South Africa's just transition to renewable energy sources can play a strong role in a national recovery strategy to building back better.

The continuing drop in technology costs – making renewable energy sources a least-cost option for generating electricity – combined with the need for new power generation facilities as coal-fired power plants reach retirement, provides an opportunity for the country to decarbonise its electricity sector, thereby not only contributing to the global endeavour to fighting the climate crisis, but also actively contributing to improving people's health through cleaner air; to poverty eradication by fostering economic prosperity in previously marginalised communities; and creating sustainable jobs in future-oriented sectors, with the opportunity to reconcile gender inequalities in power-system-related employment. Through these social and economic co-benefits, South Africa's transition to renewable energy sources can be decisive in meeting the development objectives laid out by the Government of South Africa.

The report at hand summarises the key findings of the COBENEFITS Assessment Series, quantifying essential co-benefits of decarbonising the power sector in South Africa. The COBENEFITS South Africa Assessment series can be directly accessed through www.cobenefits.info.

Building on the opportunities presented, the report formulates a set of policy actions to allow government institutions to create an enabling political environment to unlock the social and economic co-benefits of the new energy world of renewables for the people of South Africa. The policy options were generated during a series of roundtable dialogues and consultations with government institutions, industry associations, and expert and civil society organisations (CSOs) in the years 2019 and 2020.

In light of the current crisis, the results indicate that recovering from the economic shocks of the COVID-19 pandemic and avoiding running into severe future shocks triggered through the climate crisis do not represent conflicting interests but rather a mutually reinforcing coping strategy. The Paris Climate Agreement and the Sustainable Development Goals (SDG) set by the United Nations 2030 Agenda offer important, internationally agreed multi-solving frameworks to ensure economic recovery in the shorter term and to build resilient economies and health systems in the long run.

COBENEFITS Making the Paris Agreement a success for the planet and the people of South Africa

available on www.cobenefits.info

UNLOCKING THE CO-BENEFITS OF RENEWABLE ENERGY FOR THE PEOPLE OF SOUTH AFRICA — 10 OPPORTUNITIES FOR POLICY MAKERS

Boosting job creation and developing future-oriented skills

1. **Provide guidance for careers and gender equality in the renewables sector:** South Africa can significantly boost gross employment by increasing the share of energy generated from renewable sources. The numbers show a particular need for highly skilled workers for the new energy world. The explicit recommendation is to direct attention to graduates from schools and FET (Further Education and Training) colleges, who need to be alerted to the various opportunities offered by the renewables sector. Given that women are still very much under-represented in the power-sector-related labour market, the energy transition offers a huge opportunity to leave behind outdated career patterns: A gender-sensitive way of portraying and promoting education pathways (degrees, curricula, technical certifications) and career paths, including fresh formats for hands-on career guidance activities, can unleash the human capital of all South Africans while also actively reducing existing inequalities.

2 **Keeping track of the prosumer market:** The prosumer market segment is expected to be dynamic in the coming years—therefore, in order to design the most cost-efficient power system, it will be crucial to keep track of the development of rooftop solar photovoltaic (PV) by collecting appropriate statistical data. At the municipal level, it is important to set up simple and cost-effective registration systems in order to avoid the implementation of increasing numbers of unregistered systems. These local registries could also provide vital bottom-up information for a national registry. Furthermore, the examination of bottom-up uptake of PV rooftop systems nationwide is recommended.

Mobilising consumer savings through PV self-consumption

While water withdrawal and consumption by the South African power sector are relatively modest compared with other countries, power plants utilise a significant proportion of the water in some regional water systems.

Waterberg catchment: 40% expected water demand **by 2050**

Upper Olifants catchment: 23% water demand **in 2018**, with an expected water deficit **in 2030**

Current freshwater utilisation in South Africa:
Power sector: 2% for power generation and 5% for mining
Agriculture: 67% for irrigation

Water scarcity will continue to become more severe in South Africa. Conservative estimates indicate that South Africa will experience a **234-gigalitre shortfall in water availability by 2025**.

Infographic ES-1: Emerging challenges in South Africa's Water-Energy Nexus

3 **Provide transparent background research on health externalities to inform energy sector planning:** The estimation of health costs associated with current energy sector planning would gain more credibility by making methodologies, assumptions, and associated implications transparent and by opening them to discourse and consultation. More in-depth research on the health effects caused by different types of power generation technologies, combined with internationally acknowledged methods for modelling pollutant dispersion and exposure, are also available to guide the alignment of different sectoral plans and the decommissioning of power plants, especially in densely populated areas where Minimum Emission Standards are exceeded.

Improving people's health and unburdening the health system

Foster community engagement in RE development to facilitate economic prosperity for marginalised communities

4 **Establish community ownership and engagement practice guides for IPPs:** A codified guidance document underpinning the REIPPPP will support efforts to increase prosperity in marginalised communities and provide more certainty for IPPs implementing them. For instance, this could clarify questions on when and how to engage with stakeholders or communities at large, and the timing and methodology of studies that must be carried out at different stages of project development, further supported by advice on good governance and practical examples.

5 **Ensure transparency about social investments of IPPs through a Social Performance Index (SPI):** Transparency concerning the social investments of IPPs will help illustrate their value for local communities. Defining a Social Performance Index (SPI) for South Africa will allow monitoring and active improvement of local determinants and enablers of community well-being. To showcase the nature and quality of social investments engendered by renewable projects, it is recommended that detailed information should be made available. In order to compile and release meaningful information, a consistent reporting system would provide more guidelines on how to classify investments and thus ensure the consistent application of socio-economic development and enterprise development (SED and ED) categories.

6 **Detecting and reconciling conflicts in South Africa's Water–Energy–Food Nexus:** Considering that much of South Africa's coal deposits underlie almost half of its high-potential agricultural soils, and that the land capability of a rehabilitated opencast mine is significantly lower than its pre-mining condition, generally resulting in the production of acid mine drainage, the water–energy–food nexus demands additional attention, further investigation and public discourse in South Africa.

Making the Paris Agreement a success for people and the planet

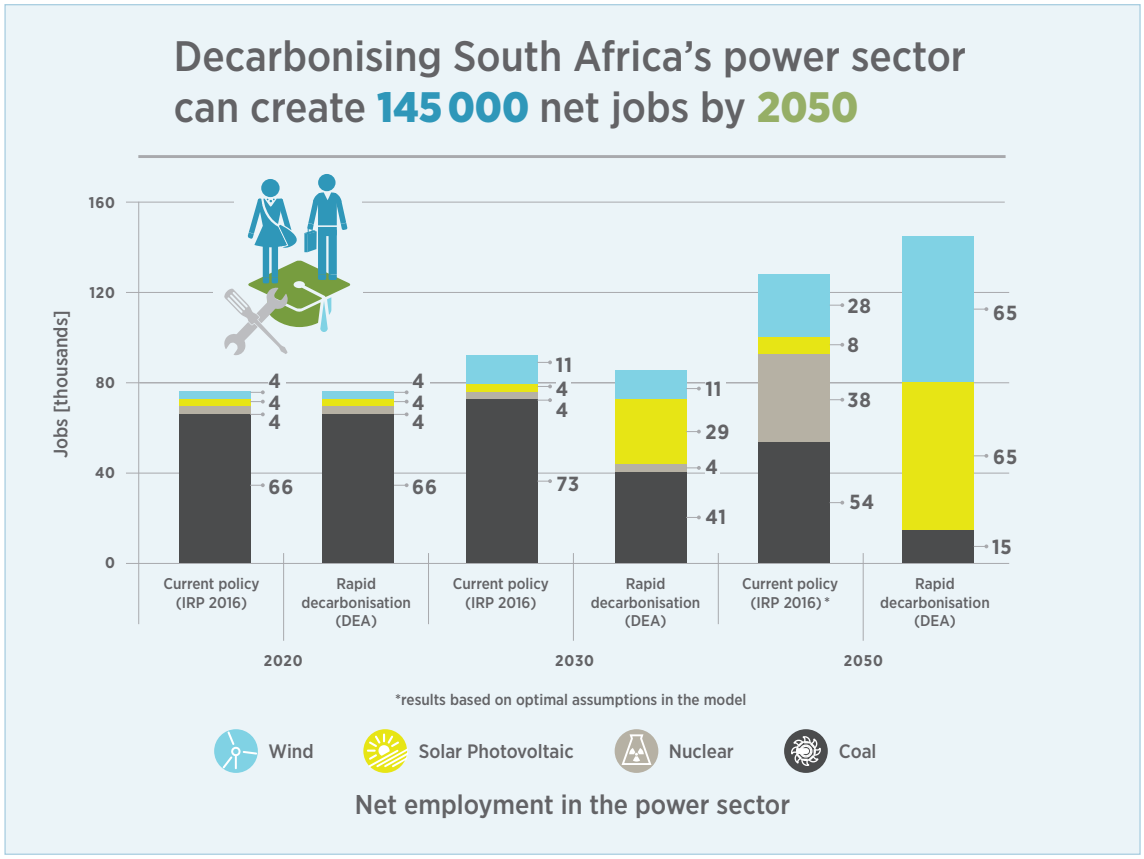
7 **Establish coordinated co-benefits monitoring and communication system:** Gaining In the current discourse about the climate crisis, countries' official communications with the U.N. Framework Convention on Climate Change (UNFCCC) (through Nationally Determined Contributions (NDCs), Update Reports and the Greenhouse Gas (GHG) Reporting mechanism) gain public attention and have a strong signalling effect to the local population. A coordinated Co-benefits Monitoring system can underpin official communication regarding climate mitigation efforts, with metrics to showcase benefits from ambitious climate action, e.g., in the Biennial Update Report (BUR) or the preparation of Sector Emission Targets (SETs). The inclusion of a co-benefits section in South Africa's reports and pledges as well as in the South Africa Climate Explorer[1] website can provide a powerful demonstration of this commitment and also communicate the potential social and economic co-benefits for the South African people.

8 **Establish Co-benefits Council[2] under the auspices of the Presidential Commission on Climate Change:** Co-Benefits can be best harnessed through joint and coordinated action across different political divisions and ministries. Under the Presidential Climate Change Commission, a working group can be tasked with harnessing the social and economic development potential of the Paris Agreement and climate action in the energy sector and beyond, while closely monitoring the social impacts of the transition and shaping an enabling policy environment for co-benefits.

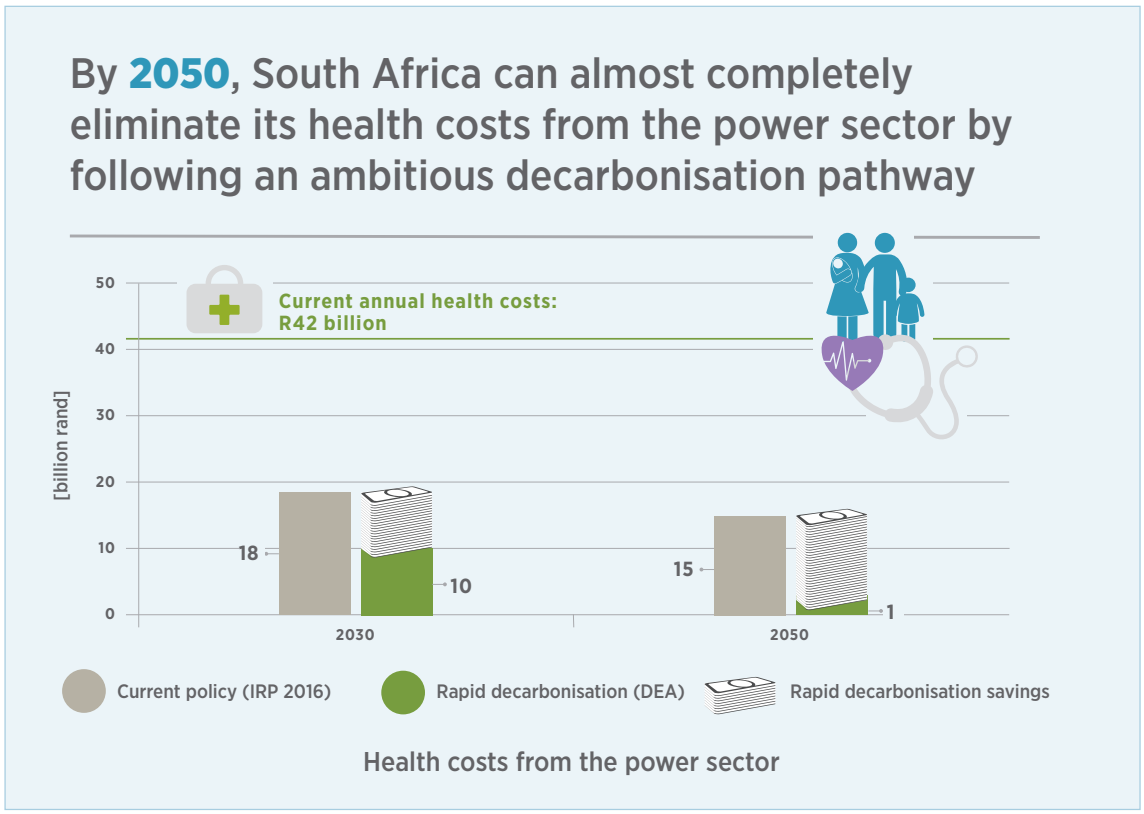
9 **Continue dialogue among social partners: Appointing a Just Transition Task force as part of the Presidential Commission on Climate Change:** The dialogue series for a Just Transition, carried out in 2018 and 2019, created momentum in the South African discourse on transition to a low-carbon economy. Building on the outcomes, it needs governance structures to steer the implementation of the visions into actions at the regional and local level. Further work on the highly praised participatory mode is needed in order to develop detailed pathways with special emphasis on the Land Use–Energy–Water Nexus.

[1] www.southafricaclimateexplorer.org
[2] Interchangeable with working group, sub-committee, or focus group.

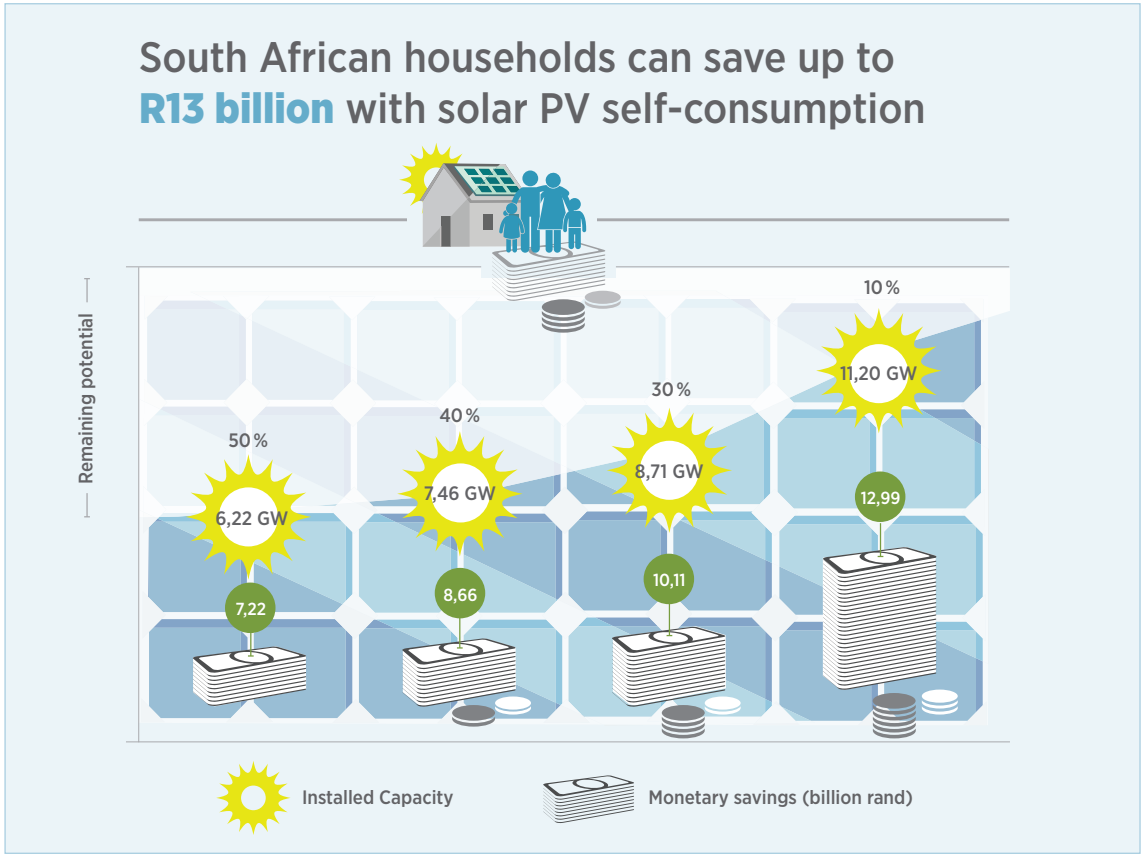
QUANTIFYING KEY CO-BENEFITS OF DECARBONISING SOUTH AFRICA'S POWER SECTOR



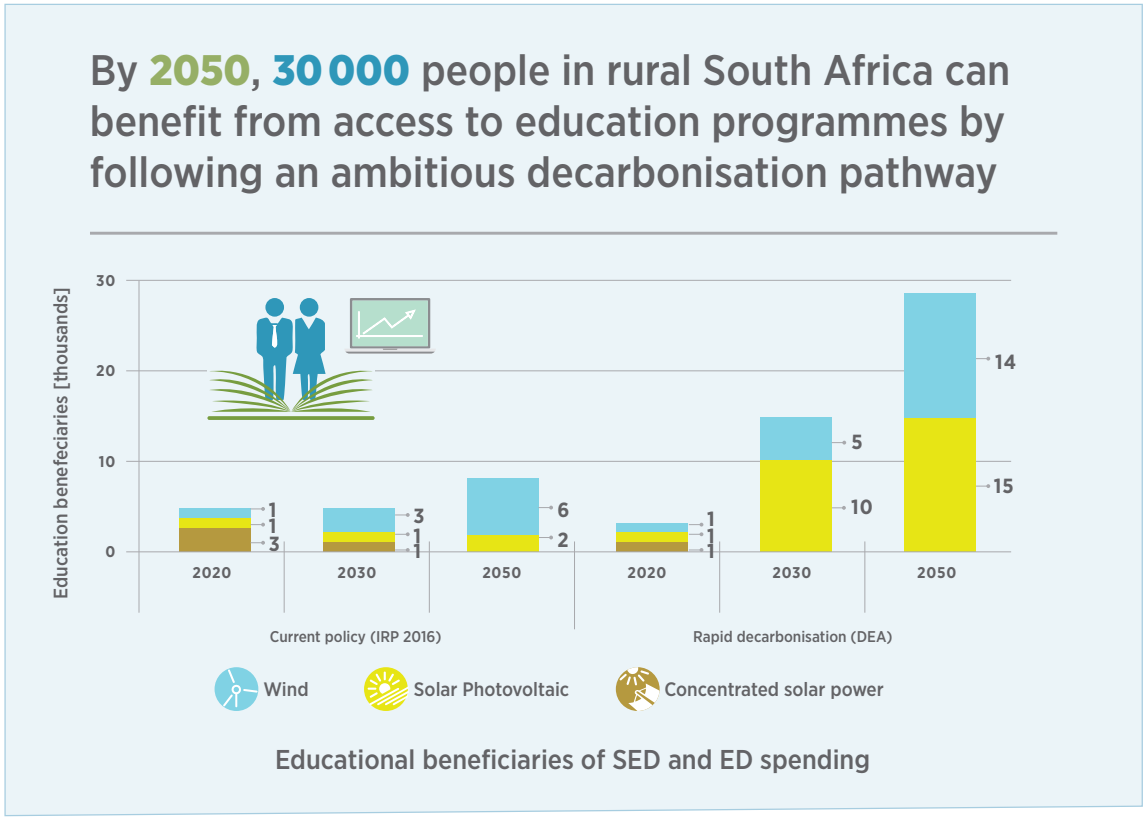
Infographic ES-2: Employment opportunities in South Africa along different decarbonisation pathways



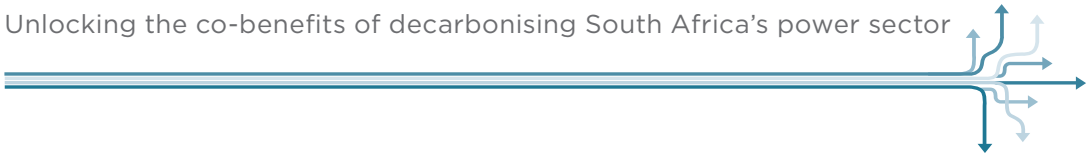
Infographic ES-3: Economic health impacts in South Africa along different decarbonisation pathways



Infographic ES-4: Household saving potential in South Africa with solar PV



Infographic ES-5: Rural capacity building in South Africa along different decarbonisation pathways



BOX 1: POWER SYSTEM PATHWAYS FOR SOUTH AFRICA

Four scenarios were analysed for the future development of the power sector in South Africa. From these four, three government-level scenarios from the Department of Energy (DoE) and the Department of Environmental Affairs (DEA)[3] South Africa represent the composition of South Africa's energy mix over medium- and long-term planning horizons, and form the basis for assessing the employment impacts of renewable energy deployment in South Africa's power sector and the wider economy.

Integrated Resource Plan (IRP) 2016
The IRP refers to the coordinated schedule for generation expansion and demand-side intervention programmes, taking into consideration multiple criteria to meet electricity demand. The Integrated Resource Plan (IRP) 2016 presents insights on the preferred generation technology required to meet expected demand growth pre-2030. The planning period further extends beyond 2030 up to 2050. The scenario's calculations are based on broadly different factors, such as technology cost calculations, energy policy direction, and emission targets. The base case scenario (BC) is used for the analysis. The power supply mix and new capacity additions from the IRP 2016 scenario developed by the DoE are chosen as the baseline, representing the policy–planning status quo in the power sector.

Integrated Resource Plan (IRP) 2018
The Integrated Resource Plan 2018 (IRP 2018)[4], also developed by the DoE, is an updated version of the IRP 2016 document, which shows revised medium- and long-term electricity sector planning under consideration by the South African Government. It shows the increased share of renewable energy sources in the energy mix.

Department of Environmental Affairs (DEA) Rapid Decarbonisation (DEA_RD)
The DEA Rapid Decarbonisation scenario[5] presents an alternative approach for rapidly reducing the greenhouse gas and harmful emissions generated from the power sector and has been issued as 'work in progress' scenario. The presented assessment results are meant to inform current political deliberations around this scenario in the context of further energy pathways. The scenario shows an increase in the share of renewable energy in the power sector to more than 70% by the year 2050. It also has a planning horizon up to the year 2030 for the short term and 2050 for the long term. The DEA_RD scenario presents an alternative mitigation pathway via emission reduction in the power sector as well as the technological requirements for power generation. The scenario has a baseline set from 2015 and is projected until 2050.

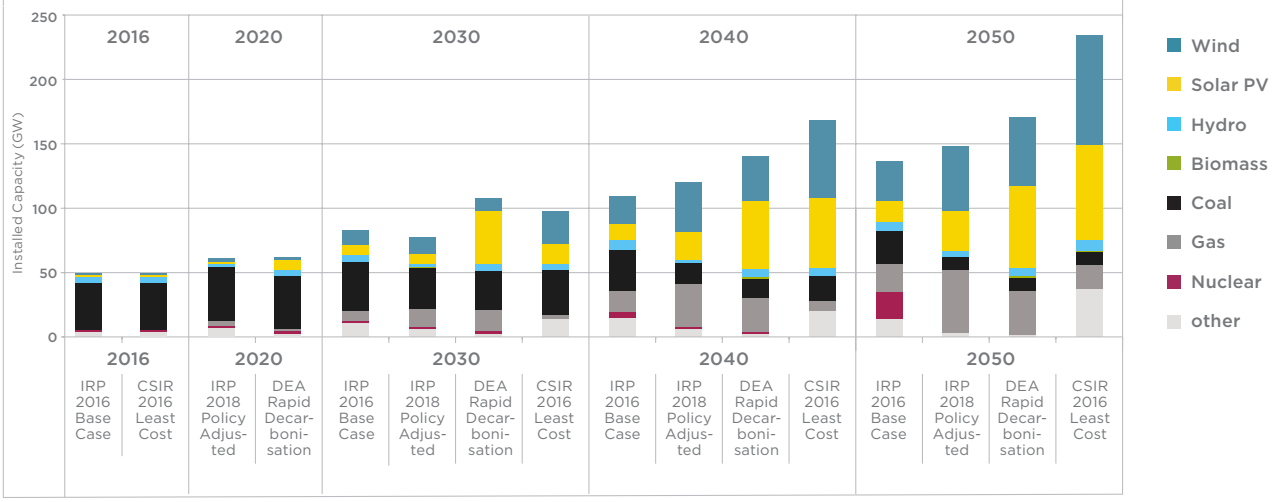
Least-Cost planning scenario by the Council for Scientific and Industrial Research (CSIR_LC)
The scenario is presented by the Council for Scientific and Industrial Research (Wright et al., 2017). This scenario was developed as the lowest-cost alternative to power sector planning, as a formal and independent review of the IRP 2016. The scenario places no annual techno-economic limitations on expanding the shares of renewable energy sources over the planning horizon until 2050. The timeline used in the analysis for decommissioning the country's coal power plants is adopted from the IRP 2016. It shows lower emissions in the energy mix and consumes less water than the Draft IRP 2016. Renewable energy costs are set to be compatible with the global learning curve on energy technologies. Furthermore, the scenario presents solar PV and wind energy as the largest contributors to the energy supply mix in South Africa by 2050.

[3] Now: Department of Environment, Forestry, and Fisheries. The government departments were reformed in summer 2019. In this report we refer to the former departmental structures under which the scenarios and documents used for this report were developed.

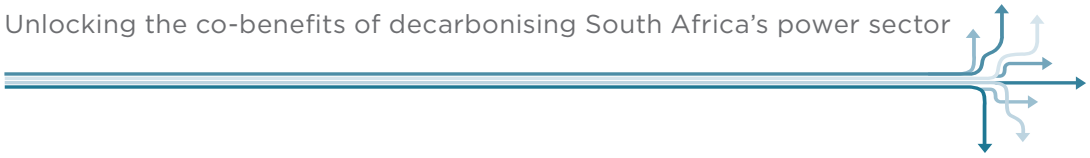
[4] Details of the scenario can be found here: http://www.energy.gov.za/IRP/irp-update-draft-report2018/IRP-Update-2018-Draft-for-Comments.pdf

[5] The data for this scenario were provided directly by the Department of Environmental Affairs (as a member of the COBENEFITS Council) to be analysed in this study.

COBENEFITS South Africa: Power System Reference Scenarios
Installed Capacities (GW)



Decarbonising South Africa's power sector can create 145 000 net jobs by 2050.



Contents

1. Creating opportunity, prosperity and justness for the people of South Africa in the new energy world of renewables

The energy transition in South Africa is in full swing. The country has abundant natural resources and favourable conditions for renewable energy generation. The expansion of renewable energy is reflected both in central planning acts and concluded power purchase agreements. South Africa's energy planning is assigning renewables a leading role in the Integrated Resource Plan (IRP) 2019. In a bid to reduce its dependence on coal and curb worsening pollution levels, the South African Government plans to add 6000 MW of new solar plants and 14400 MW of wind power by 2030. These commitments provide industry with long-awaited planning and investment security for the coming decade.

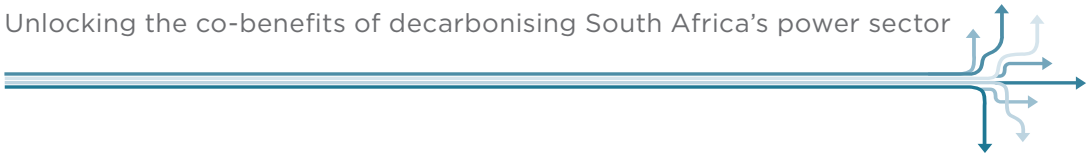
The 'Just Transition' Social Partner Dialogue was initiated in 2018 under the leadership of the National Planning Commission to build consensus on a common vision for a Just Transition to a low-carbon, climate-resilient economy and society by 2050 and develop proposals for pathways to achieve this vision. Building on this dialogue, a draft version of the resulting National Planning Commission report, "2050 Vision and Pathways for a Just Transition to a Low-Carbon, Climate-Resilient Economy" states the goal of a "zero-carbon [net-zero carbon] economy by 2050", which is significantly more ambitions than previous plans for the electricity sector and NDCs. Political decisions on South Africa's energy future link the missions and mandates of many government departments and agencies beyond energy and power, such as environment, industry and trade, and labour. Hence, the timely debate on South Africa's energy future boils down to assessing how renewables can improve the lives of South African people—and in light of recent events, how the new energy world of renewables can play an important role in reviving the country's economy and health systems following the effects of the COVID-19 pandemic (IASS, 2020a, 2020b).

Through putting people, especially those living in poverty and the vulnerable at the forefront, South Africa will have achieved a [net] zero-carbon economy by 2050. We have built the resilience of our economy and our people through affordable, decentralised, diversely-owned renewable energy systems; conservation of our natural resources; equitable access of our water resources and sustainable, equitable and inclusive land-use for all, especially for the most vulnerable. The high value we place on healthy ecosystems, land, water and air, underpins our future, and ensures a better life for all who live in South Africa.

National Planning Commission, South Africa (2019): 2050 Vision and Pathways for a Just Transition to a low carbon, climate resilient economy, and society (Draft Proposal, Version two)

The term 'co-benefits' refers to simultaneously meeting several interests or objectives resulting from a political intervention, private-sector investment, or a mix thereof.

Sebastian Helgenberger, Martin Jänicke, & Konrad Gürtler (2019): Co-benefits of Climate Change Mitigation. Encyclopedia of the UN Sustainable Development Goals



In the context of the COBENEFITS project, a series of assessment studies have been conducted to identify social and economic co-benefits of renewable energy in South Africa and to develop policy options for creating an enabling environment to unlock these opportunities for people, communities, and businesses. The key results of this process are presented in this COBENEFITS Policy Report for South Africa. The COBENEFITS programme cooperates with national authorities and knowledge partners in countries worldwide to connect national socio-economic development objectives with joint efforts to act on climate change through a mutually reinforcing co-benefits approach. The project supports efforts to develop enhanced NDCs with the ambition to deliver on the Paris Agreement and the 2030 Agenda on the Sustainable Development Goals (SDGs).

In the climate and sustainable development literature, the approach of studying, implementing, and replicating the positive externalities of an action is what we may understand as the co-benefits approach. Implementing this approach requires fostering an environment for problem solving by encouraging the idea that the solutions to global problems, such as climate change and development, have more synergies with each other than trade-offs. It aims to peel through the layers of international politics and diplomacy to bring to reality solutions on the ground.

For South Africa, ensuring that its principal developmental challenges are met would require significant investment; not only in terms of infrastructure but also research and development. The co-benefits approach endorses an approach recommending multiple benefits, a significant one being economies of scale through collaboration, which would not be accrued by individual country action. Another benefit is that this approach can be studied at disaggregated levels and emulated successfully under similar circumstances.

The COBENEFITS Policy Report for South Africa compiles key findings from the COBENEFITS Assessment series, quantifying the co-benefits of decarbonising South Africa's power sector in view of future-oriented employment and skills development, consumer savings through PV self-consumption, economic prosperity for previously marginalised communities, reduced water consumption, and health benefits related to a less carbon-intensive power sector, which can be instrumental in reviving the national health system.

Considering the government's determination to make green energy the key enabler of future economic prosperity, the report shows that expanding the share of renewables with certain improvements in the energy sector can lead to significant opportunities:

Building on the opportunities presented, the report formulates a set of policy actions to allow government institutions to create an enabling political environment to unlock the social and economic co-benefits of the new energy world of renewables for the people of South Africa. The policy options were derived through a series of roundtable dialogues and government consultations involving government institutions, industry associations, and expert and civil society organisations in the years 2019 and 2020.

In light of the current crisis, the results indicate that recovering from the economic shocks of the COVID-19 pandemic and avoiding running into severe future shocks triggered through the climate crisis do not represent conflicting interests but rather a mutually reinforcing coping strategy. The Paris Agreement and the 2030 Agenda offer important, internationally agreed multi-solving frameworks to ensure economic recovery in the shorter term and to build resilient economies and health systems in the long run.

2. Unveiling the potential of co-benefits in the renewable energy sector

This policy report section synthesises key findings from the COBENEFITS South Africa assessment series. The study results are processed to provide direct and useful input for policy makers and policy implementers who are working to further progress the social and economic environment for communities, businesses, and citizens in South Africa.

Both the co-benefits areas for South Africa – employment and skill development, air pollution and health, prosperity for previously marginalised communities, consumer savings through PV self-consumption, and reduced water consumption – as well as the reference policy pathways on which the COBENEFITS assessments are based, have been defined and specified through repeated consultation with the Department of Environment, Forestry, and Fisheries (formerly Department of Environmental Affairs), the Department of Mineral Resources and Energy (formerly Department of Energy), Department of Trade, Industry, and Competition, and the Independent Power Producer (IPP) Office. Additional information on the reference policy pathways is provided in Box 1.

Key findings and data are displayed in this section. The full COBENEFITS reports, including detailed methodology and results sections, can be found at:

www.cobenefits.info

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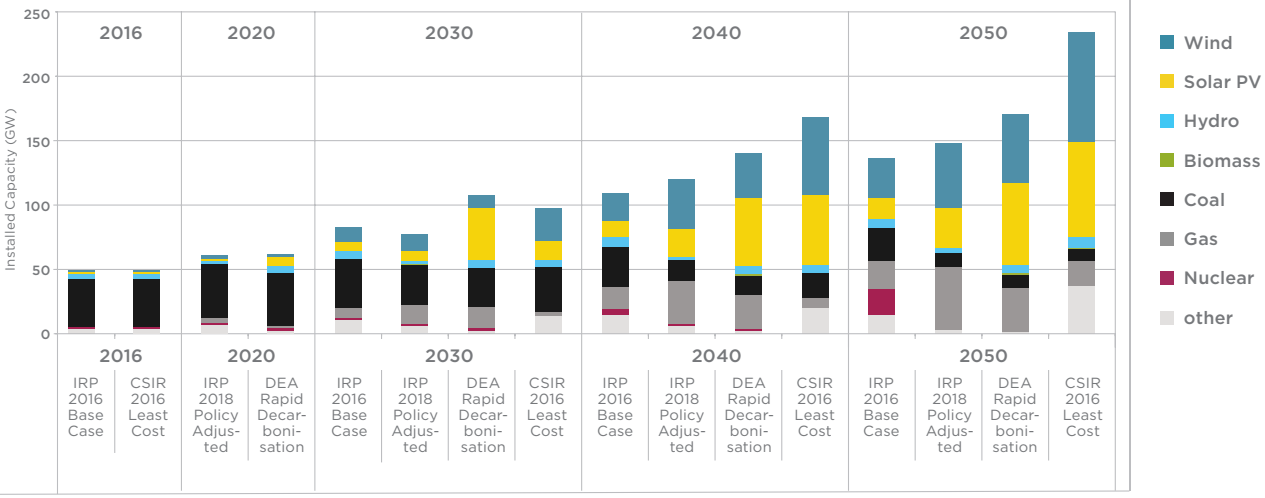
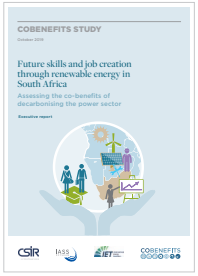
COBENEFITS South Africa: Power System Reference Scenarios
Installed Capacities (GW)



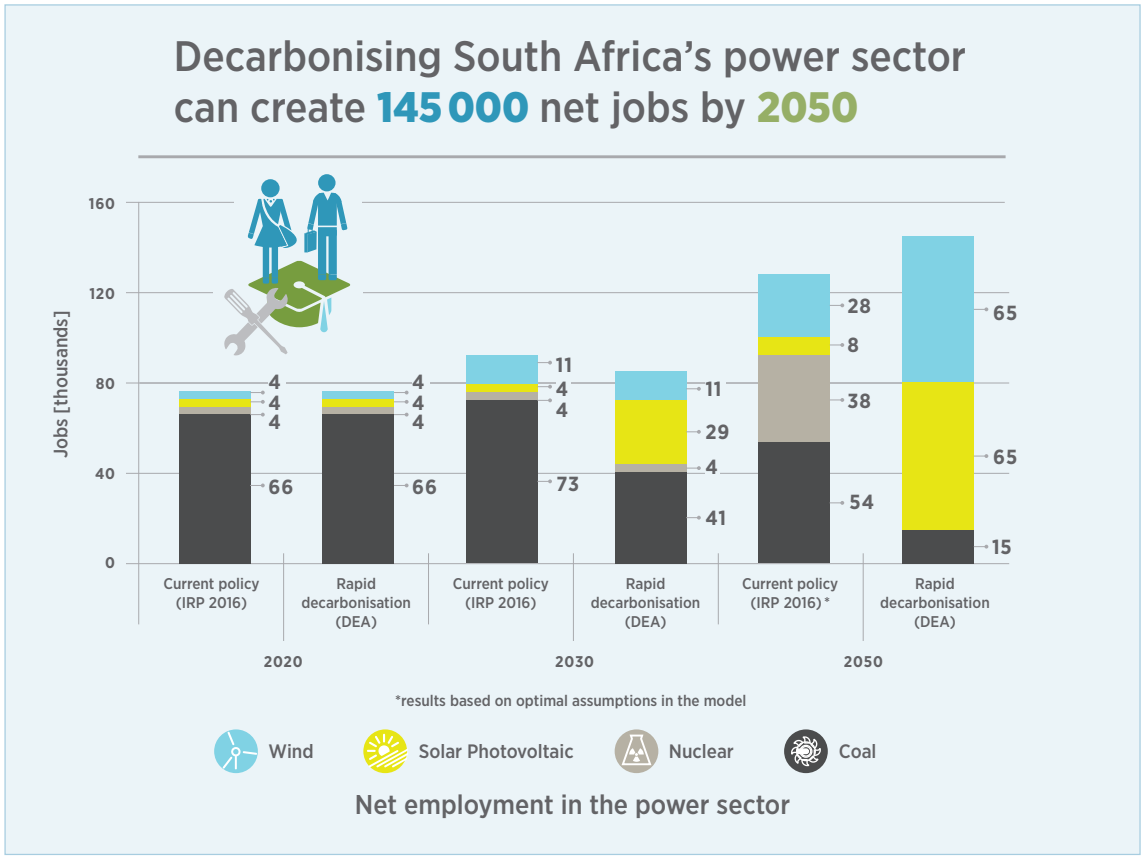
[8] The data for this scenario were provided directly by the Department of Environmental Affairs (as a member of the COBENEFITS Council) to be analysed in this study.

2.1 Future skills and job creation through renewable energy in South Africa

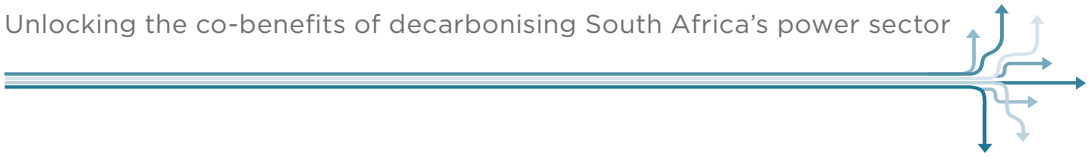
***The COBENEFITS study "Future skills and job creation through renewable energy in South Africa"* (IASS/CSIR/IET, 2019c) analyses the employment impacts of different plans for expanding electricity generation in South Africa's power sector, with the aim of assessing the co-benefits of a low-carbon energy transition in the country.**



- **Key policy opportunity 1:** South Africa can significantly boost gross employment by increasing the share of renewables. With its decision to scale up renewables by moving from IRP 2016 to IRP 2018, employment in the renewable energy sector (measured in job years) can be expected to increase by an additional 40 % in the next 10 years. But there is room for more: by following CSIR's Least-Cost pathway, this number could even be doubled.
- **Key policy opportunity 2:** Following the general trend in the energy sector in particular, the renewable energy sector is fostering the high-skill labour market, with 70 % of positions in renewable power generation being created in the highly skilled group (> Grade 12, specialised know-how). Growth in high-skilled jobs is most distinct in DEA's Rapid Decarbonisation pathway and CSIR's Least-Cost pathway, both reaching a share of 76 % in 2050.
- **Key policy opportunity 3:** Coal-sector-based employment is expected to decline regardless of a shift in power generation towards renewable energy sources, with a 35–40 % decline in employment between 2020 and 2050. However, the transition process should be managed politically, to mitigate negative impacts on affected workers and communities.



Infographic 1: Employment opportunities in South Africa along different decarbonisation pathways



KEY FIGURES

- Direct employment in the power sector can be expected to increase from currently 78 000 jobs to 145 000 jobs in 2050, including around each 65 000 jobs in the wind power and solar sector, by following the Rapid Decarbonisation pathway defined by South Africa's Department of Environmental Affairs (DEA).
- Up to 1.6 million additional jobs can be created economy-wide through the power sector transformation by 2050.
- Across all scenarios, around 70 % of new power sector jobs associated with renewable energy are categorised as highly skilled.
- Jobs in the coal sector will decline by 35 – 40 % between 2020 and 2050, with expected reductions in global demand and exports being the main drivers behind this transformation, but also influenced by the local decommissioning of coal-fired power plants.

KEY FINDINGS

- Direct employment in the power sector can be expected to increase from currently 78 000 jobs to 145 000 jobs in 2050 (in net terms, i.e., considering job losses in the coal sector), including around 65 000 jobs each in the wind power and solar sector, by following the Rapid Decarbonisation pathway defined by South Africa's Department of Environmental Affairs (DEA). With the decision of South Africa's government to scale up renewables in its power sector planning[9], additional employment effects can be expected in the short term until 2030.
- South Africa can significantly boost employment by increasing the share of renewables. With this decision, employment can be expected to increase by an additional 40 % in the period 2018 to 2030, accounting for 580 000 job years. By following CSIR's Least-Cost pathway this number can be more than doubled to more than 1.2 million job years, created along the renewable energy value chain.
- Jobs in renewable power generation are concentrated in the services, construction, and manufacturing sectors. However, employment opportunities are created in almost all sectors – including the mining sector, which is predicted to experience a net increase in employment despite job losses in coal mining.
- With the shift from IRP 2016 to IRP 2018 an additional 1.3 million jobs are created economy-wide by 2050. DEA's Rapid Decarbonisation pathway would have an equivalent impact. However, following the CSIR's Least-Cost pathway would create an additional 300 000 jobs economy-wide.
- In terms of total net employment in the electricity sector, solar PV and wind together account for more than 80% of total net employment in the CSIR_LC and DEA_RD scenarios. Scenarios with higher shares of renewables also lead to the highest net employment figures.
- By the 2030 horizon, CSIR's Least-Cost pathway will result in the highest number of jobs in the power sector, accounting for 94 000 jobs (net), and the highest number of economy-wide jobs with almost 300 000 additional jobs in comparison to IRP 2018. In general, CSIR's Least-Cost pathway performs best in terms of economy-wide jobs at both the 2030 and 2050 horizons.

[9] The calculations of the 2019 COBENEFITS South Africa Assessment Studies compare the update of South Africa's Integrated Resource Plan (IRP) from the IRP 2016 version to the proposed IRP 2018 version. The references in this report to the decision of South Africa's government to scale up renewables in its power sector planning are pointing to this comparison.

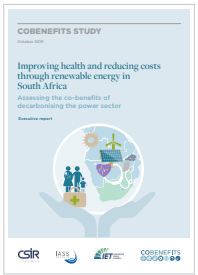
- Following the historical development in the power sector with predominant high-skilled labour, about 70 % of jobs created through the shift towards renewable energy occur in the highly skilled groups, defined as workers with specialised know-how (> Grade 12). This growth is most distinct in the Rapid Decarbonisation pathway defined by South Africa's Department of Environmental Affairs (DEA), and in the Least-Cost Renewable energy pathway developed by the Council for Scientific and Industrial Research (CSIR), both reaching a share of 76 % in 2050.

- The Renewable Energy Independent Power Producer Procurement Programme (REIPP-PP) has demonstrated the potential for localised job creation through renewable energy deployment in South Africa. The localisation requirements of the REIPPPP resulted in the development of renewable manufacturing industries and capacity in South Africa. However, growth in the manufacturing of key renewable energy (RE) technologies (and the associated components) is highly dependent on commitment by government to continuous and long-term deployment of renewable energy.

- Coal-sector-based employment is expected to decline regardless of a shift in power generation towards renewable energy sources, with a 35–40 % decline in employment between 2020 and 2050. Continued job losses are likely in the coal sector: declining global demand for coal is the largest impact factor for coal mining employment; a decline in demand for South African coal can be observed across all scenarios. Bloomberg New Energy Finance (2018) estimates that by 2050 global coal power generation will decrease to 5 % of the global power mix (from 30 % in 2017). For IRP 2018, this decline corresponds to 19000 jobs in total.

2.2 Improving people's health and unburdening South Africa's health system through renewable energy in South Africa

Air pollution, primarily from coal-fired power plants, is one of the main impacts that the energy sector has on the environment and human health. These pollutants have many negative impacts, among which those of greatest concern include heart disease, lung cancer, stroke, and chronic obstructive pulmonary disease (WHO, 2016). The consequences of such diseases include increased levels of morbidity, which further result in elevated health costs and losses of productivity.

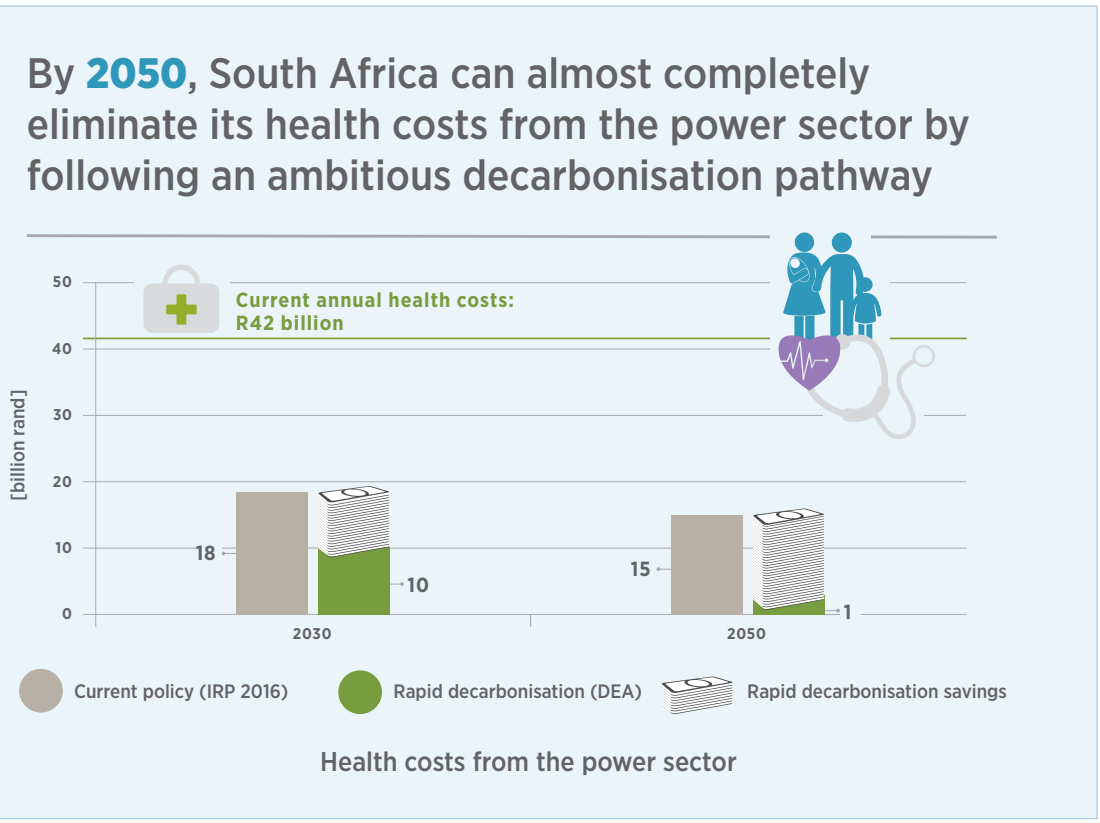


***The COBENEFITS study "Improving health and reducing costs through renewable energy in South Africa"* (IASS/CSIR/IET, 2019b) quantifies the impacts of South Africa's power sector on human health, and how a shift to a less carbon-intensive power sector can help to reduce negative impacts and contribute to reducing costs in South Africa's health system.**

- **Key policy opportunity 1:** Estimated annual health costs of coal power generation in 2018 range from R11 billion (lower estimate) up to R30 billion (upper estimate) (USD 631 million up to USD 1.7 billion)[10] and will continue to rise until 2022. This equates to a health cost externality of Rand 5 cents to 15 cents/kWh (USD 0.0029/kWh to 0.008/kWh) of energy generated from coal. As many as 2080 premature deaths annually can be attributed to air pollution from power plants in South Africa. These externalities should not be disregarded by policy makers in their integrated resource planning.

[10] 1 South African Rand = 0,057 US-Dollar (13.08.2020).

- **Key policy opportunity 2:** South Africa can significantly cut health costs by increasing the share of renewable energy. With its decision to scale up renewables by moving from IRP 2016 to IRP 2018, South Africa can cut health costs associated with the power sector by 25% by the year 2050, and considerably reduce negative health impacts and related costs for people and businesses.
- **Key policy opportunity 3:** Health impacts and related costs can be reduced even further by following (or going beyond) the DEA's Rapid Decarbonisation pathway. By the year 2050, this scenario could cut an additional 20% from health costs associated with the power sector, amounting to as much as R100 billion (USD 5.7 billion) in absolute savings.



Infographic 2: Economic health impacts in South Africa along different decarbonisation pathways

KEY FIGURES

- Up to 44 million people are exposed to air pollution from coal power plants in South Africa.
- Health costs related to coal emissions will peak in 2022, at up to R45 billion (USD 2.7 billion) in that year alone.
- As many as 2080 premature deaths annually were attributable to air pollution from power plants in South Africa.
- Health cost externalities of Eskom's power plants range from Rand 5 cents to 15 cents/kWh (USD 0.003 to 0.008).

KEY FINDINGS

- Health costs of coal power generation will continue to rise until 2022, ranging from R13 billion (lower estimate) to 45 billion (upper estimate) (USD 747 million to USD 2.6 billion) in 2022 alone, a trend shown by all energy generation scenarios. In 2018, Eskom generated about 215 TWh of electricity, at an estimated health cost of R11–30 billion (USD 631 million to USD 1.7 billion). Accordingly, the health cost externalities of Eskom's power plants are within the range Rand 5–15 cents per kWh.

- Health effects are most severe in the Highveld Priority Area, where most of South Africa's coal-fired power plants are located. The proximity of settlements to a power plant is a major factor in total health costs, and therefore considering the locations of plants when formulating decommissioning strategies could drastically reduce human exposure to pollution.

- As many as 2080 premature deaths annually can be attributed to air pollution from power plants in South Africa. Furthermore, coal power generation reduces South Africa's workforce productivity: 27% of health costs are associated with restricted activity days.

- With the decision to scale up renewables in its power sector planning, South Africa's government will have cut health costs associated with the power sector by 25% by the year 2050. In absolute terms, up to R12.7 billion (upper estimate) (USD 728 million) and at least R3.8 billion (lower estimate) (USD 218 million) will be unburdened from health costs by the year 2035. For the year 2050, the estimated health cost savings are between R168 billion and R48 billion (USD 9.6 billion and USD 2.7 billion) respectively.

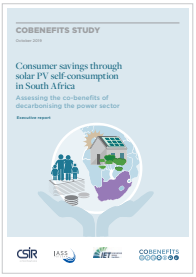
- By following the Rapid Decarbonisation pathway defined by South Africa's Department of Environmental Affairs (DEA), health costs by the year 2050 can be reduced by an additional 20%. In monetary terms, this represents additional savings (compared with IRP 2018) of at least R14 billion (lower estimate) and up to R50 billion (upper estimate) by the year 2030, and between R28 billion and R101 billion by the year 2050. Given that this pathway included coal power generation beyond 2050, health costs could be further reduced in a scenario that phases out coal power before 2050.

- Decommissioning of Eskom's oldest and dirtiest coal-fired power plants in the 2020s will contribute to bringing down health costs in the nearer future to around R5–18 billion (USD 286 million to USD 1 billion) by 2030 (compared to peak costs ranging from R13 to 45 billion [USD 745 million to USD 2.6 billion] in 2022).

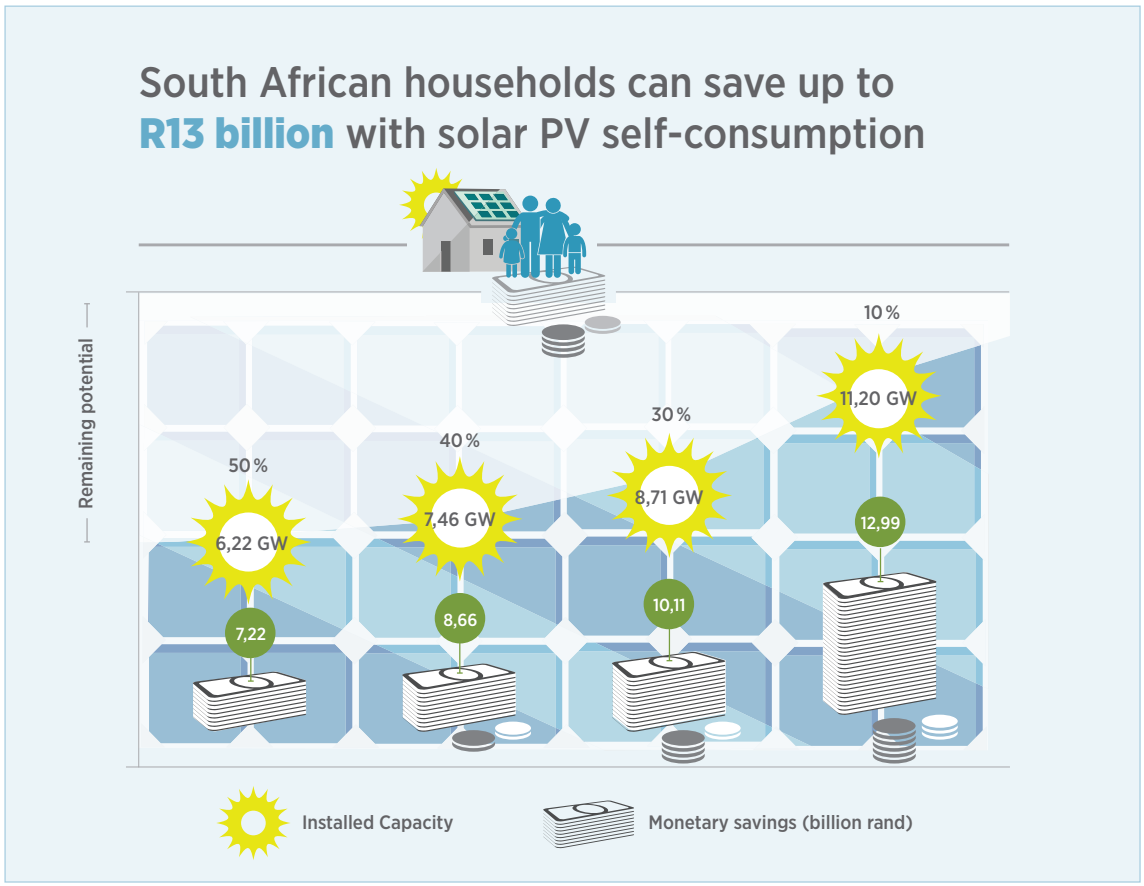
- Health impacts on workforce productivity: The study findings show that (independent of the choice of dispersion model) around 27% of health costs are associated with restricted activity days. Most studies do not model mercury; however, mercury damage accounted for up to 5% of health costs in the present study. This means that health impact assessments are highly sensitive to the estimated cost of mercury damage and to the value of a statistical life (VSL) employed.

2.3 Future skills and job creation through renewable energy in South Africa

***The COBENEFITS study "Consumer savings through solar PV self-consumption in South Africa"* (IASS/CSIR/IET, 2019a) quantifies the expenditure savings that may be achieved by residential and commercial consumers in South Africa when installing rooftop solar photovoltaic (PV) systems with the aim of consuming most of the resulting electricity directly (henceforth termed self-consumption).**



- **Key policy opportunity 1:** South Africa has tremendous potential for rooftop solar PV. In the metropolitan municipalities alone, rooftop solar PV has an economic potential of 15 GW between 2020 and 2030.
- **Key policy opportunity 2:** South African households and businesses can save money by investing in solar: annual savings for the residential sector alone amount to approximately R12.8 trillion.
- **Key policy opportunity 3:** In order to benefit from PV self-consumption in South Africa, it is crucial to establish attractive small-scale embedded generation (SSEG) rates, to manage and forecast the future uptake of self-consumption at municipal and national levels, and to establish incentives for low-income households to become prosumers.



Infographic 3: Household saving potential in South Africa with solar PV

KEY FIGURES

- In the metropolitan municipalities alone, the potential installed capacity of economically viable residential rooftop solar PV amounts to 11.2 GW.
- South African households and businesses can save money by investing in solar: annual savings for the residential sector alone sum up to around USD 734 million (nearly 13 billion Rand)
- For residential prosumers, monthly savings range from R200 to R543 (USD 11 to USD 31) for a 2 kW system. This would result in annual savings ranging from R2 400 to R6 500 (USD 138 to USD 373).
- For a typical 60 kW commercial system, average annual savings of R20000 (USD 1147) can be realised over the system's lifespan.
- At present, payback times average 6–10 years for commercial PV systems and 10–22 years for residential systems, and are highly dependent on the valuation of PV by the local utility (SSEG tariff).
- PV+Battery systems will start to become economically viable as early as 2028.

KEY FINDINGS

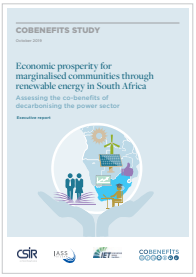
- Small-scale PV systems for self-consumption have already started to become economically viable for both residential and commercial customers. The payback period for self-consumption systems has declined sharply in recent years. This is due both to ESKOM tariff hikes and further reductions in the cost of PV systems. With a fair valuation of PV by the local utility (SSEG tariff), payback periods of PV systems for commercial and residential users can be reduced to 6 years and 10 years respectively.
- An attractive payment scheme (FIT or SSEG tariff) also fosters self-generation and self-consumption, by enabling prosumers to design more capacious systems with the option to feed-in and sell surplus electricity back to the grid. At present, prosumers must design their system to avoid generating surplus electricity (optimisation of self-consumption), because the additional installation costs of a larger system cannot be recouped by selling any surplus energy into the grid. Generally, the tariff structure (i.e., electricity price composition) has a significant impact on the economics of solar (+battery) systems. Introducing demand charges, for instance, can make the business case unattractive.
- Combined annual savings for residential prosumers in South Africa could add up to around R12.8 billion (USD 734 million) by 2030 in the metropolitan areas alone, assuming that up to 11,2 GW of rooftop PV capacity could be installed by residential prosumers. For residential prosumers, savings range from R200 (USD 11) monthly to R543 (USD 31) for a representative 2 kW system, giving annual savings of R2400 to R6500 (USD 138 to USD 373). For typical commercial customers, annual savings range from R20000 (USD 11450) (for a 62 kW system) to R65914 (USD 3787) (for a 1 MW system).
- South Africa has a tremendous potential for rooftop solar PV. It is technically and economically feasible to install more than 11 GW of solar PV on residential rooftops in the metropolitan municipalities of South Africa by 2030 (total capacity in 2018: 285 MW).
- PV+Battery solutions can play an important role in incentivising prosumers and reducing peak load during evening hours. Assuming further cost reductions for battery systems, economic viability can be reached in less than 10 years. Given that payback

periods presently exceed 20 years, PV+Battery solutions need further investment incentives to provide an attractive business case.

- Overall energy system costs can be reduced by optimally aligning the deployment of large-scale projects and distributed generation in South Africa. To this end, detailed projections of the uptake of embedded generation will be necessary.

2.4 Prosperity for previously marginalised communities

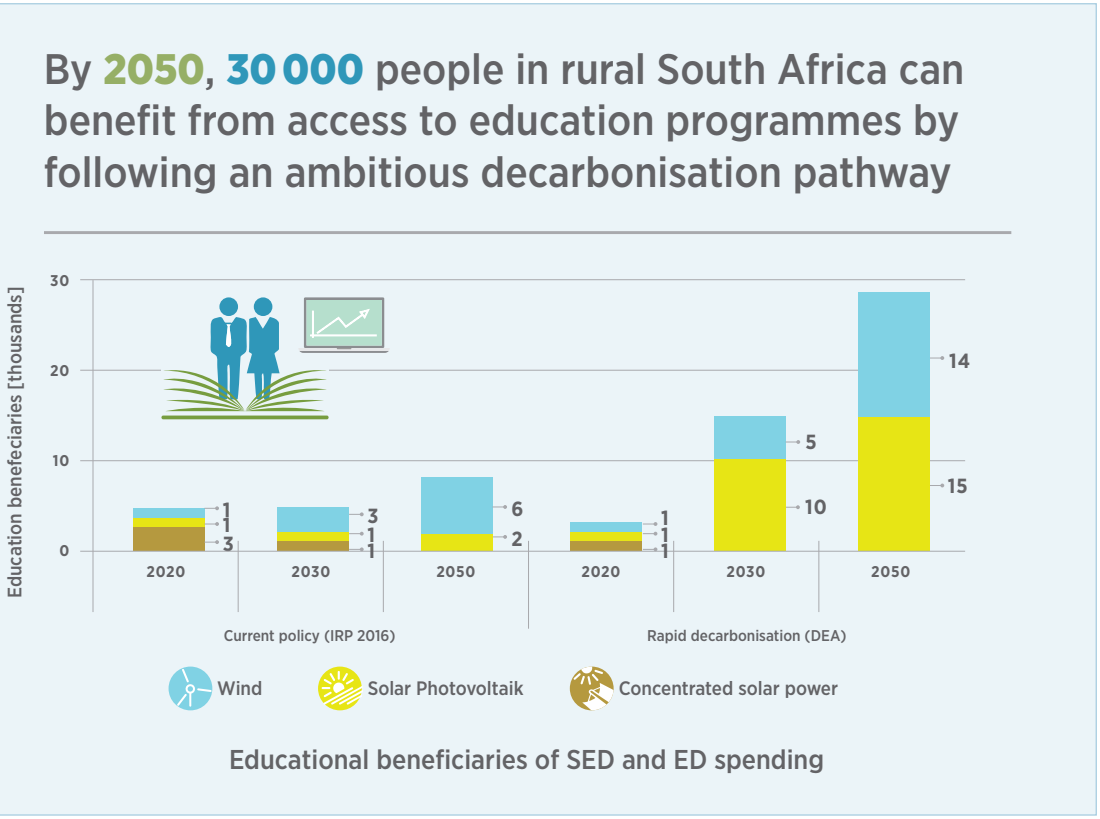
***The COBENEFITS study "Economic prosperity for marginalised communities through renewable energy in South Africa"* (IASS/CSIR/IET, 2019d) assesses the socio-economic and enterprise development (SED and ED) impacts of renewable energy deployment in marginalised communities in South Africa. It entails the assessment of selected socio-economic impacts, realised to date, in three REIPPPP project areas, along with projections and modelling the assessed impacts (up to 2030 for the medium term and 2050 for the long term) across a range of power sector decarbonisation scenarios.**



- **Key policy opportunity 1:** By the year 2050, IRP 2018 will have created almost 5000 jobs through SED and ED and enabled 19000 individuals to benefit from access to education-related programmes. These socio-economic benefits for marginalised communities could even be increased by an additional 100% and 50% respectively, by scaling up the adoption of renewable energy (RE) in line with the more ambitious low-carbon energy pathways.
- **Key policy opportunity 2:** By the year 2050, IRP 2018 will have created almost 5000 jobs through SED and ED and enabled 19000 individuals to benefit from access to education-related programmes. These socio-economic benefits for marginalised communities could even be increased by an additional 100% and 50% respectively, by scaling up the adoption of renewable energy (RE) in line with the more ambitious low-carbon energy pathways.
- **Key policy opportunity 3:** By the year 2050, IRP 2018 will have created almost 5000 jobs through SED and ED and enabled 19000 individuals to benefit from access to education-related programmes. These socio-economic benefits for marginalised communities could even be increased by an additional 100% and 50% respectively, by scaling up the adoption of renewable energy (RE) in line with the more ambitious low-carbon energy pathways.

KEY FIGURES:

- Up to 30000 individuals in marginalised communities can benefit from access to education-related programmes through REIPPPP by the year 2050.
- More than 3000 local enterprises in marginalised communities can be supported through REIPPPP by the year 2050.
- Up to 10000 local jobs can be created in marginalised communities through REIPPPP SED and ED spending by the year 2050. Local communities own an average of 11% of active IPP projects.



Infographic 4: Rural capacity building in South Africa along different decarbonisation pathways

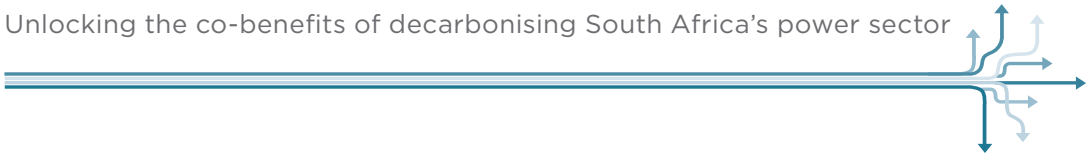
KEY FINDINGS

The employment benefits of RE deployment are distributed nationwide – which is not the case for fossil-fuel power plants. Jobs associated with the solar PV value chain mostly occur in inland areas of the country, while marginalised communities in coastal regions of the country benefit more from jobs created in the wind value chain.

- In terms of literacy access in marginalised communities, South Africa's government with its decision to scale up renewables in its power sector planning, will have substantially increased the number of individuals to access education programmes through socio-economic development (SED) schemes, increasing the number of annual beneficiaries from 8 000 to 19 000 by the year 2050. The number of local beneficiaries can be further increased to nearly 30000 individuals per year by following the Rapid Decarbonisation pathway defined by South Africa's Department of Environmental Affairs (DEA).

- Through South Africa's enterprise development (ED) schemes local enterprises in marginalised com-munities will benefit from scaling up renewable energy. Through the current energy planning pathway more than 2200 local enterprises will benefit from the ED scheme in the year 2050. However, the number of benefitting local enterprises can be expected to grow by 50% to 3300 by following the Rapid Decarbonisation pathway, defined by South Africa's Department of Environmental Affairs (DEA).

- In terms of local job benefits, with the decision to scale up renewables in its power sector planning, South Africa's government will have enabled almost 5000 additional jobs in local enterprises through the enterprise development (ED) scheme by the year 2050. These local employment benefits could be even doubled to a total of almost



10000 jobs in local enterprises, by further increasing the share of renewable energy in line of the Rapid Decarbonisation pathway defined by South Africa's Department of Environmental Affairs (DEA).

- Within the context of the sites assessed, the types of jobs created locally through SED and ED spending include non-core services offered to projects, such as cleaning and catering services. In communities with other significant opportunities for economic activity, job creation may also support other sectors in addition to renewable power generation. For example, supported enterprises may create retail jobs or service jobs for other industries, including the mining industry.

- With its socio-economic co-benefits the REIPPP programme makes important contributions toward meeting the objectives of the UN 2030 Sustainable Development agenda. While the REIPPP programme is most directly associated with SDG 7 (Sustainable Energy for All), through its socio-economic co-benefits it also makes important contributions to other objectives, such as SDG 1 (No Poverty), SDG 4 (Quality Education), SDG 8 (Decent Work and Economic Growth), and SDG 10 (Reduced Inequality).

2.5 Reduced water consumption in the South African power sector

A COBENEFITS scoping study focused on the water consumption of coal-based power plants in an increasingly water-constrained South Africa with the aim of assessing the co-benefits of a low-carbon energy transition in the country. This Policy Report summarises key results and implications:

- **Key policy opportunity 1:** Water scarcity is not an immediate threat to energy security in South Africa. However, coal power has an important impact on some regional water systems. In the Waterberg system, water consumption by power plants could account for about 40% of all demand by 2050.

- **Key policy opportunity 2:** The old Return-to-Service (RTS)[11] power plants are responsible for about 13% of water consumption by all coal-fired power plants in South Africa. By tackling the problem with load shedding and replacing these power plants with renewables, South Africa could immediately reduce water consumption in the power sector significantly.

- **Key policy opportunity 3:** Further investigation of the Water–Energy–Food Nexus in South Africa. Much of South Africa's coal deposits underlie almost half of its high-potential agricultural soils. In addition, the land capability of a rehabilitated opencast mine is significantly lower than its pre-mining condition, and generally results in the production of acid mine drainage.

KEY FIGURES:

- Water scarcity will continue to become more severe in South Africa. Conservative estimates indicate that South Africa will experience a 234-gigalitre shortfall of water by 2025.

[11] The RTS stations were mothballed in the 1990s but subsequently recommissioned due to high electricity demand.

- The water efficiency of dry-cooled power stations ranges from 0.1 litres/kWh to 0.15 l/kWh, while that for wet-cooled power plants ranges from 2.2 litres/kWh to 2.4 l/kWh. RTS fleet water consumption is approximately 3 litres/kWh.
- In the Waterberg system, water consumption by power plants could account for about 40% of all demand by 2050.

KEY FINDINGS

- South Africa is particularly vulnerable to climate change impacts and resulting water scarcity. This has been observed in Cape Town, where the increased variability in winter rainfall patterns caused an extreme drought throughout the region.
- Water scarcity will continue to become more severe in South Africa. Conservative estimates indicate that South Africa will have a 234-gigalitre shortfall of water by 2025.
- Already today, fresh water is fully allocated, which means that new developments that require water cannot proceed due to the non-availability of water rights.
- The assessment has shown that water scarcity is not an immediate threat to energy security in South Africa. Since Eskom is a "strategic" water user with guaranteed water supply under the National Water Act 36 of 1998, security of electricity supply via coal-fired power plants is not threatened by water scarcity.
- A sophisticated network of waterways has been developed in South Africa. Many of the country's inter-basin transfer (IBT) schemes were developed specifically to supply water to power plants. Eleven of Eskom's power stations are supplied with water through the Vaal River Eastern Sub-System (VRESS) which forms part of the Integrated Vaal River System.
- Water withdrawal and consumption by the South African power sector are relatively modest compared with other countries. Approximately 67% of the freshwater in South Africa is utilised for irrigation (agriculture) while only 2% is utilised for power generation (plus 5% for mining activities).
- The first partly dry-cooled power station in South Africa was constructed in the early 1970s. It was the third power station in the world to use a dry-cooling system. In the 1990s, direct or indirect dry-cooling technologies were applied as the default technology, thereby further reducing water consumption by the power sector.
- The water efficiency of dry-cooled power stations ranges from 0.1 litres/kWh to 0.15 litres/kWh, while that of wet-cooled power plants ranges from 2.2 litres/kWh to 2.4 litres/kWh. RTS fleet water consumption is about 3 litres/kWh.
- Although dry-cooling systems utilise less water, they are also less energy efficient and therefore produce more carbon emissions per unit of electricity. In addition, water consumption increases for coal-fired power plants using flue-gas desulphurisation (FGD) to remove sulphur dioxide.
- Coal power has an important impact on some regional water systems. Power plants utilise a significant proportion of the water in the Waterberg and Olifants River systems. In the Waterberg system, water consumption by power plants could account for about 40% of all demand by 2050. If water costs were not taken into account in energy-system planning through 2050, water consumption would increase from 45 Mm^3 in 2015 to almost 900 Mm3 of the total water consumption in the region. The Olifants catchment is almost fully utilised, with power generation now accounting for 23 percent of demand in the Upper Olifants, with a deficit predicted by 2030.

- About 13 % of total power sector-related water consumption can be attributed Return-to-Service coal-fired power plants. The three RTS power stations, Camden, Grootvlei, and Komati, have the highest water usage per unit sent out (USO) in any given year. The Camden and Komati stations are the oldest in the fleet, both having been commissioned in the 1960s. Significant water savings can be achieved if some of the less efficient power stations, e.g., Camden and Komati, could be phased out.
- Coal-based power generation impacts water quality. Eskom is the largest emitter of sulphur dioxide (SO_2) in South Africa. SO_2 causes a significant decline in water quality due to the formation of sulphuric acid, leading to the acidification of water bodies (e.g., rivers, streams, wetlands) that play essential roles in regulating ecosystems.

While water withdrawal and consumption by the South African power sector are relatively modest compared with other countries, power plants utilise a significant proportion of the water in some regional water systems.

Waterberg catchment: **40%** expected water demand **by 2050**

Upper Olifants catchment: **23%** water demand **in 2018**, with an expected water deficit **in 2030**

Current freshwater utilisation in South Africa:
Power sector: **2%** for power generation and **5%** for mining
Agriculture: **67%** for irrigation

Water scarcity will continue to become more severe in South Africa. Conservative estimates indicate that South Africa will experience a **234-gigalitre shortfall in water availability by 2025**.

Infographic 5: Emerging challenges in South Africa's Water-Energy Nexus

3. Unlocking the value of co-benefits for the people of South Africa

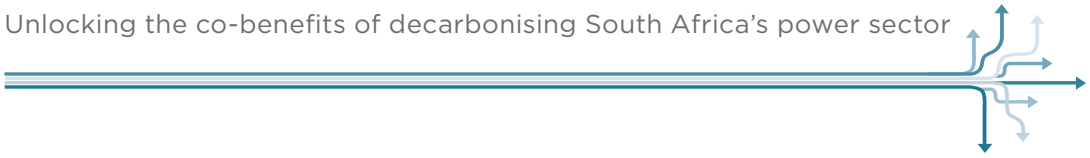
Creating future-oriented skill sets and employment opportunities, improving people's health and unburdening the public health system, saving money by prosumers, reducing water consumption, and fostering prosperity for previously marginalised communities – the COBENEFITS studies for South Africa compiled and quantified the evidence that decarbonising South Africa's electricity sector through a shift to renewable energy can yield considerable social and economic co-benefits. In that, the findings also substantiate the strong interrelatedness of energy and climate policy with development action in South Africa.

How can policy makers and policy implementers in government ministries shape an enabling political environment to unlock and maximise the social and economic opportunities for communities, businesses, and families?

Quantifiable evidence and knowledge of the socio-economic potentials are pivotal for developing enabling policies to unlock the identified co-benefits. Thereby, government departments and other government institutions can shape an enabling political environment to unlock and maximise the social and economic opportunities for communities, businesses, and families in South Africa.

Building on the evidence from the COBENEFITS studies, a broad and intensive consultation process with government institutions, industry associations, and expert and civil society organisations has yielded concrete policy opportunities to deliver on the identified co-benefits for the people of South Africa. A series of roundtable consultations were hosted in 2019 by CSIR in partnership with the Independent Institute for Environmental Issues, which were complemented by further consultations with government departments until March 2020.

In this section, these policy opportunities are presented within the five main co-benefits areas. After outlining stimuli for shaping favourable policy environments, selected High-Impact-Actions are defined and described in detail, along with suggestions for political institutions to champion each HI-Action and collaborative bodies to successfully implement the policy opportunity.



3.1 Creating an enabling environment for future-oriented employment and skill development

The COBENEFITS study showed that South Africa can significantly boost gross employment by increasing the share of renewables. By 2050, more than 150000 new jobs (+17 %) will have been created in the power sector in net terms (i.e., including job losses in the coal sector). Up to 1,6 million additional jobs can be created economy-wide through the power sector transformation by 2050.

How can government departments and agencies maximise employment benefits in South Africa's renewable energy sector and alleviate negative externalities in the country resulting from shifts away from coal?

How can other stakeholders harness the social and economic co-benefits of building a low-carbon, renewable energy system while facilitating employment opportunities through a just energy transition?

Building on the study results and the surrounding discussions with political partners and knowledge partners, we propose to direct the debate in the following areas where policy and regulations could be put in place or enforced in order to benefit from the potential employment opportunities:

- Create jobs along the value chain of the RE sector
- Manage the transition in the coal sector and regions
- Built the skills required for the future power sector in South Africa
- High Impact Action: Provide guidance for careers and gender equality in the renewable sector

Create jobs along the value chain of the RE sector

Jobs in renewable power generation are concentrated in the services, construction, and manufacturing sectors. The Renewable Energy Independent Power Producer Procurement Programme (REIPPPP) has demonstrated the potential for localised job creation through renewable energy deployment in South Africa. The localisation requirements of the REIPPPP resulted in the development of renewable manufacturing industries and capacity in South Africa. However, growth in the manufacture of essential renewable energy technologies (and the associated components) is highly dependent on the government's commitment to continuous and long-term deployment of renewable energy. The present skills shortage in renewable energy is partly a result of the 'boom–bust' cycles that have occurred in the procurement processes; for example, as an effect of the REIPPPP, projects are often constructed simultaneously, creating sharp and short-term increases in demand for skills. A sustained and predictable pace of renewable energy procurement over time will be essential to manage these cycles. A successful transition to a low-carbon power sector in South Africa will require a clear commitment from the government for a sufficiently long period (i.e., 10 years or more). The renewable energy sector presently provides employment opportunities for some displaced coal workers following minimal training effort (in jobs such as installation, manufacturing, and sales), whereas the transition plan for displaced workers must be broader and more comprehensive. For developing countries to effectively create employment, *"a multi-prong strategy, entailing a combination of manufacturing, agriculture, services, and natural resources, is needed"* (Stiglitz, 2018).

Manage the just transition in coal sector and regions

Continued job losses are likely in the coal sector. This trend is primarily driven by declining global demand for coal. A transition away from coal is therefore likely to take place in South Africa regardless of increased domestic deployment of renewable energy. In other words, policy makers would need to manage these structural changes even without any energy transition in South Africa. Bloomberg New Energy Finance (2018) estimates that by 2050 global coal power generation will decrease to 5% of the global power mix (from 30% in 2017). Across the employment scenarios, jobs in the coal sector (including the mining and power sectors) are predicted to decline by 35–40% between 2020 and 2050. Detailed data on the age- and skill-profiles of workers at each power station and mine will be needed if the transition is to be managed in an orderly manner. For

example, the estimated median age of coal miners in Mpumalanga is 38 years. This means that some portion of the present workforce will be approaching retirement age by 2040 when a bulk of coal-fired power plants would be reaching the end of their assumed technical lifespan and the associated mines would be undergoing closures. Redeployment, early retirement, and re-training costs can only be assessed through more detailed information and by acknowledging the coming closures of coal infrastructure. Notwithstanding the challenges presented by such profound changes in the energy sector and the broad economy, existing systems for professional development (through the Mining Qualifications Authority and individual mining companies) provide an institutional framework for assisting workers to transfer to new sectors. To alleviate the social impact on the energy transition in coal regions, specific measures can be taken that have proven successful in other countries around the world. In a first step, South Africa could assess the renewable energy potential in the coal regions; deploying renewables in the (former) coal regions can generate employment and economic activities in those regions. Secondly, policy makers could plan location-specific renewable energy auctions in (former) coal regions. In order to create new economic stimulus, policy makers could create economic incentives in order to strategically move future industries to these areas (e.g., develop special economic zones in former coal regions). South Africa needs to identify new opportunities for existing sectors or engender new and emerging sectors that can serve as drivers of growth. The development of these "new" sectors could act as an absorption mechanism for workers displaced as a result of net shifts in the power sector. An example of such an opportunity may lie within the mining sector. The global increase in demand for battery technologies, driven by exponential growth in both electric vehicle ownership and installed capacity of renewables has also increased demand for minerals such as lithium, cobalt, nickel, manganese, and graphite. Battery technologies also offer other opportunities for new sectors and the expansion of existing sectors in manufacturing and services. Further investigation should therefore be conducted towards enabling South Africa to become a player in this emerging sectors and delivering on the government's objective of a just transition.

Build the skills required for the future power sector

The bulk of job creation in renewable power generation is within the high-skilled labour group, defined as workers with an educational attainment level above Grade-12, although employment is also created in other skill groups. Across all scenarios, around 70% of new jobs created in the power sector by renewable energy are in fact high-skilled jobs. The employment gains obtained are dependent on the availability of a skilled labour force. This needs to be addressed through a renewed and redirected education and training systems. While not optimal for localisation, the "importation" of key high-skilled labour could be considered as an interim measure to address potential critical skills gap that arise. Eventually, higher education, training institutions, and sectoral skill plans need to align their training programmes with the skills requirements of the sector.

3.2 High-Impact Action for boosting job creation, skill development and equity in the renewable energy sector

High-Impact Action: Provide guidance for careers and gender equality in the renewable sector

Institution to champion the Action	Collaborative bodies to successfully implement the Action	Timeframe of the Action
Department of Higher Education and Training (DHET)	■ Department of Mineral Resources and Energy (DMRE) ■ Department of Basic Education ■ Department of Employment and Labour	Short term, over the next five years

South Africa can significantly boost gross employment by increasing the share of renewables. The numbers show a particular need for highly skilled workers for the new energy world. The explicit recommendation is to direct attention to graduates from schools and FET (Further Education and Training) colleges, who need to be alerted to the various opportunities in the renewables sector.

At present, there is insufficient awareness of career pathways within the renewables sector, due to an absence of information and a public discourse that is focused on job losses in the coal sector. The age structure of coal sector employees and the need for programmes in the affected regions are subject to ongoing processes, among others the Just Transition Dialogues carried out in 2018/ 2019 under the auspices of the National Planning Commission. This work is crucial for ensuring a positive future for the affected regions and employees. Nevertheless, the willingness of current coal workers to relocate or to retrain for a profession in the renewables sector is uncertain. Thus, the deployment of RE is one option, among others, for the coal regions, but the development of skills for the RE sector is also relevant to many more regions and especially for the young generation, not yet being bound to one industry.

Given that women are still very much under-represented in the power-sector-related labour market, the energy transition offers a huge opportunity to overcome outdated career patterns: A gender-sensitive way of portraying and promoting education pathways (degrees, curricula, technical certifications) and career paths, including fresh formats for hands-on career guidance activities (such as a campaign involving career guidance in schools, internships, and visiting programmes), can unleash the human capital of all South Africans and simultaneously actively reduce existing inequalities.

Career paths available through technical and vocational education and training (TVET) shall receive special attention in these communication efforts, also aiming to improve the appraisal/image of these institutions. Apprenticeships (dual education programmes) and other partnerships with the renewable industry or power producers represent opportunities for both employers and employees, which could be further developed or established where appropriate.

Additional Impact Action: Securing a participative approach for steering a Just Transition in the energy sector

Institution to champion the Action	Collaborative bodies to successfully implement the Action	Timeframe of the Action
National Planning Commission (NPC)	All government departments, especially Department of Trade, Industry, and Competition (DTIC) and regional administrations	Immediate, starting within a year

While the new energy world is developing, the impacts of job losses in the coal regions must be mitigated. Building on the Just Transition Dialogue by the NDP, the transition processes in the regions will come into focus and require a similar bottom-up dialogic approach. Setting up specific programmes and roadmaps for the coal regions will contribute to this – including incentives for developing industry clusters and future-oriented industries, deployment of renewable energy technologies/industries, and rehabilitation funds for workers. The best instrument to employ in these regions would be multi-sectoral special economic zones designed to diversify the regional economy while mitigating job losses associated with the general overall decline predicted for the coal sector, including the lesser effects of shifting to renewables.

3.3 Creating an enabling environment for consumer savings through PV self-consumption

The analysis of the COBENEFITS study has revealed the vast potential for rooftop solar PV in South Africa. The economic viability of PV systems for self-consumption will further improve in the coming years and growth rates will further accelerate. However, certain policies and regulations will need to be put in place or adjusted in order to manage sustainable uptake in the rooftop PV sector.

How can government departments and agencies create an enabling environment to maximise cost savings and financial benefits for the people and businesses in South Africa?

How can other stakeholders harness the social and economic co-benefits of building a low-carbon, renewable energy system while facilitating a just transition?

Building on the study results and the surrounding discussions with political partners and knowledge partners, we propose to direct the debate on the following areas where policy and regulations could be put in place or enforced in order to facilitate consumer savings through solar PV self-consumption in South Africa within the shift to a less carbon-intensive power sector:

- Payment modalities for excess electricity
- The future rate design for prosumers
- Incentives for low-income households to become prosumers
- Managing and forecasting the future uptake of self-consumption

High-Impact Action: Set up simple and cost-effective registration systems at municipal level

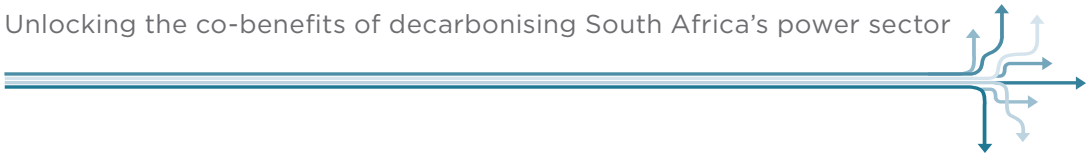
The study has shown that small-scale PV systems can be economically viable even without compensation for excess electricity. However, the analysis also indicated that municipalities can significantly improve the economics for prosumers by offering SSEG tariffs that provide payment for excess electricity that is fed into the grid. The question remains whether PV (+battery) systems will be financed based on optimised self-consumption alone. Financing a PV system based on self-consumption is relatively risky for investors, especially in the commercial sector based on certain factors. Key among them are:

- A prosumer's electricity demand might change over time, meaning that it can be challenging to calculate optimal sizing of the system (this is especially risky for commercial and industrial prosumers, where electricity demand can very largely depend on business cycles).
- The electricity rate design might change, thus undercutting the economics of existing rooftop PV systems. Currently, SSEG tariffs can change every year.
- Prosumers (especially in the commercial sector) might look for very short payback periods and high returns to justify any investment (since such investments are not part of their core business).

Therefore, several jurisdictions worldwide have supported prosumers by offering a low but stable price for any excess electricity that is fed into the grid. For investors and banks, this low but stable remuneration level can serve as a fall-back option (in case of changes to onsite demand or rate design), which can make larger projects that rely on debt-finance more bankable. By allowing rooftop PV systems to feed excess electricity back into the power network, distributed generation can contribute to meeting national renewable energy targets.

Future rate design for prosumers

The study has also shown that changes to the rate design (e.g., higher fixed charges and demand charges) can undercut the economics of self-consumption. Therefore, any modifications to the existing rate design must be approached with caution. In addition, the effects of the new rate design need to be further analysed. Research in other countries has shown that higher fixed charges can lead to higher electricity prices for low-income households (Whited et al., 2017). Moreover, demand



charges can hamper demand-side flexibility and thus become a barrier to the energy transition in South Africa. Alternative rate design options, including time-of-use rates, real-time pricing, and locational pricing should be further analysed.

Incentives for low-income households to become prosumers

This study finds that, at present, self-consumption is primarily economically viable for high-income households (e.g., LSM 7 or higher). This is largely due the 'inclining block' rate structure applied in South Africa: Consumers with higher electricity demand pay more per unit of electricity. However, the energy transition towards renewable energy sources can be managed in a socially inclusive way. In the spirit of the "just transition", specific subsidy or support programmes could be established to also enable low-income households to benefit from rooftop solar PV. Recently, the emergence of new business models (e.g., community ownership and third-party ownership) have created new opportunities that could also be explored further in the South African context.

3.4 High-Impact-Action for stimulating PV self-consumption and consumer savings

High Impact Action: Set up simple and cost-effective registration systems at municipal level

Institution to champion the Action	Collaborative bodies to successfully implement the Action	Timeframe of the Action
National Energy Regulator of South Africa (NERSA)	Municipalities	Immediate, starting within a year

There is very limited knowledge about the recent and future growth of PV self-consumption in South Africa. The draft IRPs from 2013, 2016, and 2018 include either very distinct or no projects for the development of distributed generation until 2030 and beyond. The new IRP 2019 includes a 500 MW placeholder for all years until 2030. However, it is arguably clear today that the growth of the PV prosumer market segment will be less steady than the placeholder estimates and instead more dynamic.

Therefore, it will be crucial to keep track of the development of rooftop solar PV. It is vital for policy makers to have reliable statistics to make informed decisions and to design the most cost-efficient power system (including distributed and centralised power generation units). At the municipal level, it is important to set up simple and cost-effective registration systems in order to avoid the implementation of increasing numbers of unregistered systems. Well-functioning systems at the municipal level can be promoted as best practise by NERSA, or else national regulations can be passed to assure the implementation of these registration systems in all South African municipalities.

Additional Impact Action: Set up a national registry to track the prosumer growth (aggregating data from municipal level)

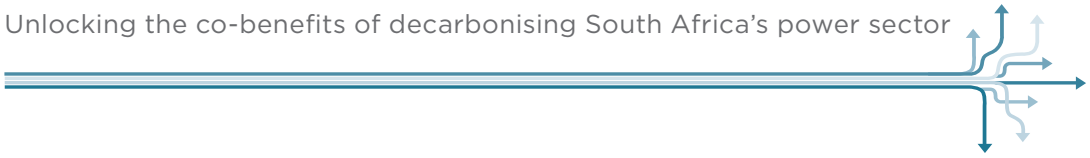
Institution to champion the Action	Collaborative bodies to successfully implement the Action	Timeframe of the Action
NERSA	Municipalities	Immediate, starting within a year

These local registries at municipal level could also provide vital bottom-up information for a national registry. Aggregating all data on rooftop self-consumption would make it easier for policy makers at national level to adequately consider distributed generation sources in national system planning and also assure that all relevant policy instruments are in place for smooth system integration. The national registry can be managed by NERSA.

Additional Impact Action: Examine bottom-up uptake of PV rooftop systems nationwide, using well-known methods such as Bass diffusion modelling

Institution to champion the Action	Collaborative bodies to successfully implement the Action	Timeframe of the Action
DMRE	■ NERSA ■ South African Local Government ■ Association (SALGA)	Short term, over the next five years

It is recommended that a dedicated study should be commissioned to examine bottom-up uptake of PV rooftop systems nationwide, using well-known methods such as Bass diffusion modelling. The Bass model requires detailed data on market trends for the technology whose uptake is being estimated. Once such data are acquired, future studies should use optimisation tools dedicated to the uptake of rooftop PV, such as DOGMMA (Distributed Generation Market Model of Australia). However, such a model would require modification in order to be applicable and reliable in the South African context.



3.5 Creating an enabling environment for improving people's health and unburdening the health system

The COBENEFITS study has quantified the potential for South Africa to significantly improve the health of its people and reduce related costs by decarbonising the power sector. With its decision to progress its energy policy from draft IRP 2016 to draft IRP 2018, thereby accelerating the decarbonisation of its electricity supply, South Africa is set to cut health costs from the power sector by 25% by the year 2050. This study has also shown how, by following (or even going beyond) DEA's Rapid Decarbonisation pathway, during the same period an additional 20% can be cut from the health costs associated with the power sector, amounting to as much as R100 billion in absolute savings. The R11–30 billion health cost estimate for 2018 is difficult to evaluate as a standalone figure; nevertheless, health cost savings as a result of reduced pollutant emissions represent a benefit and are a useful metric. In 2017, direct health care spending accounted for approximately 9% of South Africa's total GDP of R4,65 trillion.

How can government departments and agencies create an enabling environment to ensure people's health and to unburden South Africa's health system?

How can other stakeholders harness the social and economic co-benefits of building a low-carbon, renewable energy system while facilitating a just energy transition?

Building on the study results and the surrounding discussions with political partners and knowledge partners, we propose to direct the debate in three areas where policy and regulations could be put in place or enforced in order to reduce air pollution from coal-fired power plants within the shift to a less carbon-intensive power sector:

- Enforcement of Air Quality Act (emission standards) and potential retro-fitting of existing coal-powered plants
- Integrate health externalities of coal into power sector planning
- Ensure better data availability for health cost assessments
- High-Impact Action: Provide transparent background research on health externalities to inform energy sector planning

Enforcement of Air Quality Act (emission standards) and potential retrofitting of existing coal power plants

Over the past decades, South Africa has elaborated a very sophisticated regulatory framework for air quality, starting with the Air Quality Act of 2004. As part of this framework, emission limits for the power sector were defined for the year 2015 and even stricter limits for the year 2020. However, Eskom and other industries have applied for postponement, since they were unable to comply with the existing regulation for the year 2015 and will likely be unable to comply with the even stricter limits proposed for 2020. Consequently, air quality in the Highveld, which contains most of South Africa's coal-fired power stations, often fails to meet National Ambient Air Quality Standards (NAAQS) (DEA, 2009, 2012).

According to the latest DEA regulation:

- Existing coal power plants may apply for a one-off postponement of compliance with new plant standards. If granted, any such postponement cannot exceed 5 years and cannot extend beyond 31 March 2025.
- Existing coal plants that will be decommissioned before 2030 may apply for a one-off suspension of the timeframes for compliance with new plant standards, for a period not beyond 2030. In order to secure such a suspension, Eskom would need to table a clear decommissioning plan before 31 March 2019.

Technology can play a major role in reducing emissions from coal-fired power plants. For example, Eskom's current air quality improvement planning process is considering abatement technologies to reduce atmospheric pollutants, such as the use of low-NOX burners, flue gas desulphurisation, and fabric filter bags. These abatement technologies, however, can add considerable costs to power generation, either directly due to capital and operational expenditure requirements, or indirectly due to increased water consumption, carbon emissions, and landfill requirements. Therefore, any assessment of the viability of

filtering technologies should consider the costs and potential negative side effects (e.g., higher water consumption, increased carbon emissions).

Furthermore, a cost comparison of retrofitting coal power plants with abatement technologies versus the deployment of additional renewable energy plants would help to make the case for a least-cost scenario that takes into account air quality externalities.

Integrate health externalities of coal into power sector planning

This study has quantified the health costs related to coal-fired power generation in South Africa. Eskom's coal-fired power stations produced more than 202106 GWh of energy in FY2017/18. At an estimated total health cost of R11–30 billion in 2018, this equates to a health cost externality of Rand 5–15 cents per kWh. These health cost externalities should be considered transparently in power sector planning. In addition, the locations of power plants need to be considered. Power plants that affect more densely populated areas create higher costs for society as a whole. Fortunately, in South Africa, the majority of the potential health impacts of power stations are reduced due to their remoteness from major population centres. However, health costs would increase with the growth of populations close to these fossil-fuelled power stations.

Finally, the emissions from individual power plants should be considered when planning the phase-out of these existing coal-fired plants. Older power plants usually have higher emissions than those that employ newer technologies. This way, the phase-out programme in line with the economic lifetime of existing power plants already implicitly takes emission intensity into account. However, there might be cases where individual power plants should be decommissioned earlier due to their specific emissions (or close proximity to highly populated areas). Cost–benefit analysis would provide further context on the estimates made in this study, allowing these benefits (health cost savings) to be weighed against the costs of mitigation options or other power generation options.

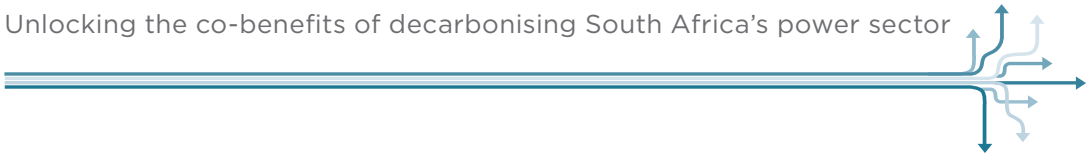
3.6 High-Impact-Action to reduce air pollution and improve people's health

High-Impact Action: Provide transparent background research on health externalities to inform energy sector planning

Institution to champion the Action	Collaborative bodies to successfully implement the Action	Timeframe of the Action
Department of Environment, Forestry, and Fisheries (DEFF)	DMRE	Immediate, starting within a year

The IRP 2019 states, that it "is an electricity infrastructure development plan based on least-cost electricity supply and demand balance, taking into account security of supply and the environment (minimise negative emissions and water usage)" (DMRE, 2019: p.8). It also contains a paragraph on costs caused by emissions externalities, using a 'cost-of-damage' approach and stating the costs associated with emissions of NOX, SOX, Hg, and PM (DMRE, 2019: p.32).

The cost estimates would gain even more credibility by making transparent the methodologies, assumptions, and associated implications used in the IRP. A large body of in-depth research on the negative health effects of different types of power generation technologies, together with internationally acknowledged methods for dispersion and exposure modelling, are also available to guide the decommissioning of power plants, especially in densely populated areas where emissions exceed the limits specified in the National Ambient Air Quality Standards defined in the National Environmental Management: Air Quality Act (NEM:AQA).



Additional impact action: Ensure Public Access to Real time Air quality data and modelling results

Institution to champion the Impact Action	Collaborative bodies to successfully implement the Impact Action	Timeframe of the Impact Action
Department of Health	Department of Energy?	Short term, over the next five years

Public access to air quality information is crucial: Currently, ambient air quality data sources are interspersed and difficult to access. Regulators should consider sharing real-time ambient air quality data, so that researchers have easier access and the public is better informed. Similarly, dispersion modelling results (shapefiles) should be shared when publishing atmospheric impact reports, to avoid the need for time-consuming and costly duplication of modelling efforts.

3.7 Creating an enabling environment for economic prosperity in previously marginalised communities

The COBENEFITS study shows that investment in large-scale REIPPPP can translate into significant socio-economic co-benefits for marginalised communities in South Africa. Up to 30000 individuals in marginalised communities can benefit from access to education-related programmes through REIPPPP by the year 2050. More than 3000 local enterprises in marginalised communities can be supported through REIPPPP and up to 10000 local jobs can be created in marginalised communities until the year 2050 through REIPPPP SED and ED spend.

How can government departments and agencies and political decision makers create an enabling environment to maximise socioeconomic benefits for South Africa's marginalised communities?

How can other stakeholders harness the social and economic co-benefits of building a low-carbon renewable energy system while facilitating a just energy transition?

Building on the study results and the surrounding discussions with political partners and knowledge partners, we propose to direct the debate in three areas where policy and regulations could be put in place or enforced in order to generate prosperity in marginalised communities via RE deployment:

- Improve data availability and data transparency
- Consistency and coordination in reporting
- Foster community engagement and establish practice guides for IPPs
- Job Creation (in conjunction with enterprise development)
- Community Ownership (Equity)
- Adjusting regulation for SED and ED Spend
- High-Impact Action: Establish community ownership and engagement practice guides for IPPs
- Additional impact action: Ensure transparency about social investments of IPPs through a Social Performance Index (SPI)

Improve data availability and data transparency

The study identified numerous lessons learned related to the practices of IPPs. Those with better access to data on the marginalised communities around their project site and a better working relationship with the local community delivered higher levels of SED and ED benefits to these areas. Transparency and availability of data: It is recommended that the government should make detailed data on the social investments of IPPs publicly available, even if the IPPs are anonymised. There is currently a dearth of data, which results in the erroneous perception that IPPs offer little to no social value. Specifically, there is a requirement for data that meaningfully represent the nature and quality of social investments engendered by RE.

Consistency and coordination in reporting

An effort should be made to ensure the consistent application of the SED and ED spend categories, and to provide guidelines to IPPs in this regard. It is important that there is greater clarity around the classification of investments, to enable a deeper understanding which programmes deliver the greatest impacts. This will also aid in improving the overall monitoring and evaluation of project implementation and further enable coordination and collaboration across the sector. Collaboration within the research and implementation communities to better understand and measure the broader socio-economic impacts: The development and application of impact factors and methodologies for assessing socio-economic impacts across a range of fields is gaining momentum amongst consulting and academic researchers. Practitioners involved in the implementation and measurement of SED and ED should participate in structured information sharing sessions; and, where possible, collaborate (where issues of confidentiality and commercial interest allow) to share and learn from best practice.

Foster community engagement and establish practice guides for IPPs

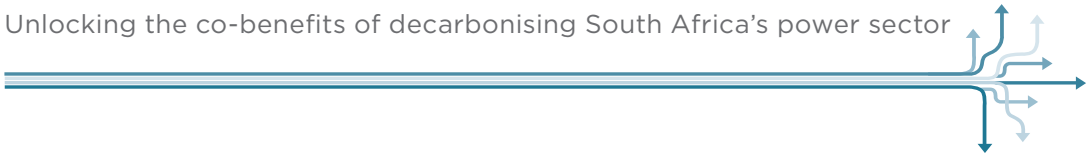
The rules of the REIPPPP serve as a good basis for providing community benefits, given that they obligate IPPs to make minimum, direct contributions towards their host communities. Nevertheless, there exists an opportunity to strengthen these rules by codifying their implementation into a set of 'practice guides' (See High Impact Action, below).

Job creation (in conjunction with enterprise development)

As part of the community engagement process preceding bid-submission, project developers are required to ascertain the skills development requirements of communities with a view to providing training for more substantive participation in the projects. Previous bidding rounds were executed at a rapid pace, making it difficult for projects to prepare communities for opportunities such as skilled employment and service provision. As a consequence, beneficiary communities have assumed the least skilled roles and provided low value services to projects, most notably catering and grass-cutting. A crucial driver of the under-investment in communities is also the funding structure of projects. Because social investments only flow during the operational phase, project developers have typically waited for this phase to then distribute funds towards skills and enterprise development. Project developers should prioritise investments that are intended to provide permanent jobs, and should set long-term service-level agreements for local community members and companies. This can take the form of a multiplier for every Rand spent, and could be integrated into the procurement rules. Furthermore, targets could be set for a defined percentage of the plant operations contract, defined in terms of service provision not equity ownership, to be in the hands of the local community by a certain date (e.g., five years post-commencement of operations).

Community Ownership (Equity)

Instruments for community ownership should be fully constituted and given access to professional services prior to the establishment of IPP projects. Currently, Community Trusts are established by IPPs and permitted to form part of the equity structure of a project without any community participation. It is recommended that Community Trusts be treated as broad investment vehicles with the ability and intent to invest in other revenue-generating investments. In so doing, the trusts can serve a longer-term objective as community wealth funds that are not solely dependent on the IPP for revenue. This structure may be funded through development financiers, who could be empowered to appoint legal and financial advisors to



negotiate their own funding terms. The REIPPPP could also incentivise active participation of Community Trusts, by allocating additional points to those that also own the land on which the project is built, and that participate in core value-chain activities. It is suggested that, in future renewable energy procurement rounds, host communities should receive necessary support to ensure they have more effective organisational skills, and be encouraged to seek out co-development partnerships with IPPs, using forms of capital such as land or collective savings. In conclusion, measures should be instituted for monitoring and evaluating Community Trusts and any other community ownership vehicle. Currently, trusts are not required to report to the IPP Office on their composition, activities, and impact. Instead, community ownership vehicles should be subject to standardised, statutory quarterly reporting requirements that include governance, financial management, and development impact obligations.

Adjusting regulation for SED and ED Spend

While there is nothing wrong, in principle, with the development role that the private sector takes on in the REIPPPP, it is important to keep in focus that SED and ED spend are a function of the state-sanctioned licence to operate. It is thus recommended that the state re-orients its approach in the following key ways:

Municipal alignment: The state should also determine key focus areas for development in each municipality and impose such a focus on IPPs, in collaboration with proven community priorities (as expressed in the Participatory Rural Appraisal, PRAs). Investing in these areas does not have to occur through the municipality, but should be collaborative, ensuring that the IPP's budget augments a larger funding pool within the local municipality, towards a key programme. Collaboration should be governed by a public social contract or memoranda of understanding.

Elective deference: IPPs should be given the option to delegate the management of their SED/ED spends rather than managing this themselves. Many IPPs lack the capacity, interest, and understanding to devise workable social investment strategies. Indeed, despite a genuine interest, many IPPs fail to implement their plans as a consequence of the complexities inherent in community development work. It is thus recommended that IPPs should be permitted to defer to the state in executing their duties; and that the state may, in turn, contract third-party service providers to execute the IPPs' mandates on their behalf.

Programme-based logic for scale: Given financial constraints, IPPs should not be permitted to invest in more than three or four SED programmes and two to three ED programmes. Assuming an annual budget of circa R5 million, this allows for at least R500000 to be spent annually on each programme that delivers on the spread of employment and enterprise development in the marginalised communities.

The study identified numerous lessons learned related to the practices of IPPs. Those with better access to data on the marginalised communities around their project site and a better working relationship with the local community delivered higher levels of SED and ED benefits to these areas.

3.8 High-Impact Action to foster community engagement and ownership in renewable energy

High-Impact Action to establish community ownership and engagement practice guides for IPPs

Institution to champion the Action	Collaborative bodies to successfully implement the Action	Timeframe of the Action
IPP Office	■ DMRE ■ Experienced IPPs	Immediate, starting within a year

Building on the study results and the surrounding discussions with political and knowledge partners, we propose to direct the debate in three areas where a codified guidance document underpinning the REIPPPP could help improve prosperity in marginalised communities via RE deployment. Such a codified practice guide would provide more advice and greater certainty for IPPs implementing projects. For instance, questions on:

- when and how to engage with stakeholders or the communities at large
- the timing and methodology of studies that must be carried out at different stages of project development
- ways to collaborate with local government
- creation of long-term strategic social investment plans could be outlined and supported by good governance advice and practical examples

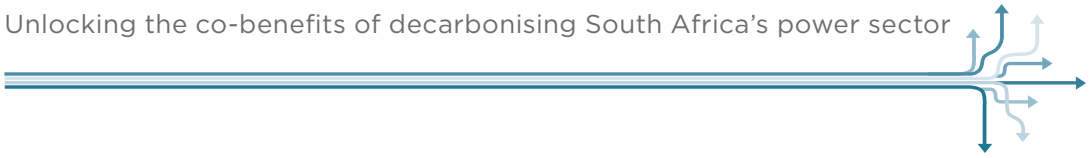
The desired outcomes of improved guidance would include, for instance: that the need for skills development within a community be analysed from a longer-term perspective and thus prioritise long-term service level agreements rather than short-term services requiring only least-skilled work. Further advisory services must be provided for community ownership vehicles, to ensure that they assume a more active role in establishing the IPP and function as a broader investment vehicle rather than relying solely on the IPP for revenue.

In addition the focus of ED and SED spending should be aligned with community priorities expressed through Participatory Rural Appraisals. Limiting the number of projects an IPP invests in would ensure a critical mass for each programme.

Additional impact action: Ensure transparency about social investments of IPPs through a Social Performance Index (SPI)

Institution to champion the Action	Collaborative bodies to successfully implement the Action	Timeframe of the Action
IPP Office	■ DMRE ■ NPC ■ Communities ■ Community Trusts	Starting immediately

Transparency concerning the social investments of IPPs will help illustrate their value for local communities. Defining a Social Performance Index (SPI, cf. IASS 2020, forthcoming) for South Africa will allow for monitoring and actively improving local determinants and enablers of community wellbeing. To showcase the nature and quality of social investments engendered by renewable projects, it is recommended that detailed information should be made available. In order to compile and release meaningful information, a consistent reporting system would provide more guidelines on how to classify investments and thus ensure the consistent application of socio-economic development and enterprise development (SED and ED) categories.



Additional impact action: Continuing diverse networking formats for project developers, community liaison managers, community trusts, and other community bodies

Institution to champion the Action	Collaborative bodies to successfully implement the Action	Timeframe of the Action
IPP Office	■ DMRE ■ IPPs ■ Communities ■ Community Trusts	Medium term, until 2030

The Community Trusts or other institutions that manage community investments play a vital role in facilitating dialogue between IPPs and the communities, and in managing engagement within the communities. COBENEFITS Roundtable participants noted that the role of these institutions could still be enhanced, enabling them to meet the challenges to consult, engage with, and empower local communities. Accordingly, measures for capacity building and exchange of good practices between projects and communities will ensure that positive lessons are passed on and pitfalls avoided.

3.9 Creating an enabling environment for addressing upcoming conflicts in South Africa's Water–Energy–Food Nexus

A COBENEFITS scoping study has suggested that water scarcity is not an immediate threat to energy security in South Africa. Since Eskom is a "strategic" water user with guaranteed water supply under the National Water Act 36 of 1998, security of electricity supply via coal-fired power plants is not threatened by water scarcity.

Considering that much of South Africa's coal deposits underlie almost half of its high-potential agricultural soils, and that the land capability of a rehabilitated opencast mine is significantly lower than its pre-mining condition, generally resulting in the production of acid mine drainage, the Water–Energy–Food Nexus requires additional attention, further investigation, and public discourse in South Africa. In addition, the coal sector causes significant water pollution via sulphur dioxide (SO_2) emissions, and conflicts for water could arise between the agriculture and energy sectors.

- High-Impact Action: Detecting and reconciling conflicts in South Africa's Water–Energy–Food Nexus
- Additional Impact Action: Assessing water scarcity risk in the Waterberg and Olifants River System

3.10 High-Impact-Action for detecting and reconciling conflicts in South Africa's Water–Energy–Food Nexus

High-Impact Action: Detecting and reconciling conflicts in South Africa's Water–Energy–Food Nexus

Institution to champion the action	Collaborative bodies to successfully implement the action	Timeframe of the action
Department of Water and Sanitation (DWS)	■ DMRE ■ DEFF	Short term, over the next five years

It is recommended that future research projects should examine the following themes pertaining to the broader Water–Energy–Food (WEF) Nexus:

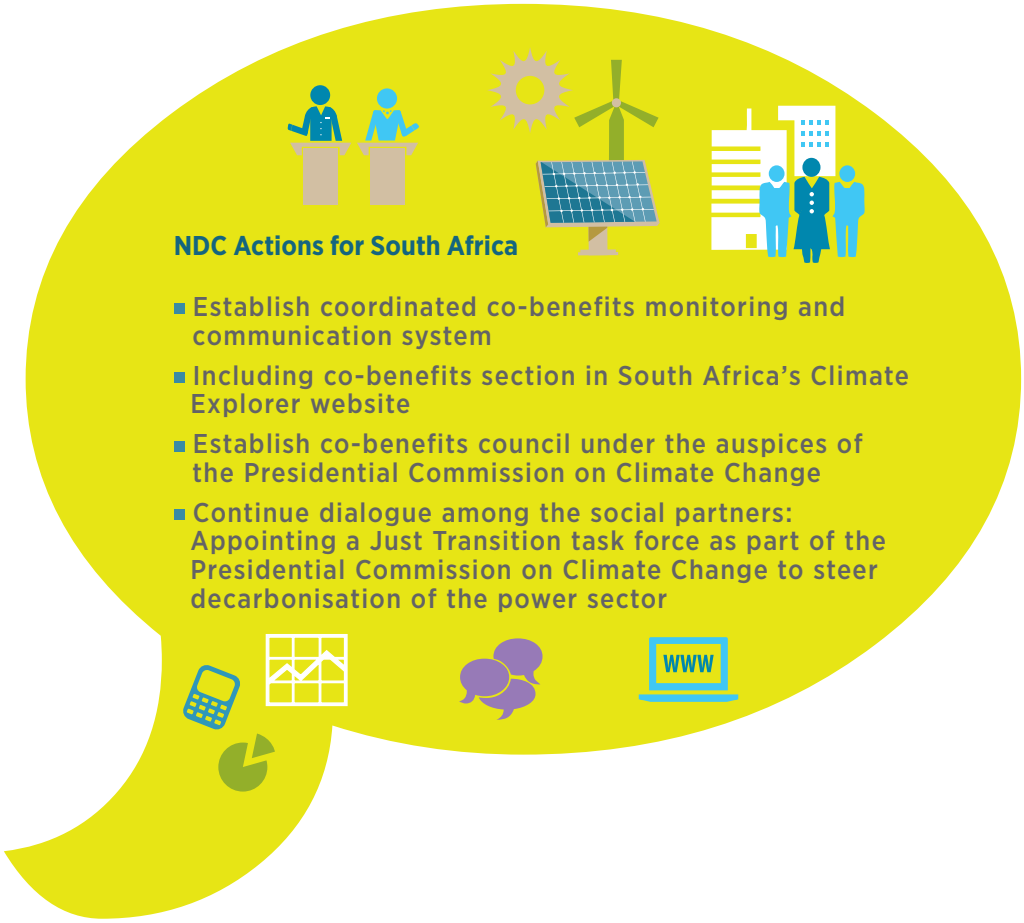
- An assessment of the potential impact of climate change on water availability in South Africa during the 21st century.
- A study of water scarcity implications for food- and energy security in South Africa.
- An assessment of how coal mining runoff and atmospheric SO_2 emissions affect regional and national water quality.
- An assessment of soil degradation in rehabilitated opencast mines.
- Water and land requirements for bioenergy implementation in South Africa.
- The development of a roadmap to achieve SDGs 2, 6, and 7 by 2030 in South Africa, utilising the WEF

Additional Impact Action: Assessing water scarcity risk in the Waterberg and Olifants River System

Institution to champion the Action	Collaborative bodies to successfully implement the Action	Timeframe of the Action
Department of Water and Sanitation (DWS)	Regional departments from Mpumalanga and Limpopo province	Short term, over the next five years

In addition, regional assessments of water consumption and potential water scarcity would be beneficial. In particular, water withdrawal and consumption by the power sector in the Waterberg and Olifants River systems are of concern. In the Waterberg system, water consumption by power plants could account for about 40% of all water demand by 2050. A catchment-based assessment is recommended of the Olifants River and Inkomati-Usuthu Water Management Area (WMA), utilising the Water–Energy–Food (WEF) Nexus as a framework to identify resilient upstream policy measures.

4. Making the Paris Agreement a success for the planet and the people of South Africa



In 2015, countries worldwide adopted an historic international climate agreement at the U.N. Framework Convention on Climate Change (UNFCCC) Conference of the Parties (COP21), known as the Paris Agreement. South Africa, among 189 parties to date, has ratified the Paris Agreement, pledging to combat climate change and provide current and future generations with opportunities to flourish.

South Africa submitted its first Nationally Determined Contribution (NDC) in November 2016 (Government of South Africa, 2016). Concerning renewable energy deployment in the electricity sector, the NDC 2016 was still based on the IRP 2010 and made reference to the early achievements of South Africa's IPP programme.

The NDC contains a long-term vision that comprises a "peak, plateau, decline" (PPD) emissions trajectory that ranges until 2050. Emissions are expected to increase until 2020–2025, to peak for about a decade, and then decline. South Africa has committed to "no backsliding" and to a "progressive approach" (Government of South Africa, 2016: p.1). However, climate mitigation endeavours need to be balanced with developmental priorities, thus one major imperative of the NDC is flexibility: As a medium-term goal, emissions can range between 398 and 614 Mt CO_2 equivalent during the years 2025 to 2030, and the PPD will be reviewed in light of scientific knowledge and national circumstances. The key implementation pathways of the NDC are described as follows: The planning is based on the

National Climate Change Response White Paper (NCCRP) from 2011 (DEA, 2011) and the National Development Plan. It will be implemented by energy, industrial, and other plans and legislation. Policy instruments mentioned in the NDC are a carbon tax, desired emission reduction outcomes (DERO) for sectors, company carbon budgets, and regulatory standards (Government of South Africa, 2016: p.6f.). In its first NDC, South Africa emphasised that human and institutional capacities need to be enhanced at all levels to estimate the impacts of investments and other socio-economic factors (Government of South Africa, 2016: p.10). With the IRP 2019 in place South Africa is well on track to achieve its 2030 targets (CAT, 2020).

The new legislative foundation for the country's adaptation and mitigation system is the Draft Climate Change Bill, which was open for public comment in summer 2018 (Government of South Africa, 2018); however, to date, it has not been promulgated. The main elements of the bill are procedural steps for the determination and review of the national greenhouse gas emissions trajectory and Sectoral Emission Targets (SETs)[12], a threshold for allocating carbon budgets to emitting companies, policy integration at the provincial and municipal levels, and horizontal coordination and alignment with other policies. The co-benefits of ambitious climate protection measures are considered in the Bill's preamble (Government of South Africa, 2018: p.7) and will get a forum in the governance structures proposed in the Bill.

In its NDC, South Africa states that it faces significant rigidity in its economy as well as any policy-driven transition to a low-carbon and climate-resilient society, since its priorities are to address poverty and inequality. The present COBENEFITS South Africa studies provide evidence of the opportunities that renewable energy presents for key areas such as employment, education, and health welfare. Including the co-benefits of climate action within South African NDC strategies would bridge the social and economic priorities to the climate goals from the Paris Agreement.

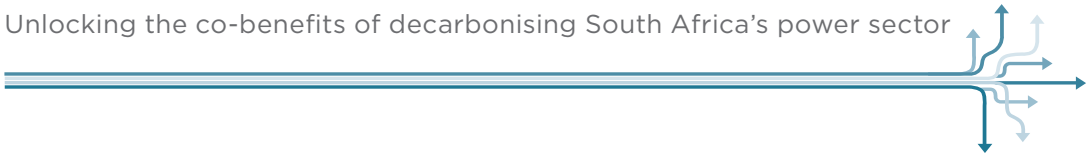
For instance, the COBENEFITS study on *"Improving Health and Reducing Costs through Renewable Energy in South Africa"* (IASS/CSIR/IET. 2019b.) presents savings per kWh if energy generation is switched from coal-based to a renewable energy source. Recognising the constrained climate action for emerging economies due to the required investments for NDC implementation, turning to renewable energy and the associated economic co-benefits in terms of costs savings would enable increased ambition in South African NDC policies without requiring greater investment.

In the governance structure outlined in the Draft Climate Change Bill there are several fora that would benefit from further research and debate on the co-benefits of ambitious climate action. The Presidential Commission on Climate Change and the Provincial Committees on Climate Change can ensure an integrated policy approach and alignment with sectoral policies. It is recommended that these Committees be equipped with sufficient resources to make use of pre-existing knowledge and, if required, to commission further work with national knowledge partners.

4.1 Action: Establish a coordinated co-benefits monitoring and communication system

Institution to champion the NDC Action	Collaborative bodies to successfully implement the NDC Action	Timeframe of the NDC Action
Department of Environment, Forestry, and Fisheries (DEFF)	Department of Planning, Monitoring, and Evaluation (DPME)	Medium term (SETs expected to be due two years after promulgation of Climate Change Bill)

[12] One key component of the post-2020 South African mitigation system will be the use of Sectoral Emission Targets (SETs) as an instrument that places quantitative limits on future greenhouse gas emissions (BUR, 2019).



In the current discourse about the climate crisis, countries' official communications with the UNFCCC (through NDCs, Update Reports, and GHG Reporting) gain public attention and have a strong signalling effect to the local population. Including a 'co-benefits' section in South Africa's reports and pledges will provide a powerful demonstration of the country's commitment and communicate the potential social and economic co-benefits available to the South African people. Besides unveiling potential opportunities and rallying domestic support for climate action (IASS 2020b), addressing co-benefits in NDC-related communications can spark imitation and contribute to creating a global momentum toward building a strong alliance for ambitious and early climate action.

For instance South Africa's 3rd Biennial Update report to the United Framework Convention on Climate Change refers to Co-Benefits Assessments only with respect to carbon budgets. It points out that an assessment of the social and economic impacts of the carbon budgets revealed that no negative impacts are to be expected (DEA, 2019a: p.74f.). To date, no assessment has been conducted of the benefits of mitigation actions by emitters. Carbon budgets will become mandatory only after the Climate Change Bill is enacted, introducing a positive approach to the budgets. This will lead to better acceptance of the carbon budgets and the promotion of mitigation actions.

Furthermore, underpinning the SETs with comprehensive cost–benefit analyses, as stipulated in the Draft Climate Change Bill, and with extensive research on social and environmental implications, will enhance the acceptance of SETs and provide a more robust basis for comparison of the externalities associated with different measures. For all those measures, a coordinated co-benefits monitoring system is recommended to ensure a comparable and scientifically sound assessment methodology.

- Establish a Co-benefits Monitoring system relevant to NDC-related communication and national climate change policies
- Include metrics to measure co-benefits impact within the Biennial Update Report (BUR).
- A SETs monitoring and evaluation system that considers the co-benefits of mitigation strategies
- Address co-benefits in NDCs and NDC-related communication efforts

4.2 NDC Action: Including a co-benefits section in South Africa's Climate Explorer

Institution to champion the NDC Action	Collaborative bodies to successfully implement the NDC Action	Timeframe of the NDC Action
Department of Environment, Forestry, and Fisheries (DEFF)	International partners and funders	Immediate, starting within a year

By understanding South Africa's climate action as a driver for social and economic prosperity, the debate can be refocused from perceived burdens towards concrete opportunities. Therefore, it is essential to ensure that the co-benefits of ambitious climate action gain widespread visibility. The inclusion of a prominent section on the website of the South Africa Climate Explorer[13] can establish a knowledge base for the interested public and decision makers, functioning as a globally accessibly repository for DEFF-approved reports on co-benefits.

[13] http://www.southafricaclimateexplorer.org/

4.3 NDC/SDG Action: Establish co-benefits counci[14] under the auspices of the Presidential Commission on Climate Change

Institution to champion the NDC Action	Collaborative bodies to successfully implement the NDC Action	Timeframe of the NDC Action
DEFF	■ DMRE ■ Department of Health ■ Department of Basic Education ■ Department of Employment and Labour ■ NPC ■ DTIC ■ Research institutions ■ CSOs ■ SAGEN	Immediate, starting within a year

Co-benefits can be best harnessed through joint and coordinated action across different political divisions and ministries. Under the Presidential Climate Change Commission a working group can take on the task of harnessing the social and economic development potential of the Paris Agreement and climate action in the energy sector and beyond, while closely monitoring the social impacts of the transition and shaping an enabling policy environment for co-benefits. The Department of Environment, Forestry, and Fisheries (DEFF) can champion and facilitate a cross-ministerial council, which should be opened to contributions by key expert organisations, such as CSIR and the Energy Research Centre as technical implementers of co-benefits assessments in South Africa, and representatives of civil society organisations working in the field. Furthermore, this co-benefits council could be additionally powered by international partnerships, such as the South African–German Energy Programme (SAGEN).

Inclusive dialogues for developing policies to harness co-benefits for people and communities

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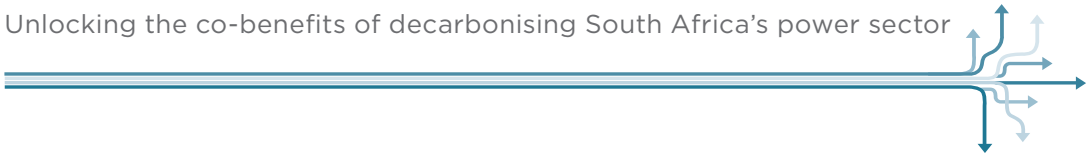
[14] Interchangeable with working group, sub-committee, or focus group.



5. Sustainable development: Activating the 2030 Agenda for a just transition in South Africa

In light of the current crisis, results from the COBENEFITS South Africa Studies indicate that recovering from the economic shocks of the COVID-19 pandemic and avoiding running into severe future shocks triggered through the climate crisis do not represent conflicting interests but rather a mutually reinforcing coping strategy. The Paris Climate Agreement and the 2030 Agenda on Sustainable Development Goals (SDG) offer important, internationally agreed multi-solving frameworks to ensure economic recovery in the shorter term and to build resilient economies and health systems in the long run.

The SDG reporting process in South Africa is coordinated by Statistics South Africa. SSA hosts the SDG secretariat and is responsible for data gathering, report writing (baseline report), and report writing facilitation (main report) as well as report dissemination. The Department of Planning, Monitoring, and Evaluation will track the progress of SDG implementation and is also responsible for aligning the SDG process with existing long-term plans and strategies. Therefore, a broad coordination mechanism was newly established that integrates Cabinet and Cabinet Clusters, an Interministerial Committee of SDG, Agenda 63 of the African Union and SADC-RISP[15], the Directorate Generals National Steering Committee, an Interdepartmental Implementation Committee, the Presidential Coordinating Council, the National Developments Stakeholders Forum, and specially appointed working groups (DPME 2019b: p.21ff.).

In October 2017, Statistics South Africa published the first SDG Baseline report, assessing the existing data related to the goals and indicators of the SDG process. This report is currently broadly disseminated. On average, 63% of the required data were available in South Africa. However, data availability varies considerably between individual goals. South Africa published a First Voluntary National Review in July 2019, which contains a status quo, policy environment, and progress description (DPME 2019b: p.21ff.). A full-scale SDG country report with data on all indicators on all indicators was published in 2020 and will be updated every two years (Department: Statistics South Africa 2020).

Notably, in the First Voluntary National Review states, the section on SDG 13 "Take urgent action to combat climate change and its impacts" states that "mainstreaming climate change actions across departments and agencies of government and also in partnership with our social and private partners remains critical".

Given the prominent role South Africa took in the formulation of the SDGs, while leading the Africa team to form a common position, its national implementation of the SDGs will also be closely followed. One challenge ahead is to align the country's National Development Plan (NDP) with the Sustainable Development Goals and Agenda 2063 of the African Union (Averchenkova et al., 2019).

The National Development Plan, as the long-term macro plan for socio-economic development of the country, considers the energy transition from coal dependency to renewables as one key policy process. Chapter five of the NDP envisions that by 2030 South Africa will have transitioned to an environmentally sustainable, climate-resilient, low-carbon economy and just society. The National Planning Commission is the independent advisory body, responsible for drafting and monitoring implementation of the NDP. Chapter 5 of the NDP did not entail a concrete plan, but was overshadowed by the prospect of future coal mine closures and decommissioning of older power plants, hence the need for more guidance on this transition was evident. The NDP initiated a broad stakeholder process on "Pathways for a Just Transition", which aimed to build a shared vision

[15] SADC-RISP: Southern African Development Community Regional Indicative Strategic Development Programme

between the social partners, with the long-term aim of culminating in a social compact for the country DPME, 2019a: p.5). The need for "policy-relevant research across the national priority areas" is emphasised in a recent report by Fourie et al. (Fourie 2018: p.16). The COBENEFITS studies realised in South Africa present opportunities to activate a number of SDGs (e.g., SDGs 3, 7, 8, 10, 13), bringing them to life, thus they and potential follow-up studies can inform the ongoing Just Transition process and the reporting on the SDGs and subsequent policy-setting and planning.

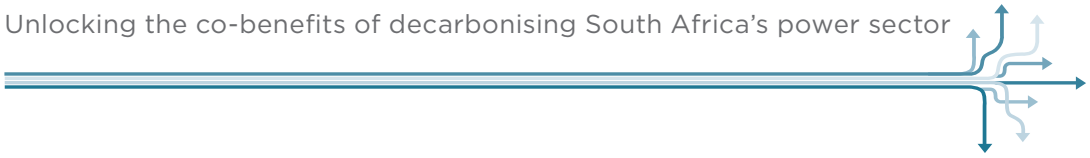
Activating the SDGs for South Africa in times of transformation of the energy supply system calls for a people-centred policy-making approach and broad consensus in affected communities. Recommended action is therefore:

5.1 SDG-Action: Continue dialogue among the social partners: Appointing a Just Transition task force as part of the Presidential Commission on Climate Change to steer decarbonisation of the power sector

Institution to champion the NDC Action	Collaborative bodies to successfully implement the NDC Action	Timeframe of the NDC Action
NPC/Presidential Commission on Climate Change	■ DEFF ■ DoE ■ Social partners ■ Social partners	Short term, over the next five years

The dialogue series for a Just Transition, carried out in 2018 and 2019, created momentum in the South African discourse on transition to a low-carbon economy. The tremendous efforts of the NPC were appreciated in the affected regions, and the participatory approach was highly valued by different stakeholder groups and has sparked wide international interest and is now considered a good practice approach for guiding transitions internationally. Building on the outcomes, which will hopefully lead to a social compact between the social partners to be negotiated starting in 2020, requires governance structures to steer the implementation of the visions into actions at the regional and local levels. Further work is needed to develop detailed pathways, with special emphasis on the Land-Use–Energy–Water–Nexus (DPME, 2019a: p.16).

Additionally to a co-benefits council (see NDC/SDG Action in Section 4), it is recommended that a Just Transition task force be established. This task force should continue dialogue among the social partners, and should have sufficient capacities to work both locally in affected communities and regions but also at the national scale, in order to align sectoral plans with the overarching NDP. It is recommended that the task force should continue the proven participatory working mode and be provided with the capacities necessary for building trust and dialogue between the social partners, while also ensuring transparency concerning its work and the resulting impacts.



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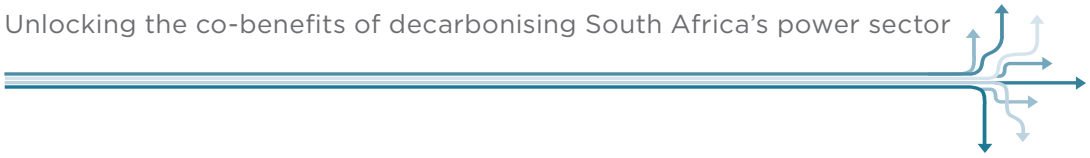

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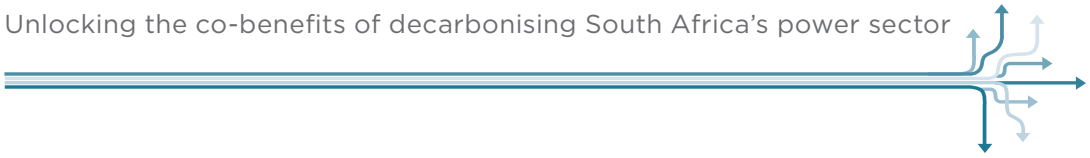
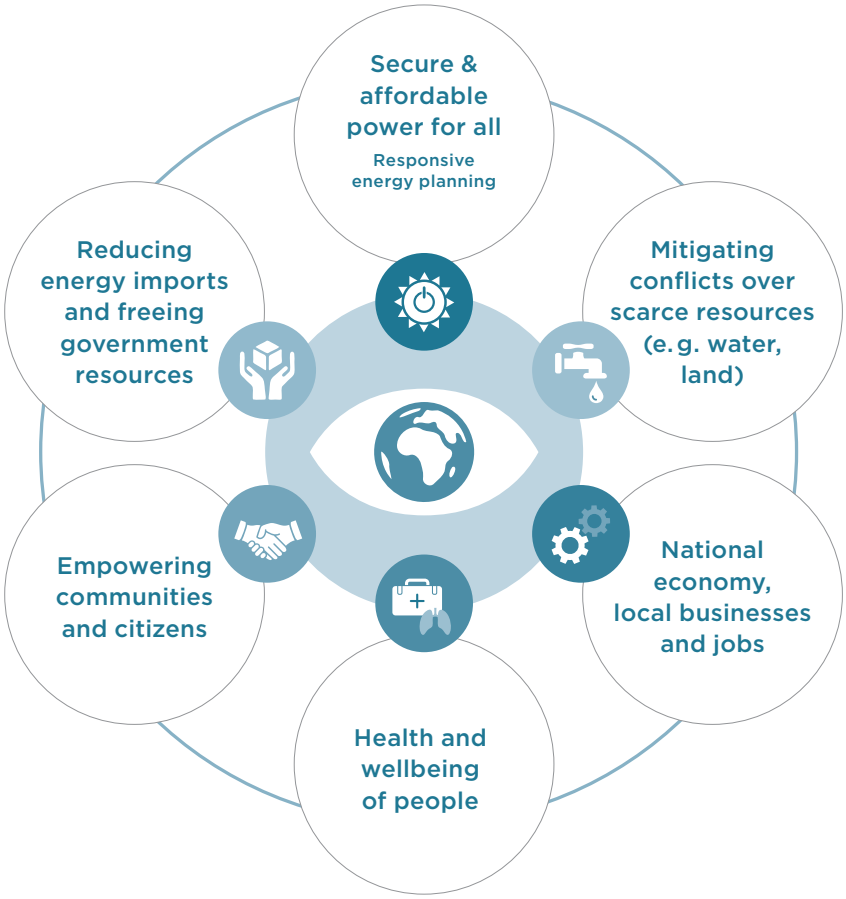
Abbreviations

BC	Base case scenario
BMU	Federal Ministry for the Environment, Nature Conservation, and Nuclear Safety
BUR	Biennial Update Report
CAT	Climate Action Tracker
COP21	Conference of the Parties
CSIR	Council for Scientific and Industrial Research
CSIR_LC	Least-Cost planning energy sector scenario developed by CSIR
CSO	Civil society organisation
DEA	Department of Environmental Affairs
DEA_RD	DEA Rapid Decarbonisation Scenario
DEFF	Department of Environment, Forestry, and Fisheries
DERO	Desired emission reduction outcomes
DHET	Department of Higher Education and Training
DMRE	Department of Mineral Resources and Energy
DoE	Department of Energy
DOGMMA	Distributed Generation Market Model of Australia
DPME	Department of Planning, Monitoring, and Evaluation
DTIC	Department of Trade, Industry, and Competition
DWS	Department of Water and Sanitation
ED	Enterprise development
ERC UCT	Energy Research Centre University of Cape Town
FET	Further education and training
FGD	Flue-gas desulphurisation
FIT	Feed-in tariff
GHG	Greenhouse gas
HI-Action	High-Impact actions
IASS	Institute for Advanced Sustainability Studies
IBT	Inter-basin transfer
IET	International Energy Transition GmbH
IKI	International Climate Initiative
IPP	Independent power producer
IRP	Integrated Resource Plan
LSM	Living standard measure
MDG	Millennium Development Goal
NCCRP	National Climate Change Response White Paper
NDC	Nationally Determined Contribution
NDP	National Development Plan
NEM:AQA	National Environmental Management: Air Quality Act
NERSA	National Energy Regulator of South Africa
NET-FIT	Feed-in tariff such as remuneration of excess power
NGO	Non-governmental organisation
NPC	National Planning Commission
PM	Particulate matter
PPD	Peak, plateau, decline
PV	Photovoltaic



RE	Renewable energy
REIPPPP	Renewable Energy Independent Power Producer Procurement Programme
RENAC	Renewables Academy
RTS	Return-to-service
SADC-RISP	Southern African Development Community Regional Indicative Strategic Development Programme
SAGEN	South African–German Energy Programme
SALGA	South African Local Government Association
SDG	Sustainable Development Goal
SED	Socio-economic development
SET	Sector emission targets
SSEG	Small-scale embedded generation
TVET	Technical and vocational education and training
UfU	Independent Institute for Environmental Issues
UN	United Nations
UNFCCC	U.N. Framework Convention on Climate Change
USO	Unit sent out
VRESS	Vaal River Eastern Sub-System
VSL	Value of a statistical life
WEF	Water–Energy–Food
WHO	World Health Organization
WMA	Water management area



COBENEFITS SOUTH AFRICA 2019 STUDY SERIES

The report at hand summarises the key findings of the COBENEFITS Assessment Series, quantifying essential co-benefits of decarbonising the power sector inSouth Africa.

The COBENEFITS South Africa Studies can be directly accessed through the hyperlinks provided below. Keep yourself posted on the upcoming 2021 studies on

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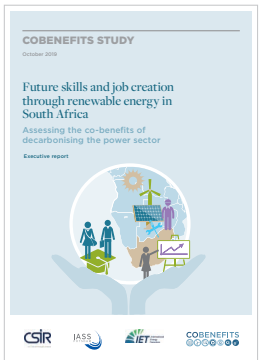

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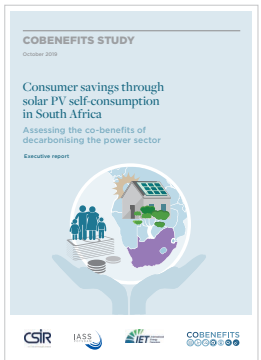

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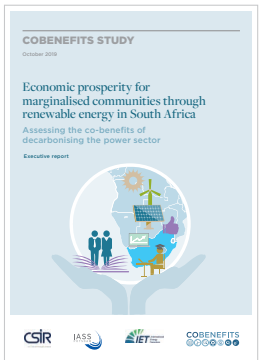

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Up to 30 000 individuals in marginalised communities can benefit from access to education-related programmes by the year 2050.

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