

Scoping the Assessment of Cobenefits of Renewable Energy in South Africa

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Abstract

The purpose of the study is to analyse social and economic development impacts of renewable energy deployment in South Africa. Renewable energy technology is new in South Africa and presents opportunities for the country to spread the benefits beyond greenhouse gas emission reduction. The study aims to link the cobenefits of renewable energy deployment in South Africa with the achievement of the climate change commitments as outlined in the Paris Agreement and envisaged achievement of the Nationally Determined Contributions (NDCs) and Sustainable Development Goals (SDGs). While some benefits might be widely known and empirically proven, there are other benefits that requires to be quantified at country level, ensuring that assessment methodologies are adapted to specific country conditions. Scoping of the relevant cobenefits for South Africa involved the following steps (i) focus group meeting with relevant government department to identify a long list of cobenefits based on policy objectives; (ii) follow-up online survey to prioritise the most important and relevant cobenefits; (iii) research methods symposium to assess the research landscape on the topic of cobenefits and to identify existing methodologies for assessing shortlisted cobenefits and to identify gaps in the existing body of knowledge; (iv) Terms of reference for the individual in-depth studies on selected cobenefits. This process resulted in the selection of the following cobenefits topics:

- Reduced electricity costs for residential prosumers and business through renewable energy self-consumption
- Employment opportunities through renewable electricity systems across different skill levels
- Economic prosperity in marginalised communities through a growing share of renewables
- Health benefits of growing share of renewables in the electricity sector
- Reliable power generation with wind and solar PV in times of water scarcity

The discourse on renewable energy has moved past whether the technology is viable or not, the biggest question now is understanding its contribution to addressing environmental challenges and socio-economic development.

1. Introduction

South Africa is considered one of the most carbon intensive energy sectors in the world and is ranked amongst the top 20 global polluters [1]. Currently coal power contributes 77% of the total energy generation in the country [2] and the energy sector contributes 55.1% of the country's total greenhouse gas emissions [3]. Renewable energy is the most obvious option to urgently decarbonise the energy system. When South Africa made a policy decision to incorporate renewable energy into the energy mix, the aim was not only to address the energy security issue, but also deal with environmental issues as well as derive economic benefits. Socio-economic benefits are closely tied with the roll-out of renewable energy.

The world has moved past the debate on whether renewable energy is viable or not. Even the need to scale it up is undisputed today as more and more countries increase the renewable energy share of their electricity generation. The cost of renewable energy, particularly solar PV and wind, has reduced drastically and therefore one cannot argue against renewable energy from an energy system cost perspective. It is the socio-economic impacts of renewable energy that require analysis and understanding.

South Africa is well on its path of transitioning to a clean energy future. To achieve energy security and energy access in the country, an expansion of the energy system is required, but this also provides an opportunity to transform the system and transition towards a less carbon intensive energy system over time, while also managing the demand and focusing on end-user efficiency. This transition will have implications for social and economic development, whether positive or negative and that requires a thorough analysis. The IRP 2010 allocated 17.8GW to renewable energy, which comprises 8.4GW of solar PV, 8.4GW of Wind and 1GW of CSP. 6.3 GW of that has already been procured and the projects that have been built and are feeding into the grid amount to 2.9GW (Figure 1).

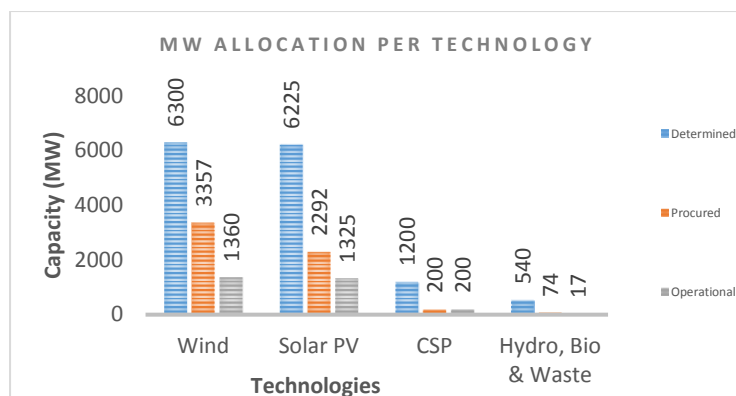


Figure 1: Renewable energy capacity allocation per technology

The draft IRP 2016 base case (which is the most conservative scenario), has committed 31 GW of wind energy and 17GW of solar PV. When considering the most ambitious scenarios like the CSIR least cost

scenario which suggests that South Africa could reach a 70% renewable energy share by 2050 which is cost optimal, replacing all old plants with the new optimal mix [4].

Renewable energy technology is new in South Africa and presents opportunities for the country to spread the benefits beyond greenhouse gas emission reduction. While some benefits might be widely known and empirically proven, there are other benefits that requires to be quantified at country level, ensuring that assessment methodologies are adapted to specific country conditions. The climate change mitigation benefits of transitioning to a renewable future may be widely supported by available data but the country is yet to understand the potential of the sector create the co-benefits to other segments of the economy such as employment creation, health improvement due to improved air quality, opportunities for small businesses and manufacturing opportunities, reduced water consumption, improved economic conditions in previously disadvantaged communities, etc.

The purpose of the project is to analyse social and economic development impacts of renewable energy deployment. This two year research project partnership between the Council for Scientific and Industrial Research and a consortium of German Partners (the Institute for Advanced Sustainability Studies (IASS), International Energy Transitions (IET), Renewables Academy (RENAC), and Independent Institute for Environmental issues (UfU)) which aims to link the cobenefits of renewable energy deployment in South Africa with the achievement of the climate change commitments as outlined in the Paris Agreement and envisaged achievement of the Nationally Determined Contributions (NDCs) and Sustainable Development Goals (SDGs). The conversation on the link between climate change, energy and sustainable development has been minimal and this study aims to contribute to that discussion and shifting of the focus from burden sharing perspective to opportunity sharing and development of green economy.

This projects focuses on cobenefits of renewable energy as it relates to electricity generation sector and it excludes heat and transport sectors. The studies will be guided by various pre-defined scenarios which suggest different levels of RE deployment over time, in order to obtain comparable results in the end.

2. Methodology

There are several methods that can be utilised in assessing cobenefits of renewable energy. The methods depend on the type of cobenefit being assessed. The most significant thing is to prioritise the most relevant cobenefits for the country being assessed. Other countries like China have done the assessment of cobenefits and their methods could potentially be adopted. However the result may not be comparable based on a number of factors such as the scale of renewable energy roll-out and the energy mix profile of the country.

On 31 March 2017, the CSIR in partnership with IASS, IET and RENAC hosted a workshop with government departments i.e. Department of Environmental Affairs, Department of Energy, Department of Trade and Industry and Department of Science and Technology; as a first step in a series of activities in the Cobenefits project. In order to arrive at a list of cobenefits most relevant for SA, a focus group meeting aimed to compile a list of potential cobenefits relevant for South Africa and provide a better understanding of how renewables impact country-level socio-economic status. The government departments representatives were asked to identify policy objectives of their department in relation to the deployment of renewable energy. That helped to identify relevant cobenefits and link them to key strategic objectives of government department in order to establish ownership of the outcomes of this study.

The purpose of this step was to solicit information about priorities of different departments as defined in the guiding policies such as the New Growth Path, and the National Development Plan, the Integrated Resource Plan, the Industrial Policy Action Plan, the National Climate Change Response Policy, the Green Economy Accord, etc. This step resulted in the creation of a long list of cobenefits. These were then grouped in broad categories.

The broad categories and subcategories were organised into an online survey in order to prioritise what is most significant within the longlist created in the initial workshop. The purpose of the survey was to identify which cobenefits were most important for the government departments within each broad category. All relevant government departments and other stakeholders participated in the survey. This step resulted in the creation of a shortlist of five cobenefits that would be analysed further in individual in-depth studies. The outcomes of the survey were limited by a small sample from government and stakeholder. The research symposium that would follow would be used partly to calibrate the results of the survey and correctly reflect what should have been prioritised.

On The 2nd October 2017 the CSIR in partnership with the German partners IASS, IET and RENAC hosted a research methods symposium in order to assess the research landscape in the subject of cobenefits and secondly, to assess the research scope and available methodologies for the proposed research shortlist of cobenefits.

The symposium aimed to solicit input from the stakeholders, which assisted the research team to improve the scope and design of the cobenefits studies, with its objectives being to:

- Identify synthesized and harmonized methodologies for estimating the economic value of the health, social and environmental benefits of renewable energy deployment,
- Examine methodologies currently used by scientists in South Africa and the international community to quantify the multiple benefits of climate change mitigation through renewable energies deployment in the country,
- Share results and methodologies being used by policy makers and South African government departments to adequately measure and seize the multiple co-benefits of renewable energies.

Researchers from various institutions including CSIR, WWF, University of Venda, HSRC, North West University, etc. were invited to present on the several topics including affordable electricity; secure and reliable electricity provision; economic development and innovation; improved access to electricity; job creation; local value creation; protecting the environment and scarce resources and health benefits of renewable energies. For other topic where no presentation proposal was submitted, the project team kicked off the discussion by highlighting main issues within that particular topic and leading a discussion with guided questions. This step resulted in a more refined short list of cobenefits to be analysed, and available methods for such analysis as well as prior research that has been conducted in South Africa on those particular topics.

3. Discussion of selected cobenefits

The government stakeholders' focus group identified five broad categories of cobenefits with subcategories underneath them as per Figure 2. Involving government department was a critical step in ensuring that the assessments focus on areas of priority for them and also to ensure that there is ownership of the outcomes.

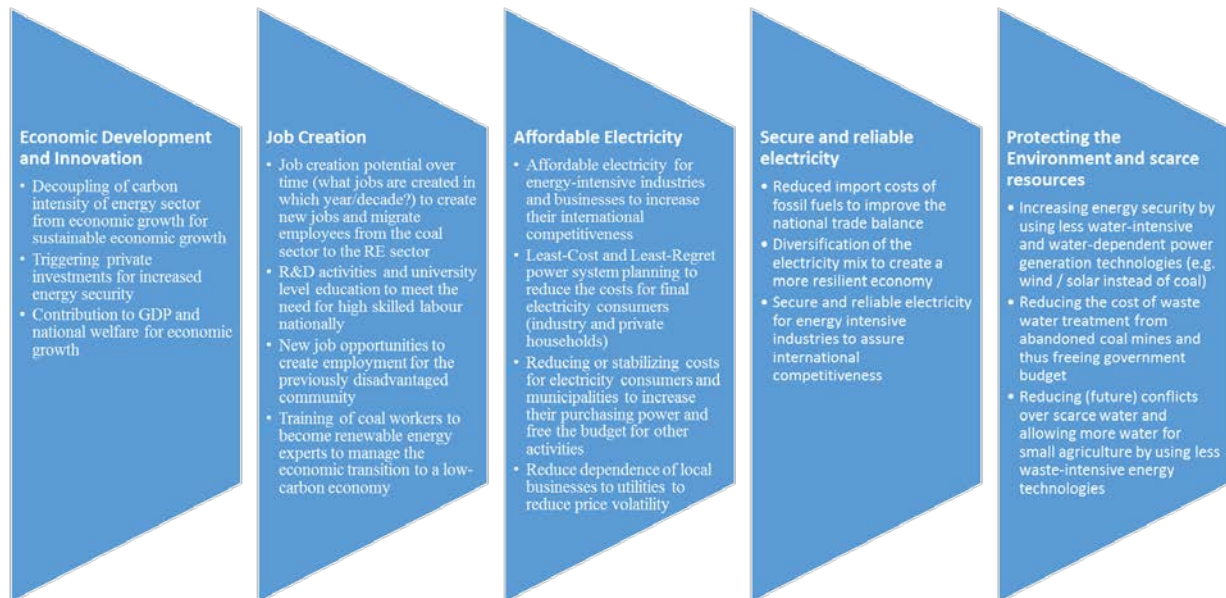


Figure 2: Broad and subcategories of cobenefits

From this long list of cobenefits that had been identified in the focus group meeting, the next step was to create an online survey in order to prioritise the most significant cobenefits that would be the focus of the in depth studies.

While the initial shortlist from the online survey included (i) Triggering private investments for increased energy security and impact on GDP; (ii) Affordable electricity for energy-intensive industries and businesses to increase their international competitiveness and (iii) Reduced import costs of fossil fuels to improve the national trade balance; the input from the research symposium suggested that renewable energy does not have great competitiveness inducing impact on energy intensive industries, since they are already receiving specially negotiated rates from the power utility, and energy security is no longer an issue so there is not much incentive for them to diversify to renewables. It was therefore decided that an in-depth study for this topic cannot be prioritized. With regards to reduced import costs of fossil fuels to improve national trade balance, it was decided that the analysis is too simple as import export data is readily available therefore it does not warrant an in-depth study. The study on triggering private investments and impact on GDP was also removed from the priority list as there is already a lot of research going on within this domain and the entire REIPPPP programme is already responding to this question.

All the suggestions on priority research in the cobenefits domain were accepted and revised shortlist of priority cobenefits was agreed upon. In the end the following five cobenefits were prioritised for further detailed analysis:

- Reduced electricity costs for residential prosumers and business through renewable energy self-consumption
- Employment opportunities through renewable electricity systems across different skill levels
- Economic prosperity in marginalised communities through a growing share of renewables
- Health benefits of growing share of renewables in the electricity sector
- Reliable power generation with wind and solar PV in times of water scarcity

The next sections discuss in detail the prioritised cobenefits, their significance and prior research that has been conducted, particularly in South Africa, therefore identifying research gaps. This is important for refining the research focus designing the terms of reference for the studies in a way that will address the knowledge gaps.

3.1 Employment opportunities through renewable electricity systems across different skill levels

The renewable energy industry has created more than 9.8 million jobs globally by 2016 [5], and that number continues to grow with the growth of the sector. These jobs are spread across various skills sets, which include engineering, technicians, installers, and the whole legal, financial and administrative sector supporting renewable energy development. This analysis intends to assess the overall impact on job creation and supporting of existing jobs, whether direct, indirect or induced. It is not surprising that South African government would prioritise job creation because country's unemployment rate is at its highest, at 27.7% [6].

Jobs have a big impact on socio-economic development. If the citizens earn income, that helps to stimulate economic activity in localised areas, and contribute to poverty alleviation. New jobs help individuals to gain new knowledge and acquire skills they can use in other sectors, which improves their chances of employment in the future.

When the renewable energy procurement programme kicked off in 2011, there was no baseline to measure progress against. However, six years later significant amount of data has been collected to form a sound base case against which future development can be measured. The sector has created 30000 full time equivalent (FTE) jobs during this period across different technologies, mainly solar PV, wind and solar CSP. (Figure 3)

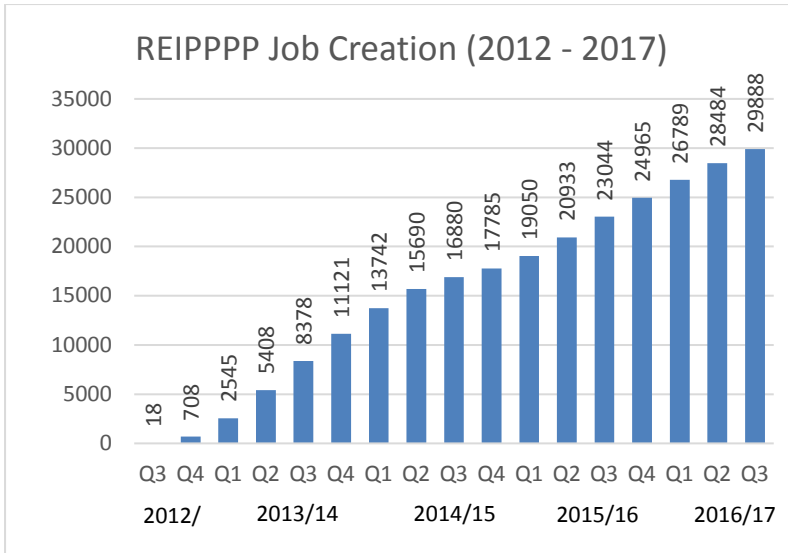


Figure 3: Job creation in the REIPPPP 2011 to 2016

The preliminary analysis of the job creation potential of the Draft IRP 2016 indicates that the wind energy sector can support an average of 60000 jobs per annum from 2023 to 2050. While Solar PV construction jobs alone can support an average of 20000 jobs per annum. It is important to note that in infrastructure development projects, jobs are not only created, but these development also support a significant number of existing jobs. Further analysis is required to quantify jobs impacts of different scenarios.

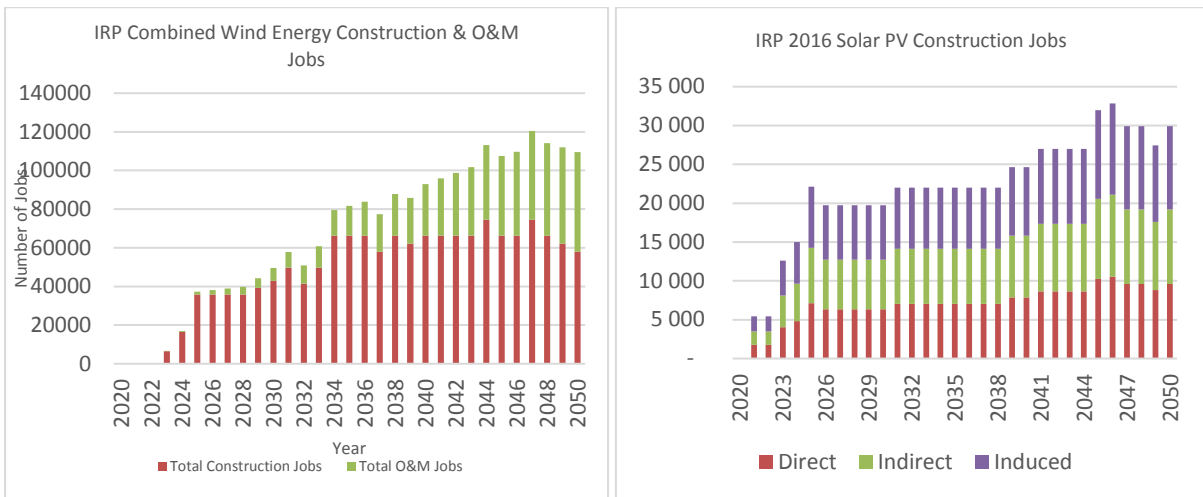


Figure 4: CSIR Analysis of the Jobs Impact of the IRP 2016 Base Case

This analysis was done for only one scenario of the draft IRP 2016 (the base case). The IRP has gone under extensive public review and comments submitted to the DOE may warrant a drastic revision of the IRP 2016. A jobs study will then need to be conducted taking into consideration various scenarios of the Final IRP 2016 once it is published. An additional scenario need to be created that considers additional capacity created by the embedded generation market. Furthermore in the context of “Just Transition” from carbon intensive economy to a green economy, it is equally important to analyse the

impact of job losses in the coal sector both at national and regional levels in order to present a net effect of renewables deployment on job creation.

3.2 Economic prosperity in marginalised communities through a growing share of renewables

More often than not the utility scale renewable energy projects are deployed in rural areas which are lagging behind in terms of development. The REIPPPP created a very structured programme on how utility scale renewable energy development should impact on the local communities. The REIPPPP bid evaluation criteria allocated 30% of the evaluation points to economic development. Fifteen percent of that counted towards socio-economic development. The Department of Energy recognised an opportunity for the REIPPPP to contribute a positive socio-economic impact, including in the communities where Projects are located. Bidders were required to identify needs of the surrounding communities, where the Project Site would be located and to formulate strategies on how such needs could be met utilising the Socio-Economic Development Contributions. At bidding stage IPPs were required to commit not less than 1% of their total project spend to local community development, but aim to reach a target of 1.5%. At this stage they were allowed to make high level commitments, however, these would need to be refined at implementation stage.

There are several studies that have been conducted to assess the impact of renewable energy on community development, particularly at utility scale level within the REIPPPP. Once such research was conducted by the Mandela institute where they investigated the extent to which the REIPPPP has managed to promote local development within project communities in line with commitments made by Independent Power Producers (IPP) during the bidding and project-award process [7]. This identifies several challenges that hamper progress in community development initiatives within the REIPPPP. These challenges included: lack of transparency and information sharing and coordination amongst spheres of government and industry, community trust pay-back arrangements prolong community benefits, fifty km radius rule is arbitrary and creates community divisions and affects, amongst others.

Wlokas (2014) highlights the intricacies of the actual community development programmes in the REIPPPP as a challenge, she highlight the identification of beneficiary communities within the prescribed 50km radius as a challenge as often results in the unintended exclusionary effect for communities outside of this radius. She adds that the identification of needs and priorities of the beneficiary communities can also be a challenge if appropriate processes aren't followed. Her research also indicated that supporting SMMEs can be a challenge as these initiatives have a poor success rate due to a lack of business experience among the individuals and organisations tasked to support and grow such initiatives [8].

From available information it seems the utility scale community impact subject is well researched and a lot of recommendations have been made to improve the system and increase the benefits for communities. The gap identified is the community impact of embedded generation renewables deployment in SA. This could be because the market is not well defined and not well structured and is mostly private sector led with no stringent requirements from government to develop marginalised communities. Most labour unions and activist organisations have been calling for a socially owned renewable energy sector. This area requires further research to clearly define what “socially-owned” really means for South Africa and how the social ownership could be broadened beyond community trust structures in the locations of project development.

3.3 Health benefits of growing share of renewables in the electricity sector

It is a widely known fact that increasing a share of renewable energy in coal intensive energy system can improve the air quality, particularly in regions where power stations are located. Conventional electricity generation doesn't only produce carbon dioxide, but it also produces methane, nitrogen oxide, and sulphur dioxide, alongside particulate matter, mercury, carbon monoxide, and the hydrocarbons that create ozone. These by-products lead to smog, acid rain, and many human health impacts including chronic respiratory illness (like asthma and bronchitis). Emissions from South African coal-fired power plants are significant on a global scale. The energy sector in South Africa is the biggest contributor to SO₂ and NO_x emissions and second highest contributor to PM emissions of all sources of air emissions in the country [9].

Holland (2017) conducted a study that aimed to “provide a first estimate of the health impacts and related social costs of emissions of air pollutants from existing coal fired power stations in South Africa”. He found that the total quantifiable economic cost of air pollution from coal fired generation in South Africa is in the region of \$2.37 billion annually. This is made up of impacts in terms of early death, chronic bronchitis, hospital admissions for respiratory and cardiovascular disease and a variety of minor conditions leading to restrictions on daily activity, including lost productivity. These results demonstrate the importance of factoring in these external costs of coal on health into future energy planning for South Africa [10].

While existing body of knowledge had focussed on quantifying the impact of coal fired power stations on air quality and health, the intended research of the cobenefits study will build on this research by analysing the impact of phasing out coal fired power stations and increasing the share of renewables, based on predefined deployment scenarios.

3.4 Reliable power generation with wind and solar PV in times of water scarcity

There is a close link between conventional energy production and water usage. Thermal power stations use a lot of water for generation steam to power turbines, for extracting pollutants from exhaust, and for cooling production facilities. However this is a subject not often discussed. The water-energy nexus has only recently moved from the periphery to the mainstream policy discourse. This is due to the recently water shortage that South Africa experienced during the 2015 droughts, and still being experienced in Cape Town. While the country has relied so much on energy security for economic growth, the water security on the other hand although considered, has not been on the mainstream. Both resources are significant to the economic development.

An article written by [11] highlights the findings of the study by the Water Research Commission on the water needs of power generation. According to the study South Africa's electricity generation activities account for 6% to 8% of the country's total freshwater resources used which amounts to about 360 ggalitres. The study also indicate that South Africa could face a water deficit of 234 ggalitres by 2025. This means energy planning must take this fact into consideration,

Increasing the share of renewables could help address this problem as renewable energy is less water intensive than coal. It is therefore important to assess, based on the integrated resource plan, the impact of renewable energy deployment on water in South Africa.

4. Conclusion

The COBENEFITS project is part of the International Climate Initiative (IKI). The German Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB) supports this initiative on the basis of a decision adopted by the German Bundestag. The funding contribution by IKI is acknowledged. The project partners: Institute for Advanced Sustainability Studies (IASS), International Energy Transitions (IET), Renewables Academy (RENAC), and Independent Institute for Environmental issues (UfU) are also acknowledged for their contribution to this work.

5. References

- [1] National Treasury. (2010). *Discussion Paper for Public Comment - Reducing GreenHouse Gas Emissions (Carbon Tax Option)*. Pretoria: National Treasury.
- [2] Department of Energy. (2017, November 5). *www.energy.gov.za*. Retrieved from http://www.energy.gov.za/files/coal_frame.html: http://www.energy.gov.za/files/coal_frame.html
- [3] Department of Environmental Affairs. (2014). *GHG National Inventory Report South Africa (2000 - 2010)*. Pretoria: Department of Environmental Affairs.
- [4] Council for Scientific & Industrial Research. (2017, March 31). *www.csir.co.za*. Retrieved from www.csir.co.za:
https://www.csir.co.za/sites/default/files/Documents/Presentation_CSIR%20Comments%20on%20Draft%20IRP2016.pdf
- [5] International Renewable Energy Agency. (2017). *Renewable Energy and Jobs - Annual Review 2017*. Masdar City: IRENA.
- [6] Trading Economics. (2017, November 5). *www.tradingeconomics.com*. Retrieved from <https://tradingeconomics.com/south-africa/unemployment-rate>: <https://tradingeconomics.com/south-africa/unemployment-rate>
- [7] Kiragu, E., Adeleke, F., & Murombo, T. (2016). *Empowering Communities through Renewable Energy Investment*. Johannesburg: Mandela Institute.
- [8] Wlokas, H. (2017, November 5). *www.energyblog.co.za*. Retrieved from <http://www.energyblog.co.za/news/127-the-challenges-of-meaningful-development-through-the-reipp>: <http://www.energyblog.co.za/news/127-the-challenges-of-meaningful-development-through-the-reipp>
- [9] Pretorius, I. (2015). *Impacts and control of coal-fired power station emissions in South Africa*. Potchefstroom: North West University.
- [10] Holland, M. (2017). *Health Impact of Coal Fired Power Plants in South Africa*. Johannesburg: Groundwork South Africa.
- [11] Kotze, P. (2015, June 1). How much water will we need to keep the lights on? *The Water Wheel*, pp. 22 - 25.