National Union of Mineworkers

Energy Policy Discussion Paper

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Abbreviation and Acronyms

IRP	Integrated Resource Plan
NUM	National Union of Mineworkers
UK	United Kingdom
USA	United States of America
IPPs	Independent Power Producers
GDP	Gross Domestic Product
HELE	High Efficiency, Low Emissions
PSA	Probabilistic Safety Analysis
ED	Economic Development
REIPPPP	Renewable Energy Independent Power Producer Procurement Programme
BW	Bid Window
M&E	Monitoring and Evaluation
CCS	Carbon Capture Storage

Preamble

As the main union in the energy, mining, and construction sectors dedicated to the socio-economic emancipation of workers especially in these three sectors, it is the intention of the National Union of Mineworkers (NUM) to pro-actively participate in the formulation of any policy that may have a bearing on the interests of its constituency.

NUM is well aware that the energy policy that is being proposed by the South African Government will have far-reaching implications for the well-being of workers in both the energy and mining sectors. Moreover, the effects will spread to all workers across all sectors of the South African economy because energy is a key input in all productive activities of the country. The effects of the energy policy will include, but will not be limited to, job losses, increases in prices of goods and services, and general economic exclusion of citizens whose lives are at the margins of the mainstream economy. The energy sector is an employer in its own right; but it is also a catalyst of employment in all other manufacturing sectors of the economy. Downstream, the energy sector supports employment in the mining sector by sustaining the demand for coal. As such, changes in South Africa's energy sector have far-reaching implications for employment, and for the well-being of people and communities across the country. It is, therefore, the revolutionary duty of NUM to be vigilant in engaging and coming up with an informed position on the country's energy policy and energy mix proposals.

The Union's engagement with energy policy and energy direction is not a new undertaking. As far back as 2009 the Union, in its own capacity and sometimes as part of COSATU, has interrogated and made pronouncements on the country's energy policy direction. In the NUM resolution of 2009 to the COSATU National Congress, NUM requested COSATU to re-debate and re-visit its anti-nuclear energy position to assess whether concerns pertaining to nuclear energy that motivated the position were still relevant. The resolution also highlighted the position that the coal sector, as a major employer, still has to play an important role in the country's energy space; although given the concerns around coal's impact on the environment, research on Clean Coal Technology should be prioritized.

Another concern raised by NUM around nuclear energy has been the safety issue. The concern has been that nuclear power generation has a range of health and environmental risks for the workers and labour movements. For instance, many environmentalists have pointed out that nuclear waste remains radioactive for a number of years, and most countries are unable to find safe methods for storing the waste. Furthermore, there is enough evidence available that these health and environmental hazards mostly affect the workers and the poor.

Concerns raised by NUM in 2009 pertaining to the Union's position on nuclear energy, coal-generated energy and renewable energy are still valid and are even more urgent today. There has been new developments in the energy policy space since then, and the process of the proposed transition has been characterised by controversies. Being vigilant about the policy direction being taken by the country is now more critical, given the noticed tendency of the state to be captured by the private sector.

There are now two risks when it comes to the national policy. The first is that the state may come up with a policy or policy direction with the best intentions for the country and the workers, but the policy may have unintended consequences that could end up adversely affecting workers and the poor in general. The second risk is that the state may be influenced to come up with a policy that is out-rightly against workers' interests but because the state is captured, it goes ahead and implements it. With the recognition of these two risks, the Union more than ever before needs to devote more time to scrutinizing all policies relevant to workers that the state intends to implement, and come up with informed positions on whether to support, reject or advocate revisions.

There are a number of unanswered questions of interest to labour and the nation that relate directly to the energy policy of the country. Some of these questions are:

1. Who will be the winners and the losers when the proposed national energy policy is implemented in its current form?
2. In the case of losers, does the policy provide some indication on their right to existence and their right to have meaningful livelihood that is protected?
3. Are the timeframes appropriate for the planned change in the energy mix?
4. What will the country do with some of its natural resources, like coal, that may end up being rendered redundant?
5. What about the issues of affordability to consumers?

With these questions still unanswered, this discussion paper presents sets of facts and research findings on South Africa's energy policy, and the implications thereof. The paper intends to trigger debate and provide guidance to NUM, as NUM deliberates its stance on the country's energy policy and direction.

1. Background

Due to electricity shortages in South Africa, the government drafted the Integrated Resource Plan (IRP2) which was promulgated in March 2011. The plan was formulated to ensure secure and sustainable provision of energy for socio-economic development of the country. Recommendations in the plan include diversifying power sources and broadening electricity supply technologies to include gas, nuclear, biomass, and renewable energy resources (wind, solar and hydro) to meet the country's future electricity needs.

According to the IRP, South Africa's energy generation mix by 2030 should include: 48% coal; 13.4% nuclear; 6.5% hydro; 14.5% other renewables; and 11% peaking open cycle gas turbine. South Africa's electricity generation has to be increased significantly in the next few decades to facilitate economic growth and social progress. However, fixing the country's energy crisis is not just about generating more electricity, it must ensure that energy efforts are steered towards a lower carbon future, underpinned by attention to issues of equity and justice.

Civil society and labour movements have called for a 'just transition' and have emphasised a transition compatible with the pursuit of 'climate justice' for current and future generations exposed to the social and ecological disruptions produced by increasing concentrations of greenhouse gas emissions in the atmosphere.

There has also been concern over some of the energy sources, such as nuclear. These concerns relate to the financing, potential health issues and safety threats that nuclear power generation poses to the environment, the people, and property. NUM had previously taken a position against nuclear energy inclusion in the energy mix based on these concerns. The decision at the time was not supported by prior research to gather the prerequisite factual information. Questions are being raised now on whether the NUM position on nuclear energy production in the country should be maintained, and whether the reasons behind the positon are still relevant.

Moving to a low carbon economy will require huge financial and technical resources which will consequently affect workers and, especially, the poor. It is, therefore, vital that this is done in equitable ways which seek to create jobs and new industries which are more sustainable.

For NUM, a 'just transition' means a comprehensive effort to support coal communities and workers as the country shifts away from relying on coal-fired electricity to more sustainable and equitable

sources. This research will look into how labour will be affected by the proposed energy mix. Emphasis is put on job creation and the skills that are required to support the energy mix and energy transition initiatives.

1.1 Purpose of the Paper

The purpose of this research was to generate factual information that would contribute towards understanding the implications of the proposed energy mix for South Africa, with a particular focus on how it will affect workers. The research also intended to generate informed positions for NUM on different forms/ sources of energy production in South Africa.

1.2 Objectives of the Paper

This research reviewed the status of the energy production mix, including nuclear energy production in South Africa in the context of employment dynamics.

The specific objectives of the study were:

- To provide an overview of the current energy situation in the country in the context of the dynamics of employment and workers' interests.
- To assess the appropriateness of different energy sources in South Africa's energy production mix given the socio-economic needs of the country.
- To assess the implication of the proposed energy mix on workers and their communities.

1.3 Research Methodology

Phase 1
Phase 1 of this project was aimed at igniting discussions around the energy mix by NUM leadership and members. The goal was to get them to appreciate and understand how the transition to clean energy will affect workers in general. South Africa's transition to a clean energy economy will have profound impact for working people across many sectors. It will fundamentally change the structure of the country's economy. Often, the working class and their families unfairly bear the burden of the structural changes in the economy. It is the working class that loses stable jobs and is forced into insecure jobs, early retirement, or long-term unemployment. As part of Phase 1, an energy mix symposium for NUM members and various interest groups was organised at which facts and concerns of the Union on the energy issue were discussed. A document capturing what was discussed at the symposium was then drafted and presented at the NUM Central Committee (CC) for discussion.

While acknowledging the importance of the research done so far, the NUM Central Committee took a position that more evidence-based research was needed on jobs and skills that are required for each of the energy sources. The NUM CC requested SATRI to proceed with such research and produce more evidence-based findings to guide the Union's position going forward. Phase 2 of this project is based on this request.

Phase 2
After having completed Phase 1, which focused on the discussions of the advantages and disadvantages of different energy sources, Phase 2 focused on South African case studies on solar, wind and nuclear energy. The aim was to understand and document employment dynamics including required skills in these energy sectors in comparison with the coal sector. Data collection on the three case studies will take place in Western Cape (nuclear plant), Centurion, Johannesburg-IPP office (wind plants) and Northern Cape (solar plants).

These case studies are intended to answer some of the following questions:

- What are the actual numbers of jobs that can be created by different renewable energy projects?
- Is the employment profile in the renewable and nuclear energy sectors comparable, in any way, to that in the coal sector?
- What are the specific skills requirements for each of the renewable energy projects based on empirical evidence?
- Are there any skills in the coal sector that may be relevant to the renewable and nuclear energy sectors?
- Are there specific training programmes that allow job seekers to enter into the renewable energy job market?
- To what extent is South Africa ready for transition to renewable energy given the implications of such a move on employment and community disruption?

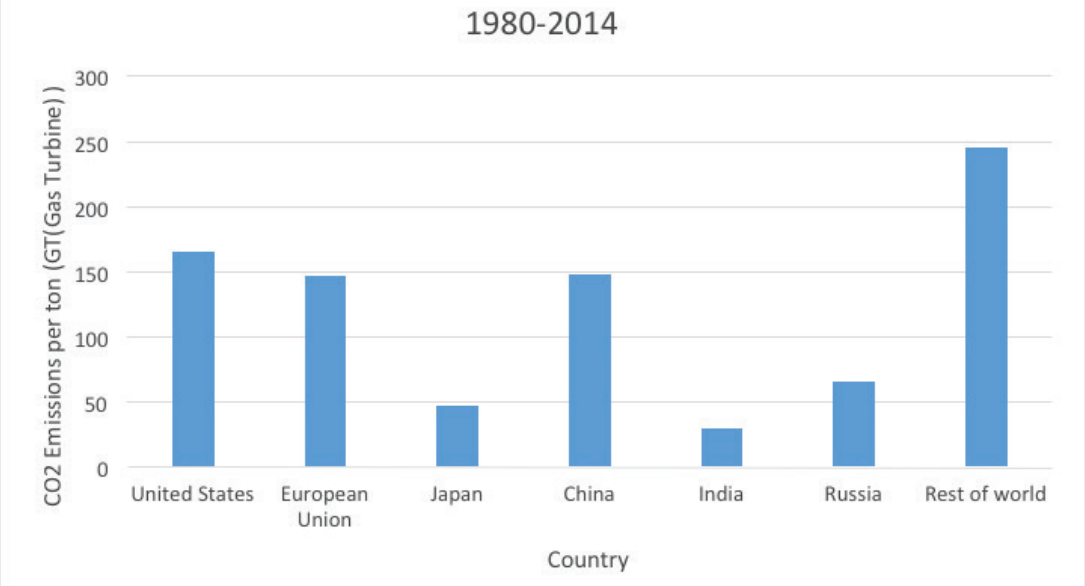
The team visited Koeberg Nuclear Power Station on the 24th April, and the Independent Power Producers Office was visited on the 29th May, 2018.

2. Why Migrate to a Low Carbon Economy: Climate Change and Energy

Research has shown that climate change is an urgent issue that all countries have to take into serious consideration, while enhancing the awareness of renewable energy. Wahlers (2007) believes that climate change and energy work hand in hand, as a failure to move to renewable energy would have a negative impact on climate change. He further stresses that global warming is not something new, and that it is a result of human action which can be controlled and be slowed down, as preventing it may be impossible. Thus, it is of paramount importance to encourage the move to renewable energy in order to control climate change and, ultimately, global warming.

The following chart (Figure 1) presents the carbon dioxide emissions around the world over the past two and a half decades.

Figure 1: Carbon Dioxide Emissions Around the World



Source: International Energy Agency, 2015.

The data in this graph demonstrates that over the past two-and-a-half decades, carbon dioxide emissions have been on the increase. The International Energy Agency (2015) strengthens this notion by highlighting that indeed, over the past two-and-a-half decades, carbon dioxide emissions have gone up by over 50%. The agency further stresses that emissions from particularly electricity and heat generation have doubled ever since the beginning of the 21st Century. Evidently, it is these carbon dioxide emissions which fundamentally resulted in the crucial need for renewable energy today.

It is, therefore, important to encourage awareness about renewable energy - with the ultimate goal of combatting carbon dioxide emissions. Wahlers (2007) explains that the awareness about renewable energy would address issues concerning energy security and climate change. In his discussion, he also states that natural power has always been used through the centuries as wind power and hydro power have been in existence way before fossil power. In this regard, humans have in the past resorted to energy sources that seemed convenient and sustainable for them at the time, without taking serious consideration of the consequences on the environment.

2.1 A Just Transition

In recent years, a growing number of unions and civil society movements around the world have emphasised the need to move towards low carbon economies in a fair manner. Such views pushed forward what is now known as a *just transition*. Indeed energy transitions have occurred in the past as technology and energy evolved. Often, it is workers, the poor and the vulnerable that face serious consequences. As an example, as fossil fuels are phased out, workers in that sector will need new jobs. According to the Public and Commercial Services Union in London (2017:26) a 'just transition' comprises of:

- Greener jobs – sustainable, decent work and fair terms and conditions;
- Worker representation and consultation;
- Social protections – income support, re-training and re-deployment opportunities, pension security for older workers, and help for communities to adapt to climate change;
- Support for innovation and technology sharing to enable a rapid transformation of energy and manufacturing opportunities;
- Fair distribution of costs and recognition of social and human rights;
- Social dialogue with all relevant parties including collective bargaining with workers and unions for workplace change.

This characterisation of a 'just transition' is consistent with COSATU's Central Committee 2011 resolutions on climate change. COSATU (2011) resolved that a transition should be based on the following principles:

- Capitalist accumulation has been the underlying cause of excessive greenhouse gas emissions, and therefore global warming and climate change.
- A new low carbon development path is needed which addresses the need for decent jobs and the elimination of unemployment.
- Food insecurity must be urgently addressed.
- All South Africans have the right to clean, safe and affordable energy.
- All South Africans have the right to clean water.
- We need a massive revamp of public transport in South Africa.
- The impacts of climate change on health must be understood and dealt with in the context of the demand for universal access to health.
- A just transition to a low-carbon and climate resilient economy is required.
- We need a carbon budget for South Africa.
- African solidarity is imperative.
- An ambitious legally binding international agreement designed to limit temperature increases to a maximum of 1.5 degrees is essential as an outcome of the UNFCCC process.

- We reject market mechanisms to reduce carbon emissions.
- Developed countries must pay for their climate debt and the Green Climate Fund must be accountable.
- We need investment in technology; and technology transfers to developing countries must not be fettered by intellectual property rights.
- The South African government's position in the UNFCCC processes must properly represent the interests of the people.

2.2 The Benefits of Migrating to Renewable Energy

Renewable energy is much cleaner than fossil fuel energy. It causes no harm to the environment, and is thus not a threat to the planet's survival. This segment draws attention to the benefits of transitioning to renewable energy, breaking down each energy source - from hydro energy to wind energy and so forth. There are a number of developed and developing countries which have already undergone the energy transition. In these cases, it is mostly found that developed countries like the United Kingdom (UK), the United States of America (USA) and other European countries have completely transitioned, while developing countries such as India and China have settled for an energy mix.

2.2.1 Hydro Energy

As discussed earlier, hydro energy is not new as it has been used over the centuries. The make-up of hydro energy, according to Kadar (2014), comprises of the hydro power station and waterways in the form of dams and lakes, to mention just a few. Kadar further adds that some of the benefits of hydro energy are that it is a renewable energy source, it does not require any exterior carriage as the water goes through a turbine, and the dams which are used essentially keep the nearby areas from flooding. Moreover, the channel of water transportation is safer as the hydro energy source generally has a life expectancy of more than one hundred years. Hydro energy can be regarded as sustainable in terms of its lifespan, economic value, and safety.

2.2.2 Wind Energy

Like with any other energy source, wind energy is advantageous because it is a source of renewable energy. In his discussion, Kadar (2007) outlines the main benefits of wind energy. He points out that it is cheap in terms of the required capital outlay, that it is not very costly for the end consumer and that it does not emit a lot of waste. In order to introduce wind energy in an area, that area would need to have a specific amount of wind for it to function effectively. Collins (2008) substantiates the notion of wind energy being affordable by stating that wind energy is among the most industrially and commercially developed forms of renewable energy generation. Wind energy seems to be the most convenient source of energy thus far.

2.2.3 Pump Storage Schemes

South Africa created Pump Storage Schemes (PSS) to supplement Eskom when it is experiencing peak demand within the national electricity grid. All installed PSS energy storages supplement hydro energy to the national grid in the specific times of the high demand for electricity (Barta, n.d.). There are currently four large PSS's operating in South Africa. One of the operations is Steenbras (180 MW) and it is a municipal asset of the City of Cape Town. The other three plants owned by the national entity, Eskom, are Drakensberg (1000 MW), Palmiet (400 MW) and Ingula (1 330 MW) (ESKOM, 2016). With PSS's, energy is stored in the form of water during off-peak periods and released during the peak electricity demands (Barta, n.d.). The advantage of PSS is that it is more efficient and it complements the volatile renewable energy production that is steadily increasing (Ilupeju, 2015). PSS uses reversible pump or turbines and it is the most effective way to store electrical energy at acceptable costs (Ilupeju, 2015).

2.2.4 Solar Energy

Solar energy has not always been widespread. The awareness of solar energy emerged, as stated by Kadar (2014), in the past decade and since then there has not been much to report on about solar energy except that it has been successful. Kadar further adds that a major advantage of solar energy is that it does not emit carbon dioxide while it is functioning. Other advantages include solar energy being less costly, and it does not produce noise which could come as an environmental disturbance. It can also be re-used.

2.3 Nuclear Energy

Nuclear energy is questioned by many people in terms of its safety and affordability. What is lacking is adequate research to support these sentiments. As Comby emphasises in his journal entry, nuclear energy is the most consistent, viable, harmless, and uncontaminated source of energy. He adds that it essentially has the ability to override fossil fuels, especially taking into account that they are major atmospheric pollutants. Moreover, nuclear waste is much smaller than fossil fuel waste. Thus according to Comby's findings, nuclear energy ultimately overpowers every other energy source.

3. International Experience

This section presents what the international experience has been of countries transitioning from one energy source, particularly coal, to alternative energies, especially renewable energies. The intention of the section is to highlight what can happen to South Africa should it take the same energy policy path. The experience is limited to two countries: the UK and India.

3.1 UK's Experiences of Transitioning from Coal to Renewable Energies

The UK is one of the countries that have almost completely shifted away from coal to renewable energy. The last deep coal mine in the UK closed down in December 2015. For over ten decades, coal had been the largest contributor of electricity and employment in the UK, particularly in the mining and energy sectors (Fothergill, 2017).

A number of factors contributed to the UK's reduction of coal production and the subsequent energy transition from coal. The two most significant factors were the increase in the relative cost of coal-generated energy compared to alternative energies, and the UK government implementation policy interventions that were not in favour of coal production. The existence of cheap coal on global markets further exacerbated coal production in the UK, as imports of coal emanating from countries like USA and Russia declined.

Although the coal industry was privately owned, the UK government played a significant role in encouraging the move towards clean energies by adopting anti-coal policies. Such policies included the introduction on carbon tax and the opening of the electricity market to Independent Power Producers (IPPs).

Carbon tax was a major driver of transition from coal energy in the UK. The tax was aimed at decarbonising electricity production in the country. It changed the relative prices of energy in favour of renewable energies. In so doing, the carbon tax gave a competitive edge to non-coal power producers.

Opening of the energy market to IPPs also played a role in the UK's energy transition. Being private actors, IPPs were driven by profits, hence when the carbon tax made coal energy generation less competitive, the independent actors focused and invested in alternative renewable energy sources. It is also important to note that government incentivised IPPs through offering favourable and

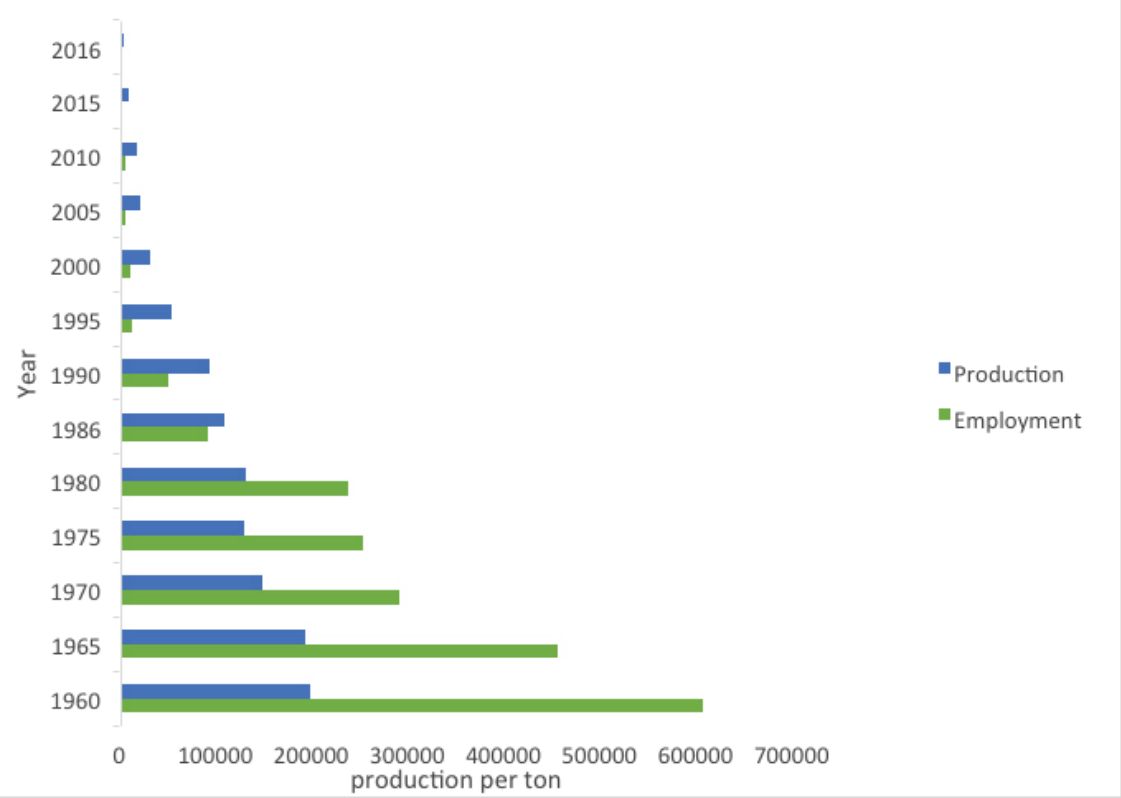
guaranteed prices on the power they were to generate. This gave them a further competitive edge against the coal energy producers. The concessions provided by government to IPPs accelerated the displacement of coal-generated energy demand in the country.

3.1.1 Socio-economic Effects of the UK's Transition from Coal to Alternative Energies

The first and most vivid effect of the UK's transition from coal to alternative energy sources was job losses in the coal mining sector. Between 1980 and 1986 employment in the coal mining sector decreased from 237 000 to 91 000. By 2016, employment fell to a mere thousand workers, yet this was an economic sector that once employed more than 600 000 people in the 1960s.

Undoubtedly the reduction in employment was a direct result of the reduction in coal mining and production in the country. From the mining side, coal production in the UK decreased from 130 000 tonnes in 1980 to 18 000 tonnes in 2010. By 2016 coal mining in the UK was non-existent. Figure 2 shows the impact of the transition from coal to alternatives on employment and production.

Figure 2: Employment and Production of UK's Coal Sector 1960-2016



Source: (Fothergill, 2017)

Related to job losses in the coal mining sector was the collapse of trade unionism in the UK mining sector. The loss of jobs meant that there were no workers in the sector to organise. As a result, the National Union of Mineworkers of the UK is no more.

Implicit to the job losses was also the collapse of communities and decline of coal mining towns. Communities had been formed around the coal mining areas. With the ceasing of coal mining, these communities could not be sustained as people had no source of income. Those who could had to migrate to other areas seeking jobs, while those who could not remained in the now ghost towns living impoverished lives.

The other socio-economic effect of the transition was the general increase in the energy prices that consumers had to pay indirectly and directly. The indirect payment was a result of the government

subsidies taken out of the taxes given to the IPPs. Although contested by some, the direct price increase effect emanated from the higher prices being set for final energy consumers by the private actors in the energy business, aimed at getting higher returns on their investments. According to Newbery (2015), the challenge of delivering a reliable low-carbon electricity industry at least cost to UK citizens still exists despite the transition made by the country; this is attributed in part to coal energy generation becoming un-competitive.

3.1.2 Lessons for South Africa from the UK's Transition Experience from a Workers' Perspective

South Africa can learn a number of lessons from the UK's experience of moving away from coal energy generation to alternatives. Some of the key lessons in this regard are:

- Transition from coal to alternative energies especially renewable energies will have an immensely negative impact on jobs; not only for mineworkers, but also for those in the coal-fired energy industry too. The effects will not only be limited to the mining and the energy production sectors but to the other sectors of the economy. If not carefully approached it can trigger social unrest, given the country's unique circumstances.
- Policies like carbon tax and incentives for IPPs are part of the subtle interventions that push for migration from the use of coal in energy production to renewable energies. They displace rather than supplement coal-fired energy generation. Specifically, the IPPs are one of the ways through which the private sector 'gets its foot' into energy generation of a country. When the private sector takes control of the energy sector, government policies must ensure that consumers, especially the poor, access energy at reasonable prices.
- The massive un-employment that can accompany the transition from coal energy generation through IPPs and renewable energy promotion can cause the collapse of a unionism in the sectors.

Through incentives to IPPs, government may be indirectly funding future job losses and loss of its ability to determine what happens in energy generation and provision to the citizens.

3.2 India's Energy Transition

India is one of the developing countries that is also in the process of transitioning from coal energy use. Unlike the UK, India has not yet made a complete transition. The Indian experience can be more relevant to South Africa since both countries have a significant number of people who are poor, and it is the responsibility of the state to protect the livelihood of such people.

3.2.1 India's Coal Transition

In principle, India acknowledges the need to move towards cleaner energies. Nonetheless, the country is very conscious of its own socio-economic challenges which it has to give priority to and which can be made worse by the transition. Hence, in mapping out its energy transition India did not commit itself to move away completely from coal energy production but rather decided to have an energy mix that includes renewables and other energies. India uses several devices to form its energy mix, together with forms of economic incentives, controlled energy prices and other forms of government support (IISD, 2017). The coal transition in India has been and remains a complex one. While coal has always been and remains a main energy source in India, various paths have been taken for cleaner energy. The goal was and still is to deliver clean energy to communities at really low costs.

India did not commit itself to timeframes for the energy transition to be completed despite appreciating climate change concerns associated with coal energy generation. As a result, the country's transition from coal to alternative energies is taking long time and the exact timeframe for complete transition, if ever, is likely to be determined by socio-economic considerations. According to Planete (2017), in principle but in a non-committal way, India still aims to reduce emissions and to significantly increase electricity generation from non-fossil sources by 2030. The country further plans to enlarge its forest areas to aid the capturing of carbon dioxide; but access to electricity, and affordability of such, remains the key determinant of India's energy policy direction.

Another important aspect of the slow pace for India's transition from coal energy is that energy demand in the country is still very high relative to the energy supply, given the country's ever increasing population. India is the next most populous country after China. About half of the country's population is said to be mostly young people under the age of 26 (Pandey, 2017). In any country where the population is rapidly growing, there is bound to be a high demand for services, one of them being electricity.

3.2.2 Use of Subsidies in India's Energy Transition

In order to balance between the desire to reduce carbon emissions and providing affordable energy to its citizens, India opted to introduce subsidies for its energy sector. Subsidies were given to investors in the energy sector so as to increase investment but without increasing prices paid by consumers of energy.

A number of subsidies were put in place by the government. Some subsidies were meant to encourage the move to clean energy while delivering energy at low costs while others were meant to reduce the transmission and distribution costs.

Nonetheless, coal remains a major contributor of energy in India and it seems that this will continue to be the case. This is partly because India, like South Africa, has an abundance of coal reserves. Moreover, the coal sector employs a significant number of citizens.

3.2.3 Lessons from India's Transition Experience for South Africa

With both South Africa and India being developing countries, it would be more realistic for South Africa to take lessons from India. Despite India's lack of commitment to climate change, the country took measures to decrease its greenhouse emissions. As a developing country, India did not want to completely transition, but rather, wanted to keep energy options open for all to afford. Hence it took an energy mix approach that included coal as part of the mix. A few lessons can be learnt from the Indian energy transition experience:

- South Africa needs to take into consideration its social economic aspirations, especially the welfare of its citizens when considering the energy direction. If need be, a balance has to be struck between the desire to migrate to cleaner energies and safeguarding access to affordable energy especially by the poor.
- Energy transitions need not be rushed. South Africa should set its own timeframes based on local circumstances about how and when it wants the energy transition to unfold.
- For the protection of the vulnerable people in society, local investors who allow access to energy at affordable prices can be considered. The energy policy should not focus on only giving incentives to investors without considering the consumers' welfare.

4. South Africa's Energy Mix Policy Choices and Implications

4.1 Coal and Coal Power Generation

Despite the negative sentiments surrounding the usage of coal in industrial processes due to its high levels of greenhouse gas (GHG) emissions, and most of the world's prime economies moving away from it, in South Africa coal remains a vital energy source. Its economic contributions alone cannot be overlooked. However, taking into account the negatives that accompany the usage of coal, the Chamber of Mines (2018) has enacted environmental measures to curb the harms of coal, and this has in turn affected demand as the search for alternative energy sources ensues.

While other economies have adopted some measures to minimise the high levels of greenhouse gas emissions through adoption of new technologies, this is not necessarily the most economically viable option due to the high costs of such technologies. Moreover, South Africa has to consider the implications that accompany this move and devise measures which will not drastically harm the sector.

At the moment coal, after oil, is considered to be the world's principal energy source and comes at a reasonable cost. According to the South African Yearbook (2013/2014), South Africa is cited as the fourth largest coal producer in the world with an estimated 28% in exports of the coal produced. With a further estimated 116 years of coal reserves remaining (Chamber of Mines, 2018) it is evident that this is not a dwindling resource, and given constant demand, it can prove rather critical for economic growth. However, the move towards greener, less polluting energies by other economies has resulted in South Africa becoming the sixth largest coal producer in the world. With Asian economies' growing demand for coal, this shift from fourth to sixth has not necessarily stifled growth within the sector as coal has even gone to surpass gold in importance within the South African economy.

4.1.1 Labour Absorption in the Coal Sector

Numerous indicators emphasize the importance of the coal industry for the economy of South Africa, owing to the substantial labour absorption within the sector as well as monetary expenditure on goods and services. Coal is a multi-billion rand energy generating industry and as such it is a key employer contributing to numerous direct and indirect jobs in the economy. This section will focus on highlighting employment trends within the coal industry by highlighting the number of employees and the various skills required. StatsSA (2015) states that there are 72 688 employees within the coal sector, a 14% increase from 2012. According to information from the Chamber of Mines (2018) Coal Strategy Report, 77 056 employees were reported for the year 2016, highlighting a further upward trajectory in employment within the sector. Omarjee (2018) says there are 81 000 direct jobs and 170 000 indirect jobs within the sector, with the industry having paid employees an estimated R22 billion in 2016. These numbers indicate that the coal sector accounts for 20% of total employment within the mining sector (Figure 3).

Figure 3: Employment in Mining

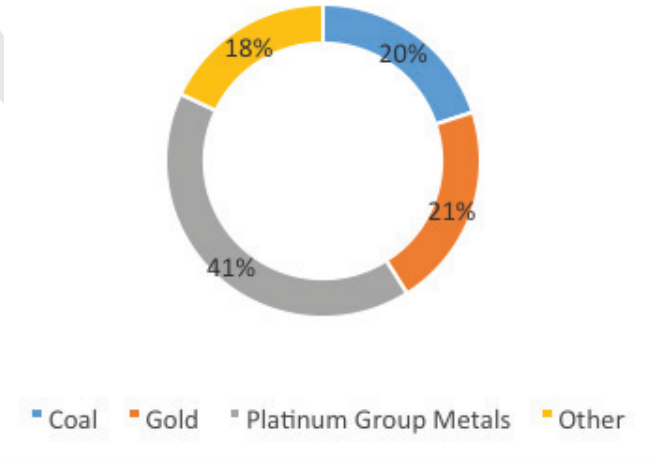
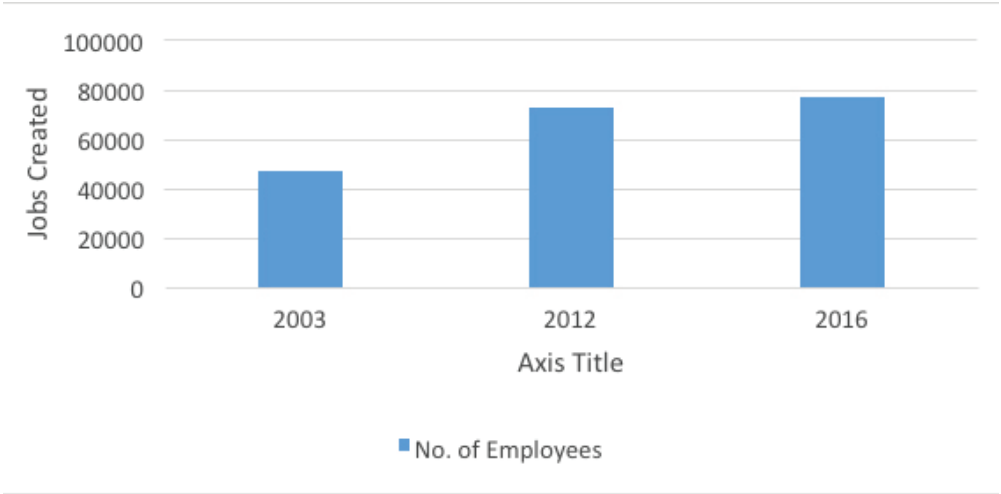


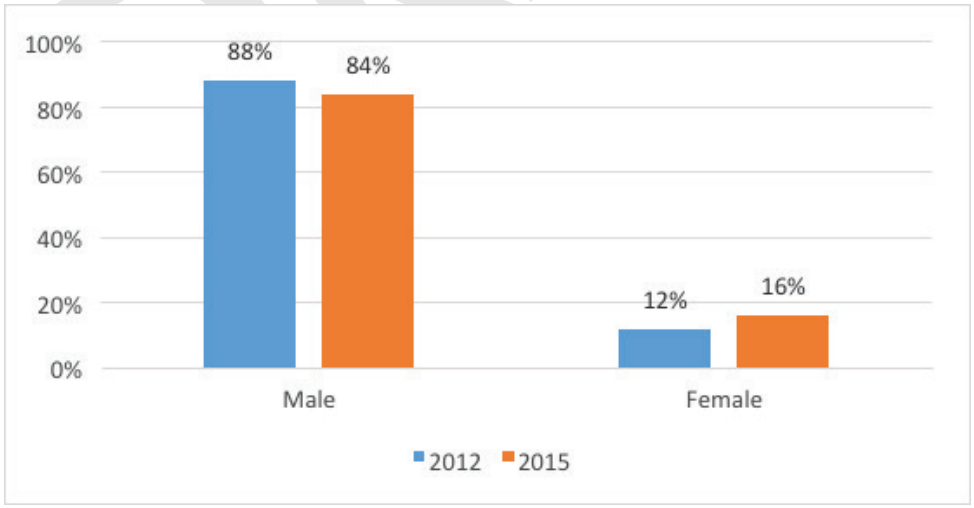
Figure 3 shows the contributions to employment from the various mining sectors for the year 2015, with coal and gold differentiated by one just per cent. Coal, according to the Chamber of Mines' Coal Strategy Report (2018), has come to surpass gold's importance in the South African economy. Figure 4 below shows increasing employment over the years in the coal sector.

Figure 4. Employment in the Coal Sector



Despite this upward trajectory in employment concerning, however, is the gender equity in the employment mix (Figure 5). StatsSA (2015) reports that of the 72 688 employed within the sector, only 11 000 are female. The gender equity ratio within the mining sector in general is highly unequal; the improvements have been very insignificant. Even after the Employment Equity Act of 1999, the mining sector has not been quick to transform as only 11% of the mining workforce is female. Women within the sector are found mainly in human resources, finance or lab work above the ground, and this is largely because for a long time mining work was exclusively for males (Dlamini, 2018). Even the 2017 Mining Charter makes provisions for increased women representation, especially on two burning issues which are decision making as well as career advancement for women within the sector.

Figure 5: Gender Inequalities in the Mining Sector



More meaningful contributions on the number of jobs created by the coal industry in various sectors of the economy are highlighted by the Chamber of Mines Report (2016). What these statistics allude to is the fact that as a major labour absorber, the contributions to GDP by the sector alone are significant.

4.1.2 Emerging Trends

Due to international calls towards reduction of greenhouse gas emissions, the future that the South African coal industry faces could potentially be bleak, and the effects of this on the economy could prove detrimental. High Efficiency, Low Emissions (HELE) technologies have been suggested as a

response to lower emissions; economies such as China and Japan amongst others have lowered their air pollution through usage of such technologies. Due to these climate change concerns, there is a lot of uncertainty as to what future possible steps will be taken to address these concerns.

Omarjee (2018) makes reference to 'four' possible futures for the South African coal industry as the country explores means to curb the levels of gas pollutants. One of them is the possibility of shifting from coal to nuclear and renewable energy sources. Whilst this consideration attempts to address climatic concerns, the Department of Energy's Integrated Resource Plan (IRP, 2016) highlights the reasonable price of coal for the electricity sector. The report points out that coal is cheaper than renewables, and that the move will affect coal mining communities as this will lead to job losses in the sector. According to the Chamber of Mines (2018), Eskom has over the next ten years opted to close down some coal power stations, namely Hendrina, Camden, Komati, Kriel and Grootvlei. The reason cited for this closure is that the mines are approaching the end of their lifespans. This further shows how bleak the future of coal mining could be, especially in terms of employment as the report further approximates some 30 000 job losses should these closures happen. No plans have been put forth as to how those affected will be compensated or how they can potentially be absorbed into other sectors. Whilst the ministry of energy puts forth the notion of IPP's, they overlook how these renewable energy sources have a bearing on the coal sector. NUM has been very vocal against this, threatening to withdraw votes as the 2019 elections approach. Whilst renewable energy sources and reduced greenhouse gas emissions are ideal, one needs to consider the potential harm of such a move before any implementation takes place.

5. Nuclear Energy

Nuclear energy debates are an exceptionally sensitive subject in South Africa. This is because in recent years, the debates on nuclear energy have resurfaced as a major area of review for the policy agenda in South Africa. The reason is because of the growing interest in reducing greenhouse emission due to global concerns on climate change. The other important reason is the recent electricity shortages experienced due to supply shortages. Given that the largest component of greenhouse gas emissions is the consumption of fossil fuels, there has been great emphasis for South Africa to transition to a low-carbon economy. The transition towards a clean energy economy will fundamentally impact on the structure of the economy and, consequently, the labour market. Whilst there has been widespread consensus that South Africa needs a 'just transition' - precisely 'how' this 'just transition' is to be effected is a matter of heated debate. Some advocate renewable energy as a solution, whilst others see 'just transition' as including more emphasis on nuclear energy.

Proponents of nuclear energy argue that nuclear energy is one of the defining features of the energy sources of our century and is an essential, unavoidable, and potentially beneficial component of the economic and social life of countries. As such, the nuclear energy industry is seen as having the potential to play an important role in any energy programme to stimulate creation of new jobs and economic expansion, providing both short-term and lasting employment and economic benefits (Nuclear Energy Institute: n.d.). They argue that the question should, therefore, no longer be whether or not nuclear energy should be accepted; instead, it should be about how to deal with it and manage it effectively so that the benefits it has to offer can be fully exploited, and its negative effects reduced or minimised.

The government, under President Zuma's administration, emphasised that South Africa needed to attract highly skilled reactor suppliers to help erect six new nuclear power plants. Some critics felt that the process as well the debates around nuclear power were politically driven and not so much about power supply needs nor the interests of South Africa. Many commentators have remarked on what they perceive to be a politically motivated decision; groups such as EarthLife Africa and the Southern African Faith Communities' Environment Institute even brought legal action against the

energy minister in 2015. The application requested the court to pronounce the procurement process of nuclear power plants as unlawful and unconstitutional. The groups also argued that an out-of-date 2010 assessment had been used to determine electricity requirements as opposed to current electricity needs.

As a result, the 2016 updated IRP draft emphasised on lower and slower nuclear targets because of lower demand forecasts and increased capital cost (DoE, 2016). The policy aimed to set achievable targets, as there was also a growing number of critics around the need for nuclear energy. The then Energy Minister, Tina Joemat-Peterson, reported to parliament that because the country lacks adequate water to support coal-fired power generation, nuclear had become a non-negotiable option for South Africa (Trusted Sources, 2016). As a result, the government under President Jacob Zuma pushed ahead with the nuclear deal. Many commentators have remarked on what they perceive to be a political agenda in the context of the so called 'state capture', and possible corruption on the part of President Zuma.

5.1 Koeberg Nuclear Power Station

Koeberg Nuclear Power Station is the only nuclear power plant in South Africa as well as regionally. It has two reactors and produces about 5% of South Africa's electricity. The Koeberg plant construction began in 1976 and Unit 1 was synchronized to the grid in 1984, and Unit 2 in 1985 (ESKOM: 2015). The plant is owned and operated by Eskom and has twin 900 MWe class (ESKOM n.d.).

At the time, the government resolved that it would be too expensive to build coal power stations in Cape Town. This is because the majority of South African coal reserves are found in Mpumalanga and so it was not practical to transport coal to the Western Cape. Hence Koeberg Power Station was constructed in Cape Town, to be the sole provider of power in the Western Cape.

Koeberg was one of the first nuclear power stations designed to be specifically resistant to earthquakes (Eskom: 2010). According to Eskom, the reactors at the Koeberg nuclear power station are built upon an aseismic raft designed to withstand a magnitude seven earthquake at a focal distance of about 10 km, 0.3g zero period ground acceleration (Eskom n.d). This is one of the reasons why the power station is ranked amongst the safest of the world's top-ranking nuclear power stations. And for this reason as well, Koeberg's operating life span of 30 to 40 years has recently been extended by another 20 years.

5.2 Findings of the Empirical Research – Koeberg

5.2.1 Employment Creation

The information supplied by Eskom (Koeberg Power Station Office) shows that the 1 700 staff members are employed on a permanent basis at Koeberg, of which 46% are female. In addition to that, there are 600 people working as contractors. Many proponents of nuclear power argue that nuclear power can stimulate job creation. As an example, in 2017 the then Public Enterprise Minister, Lynn Brown, reported that the findings of a KPMG study on socio-economic impact of Koeberg found that over the period 2012/13 to 2015/16, the power station supported and stimulated economic activity in South Africa to the estimated value of R53.3 billion. Furthermore, Minister Brown highlighted that between 2016 and 2020, Koeberg is expected to weigh-in with an average of 2 300 direct and 42 000 indirect jobs per annum in the Western Cape.

In a study about nuclear power and employment growth in the United States of America, a joint report from the OECD Nuclear Energy Agency and the International Atomic Energy Agency claimed that approximately 200 000 job-years of employment are created by each 1 000MWe of nuclear capacity constructed (Willmitt, 2017). Willmitt argues that nuclear power contributes more to increases in employment than the other clean energy sources.

5.2.2 Skills Development and Training

In addition, the study found that Koeberg is run by locals from different socio-economic backgrounds. Also, the responses from some of the Koberg staff members indicate a high level of satisfaction with their jobs. According to these staff members, the power station has quality jobs that require highly-skilled employees. As a result, nuclear professionals earn salaries that are above the industry average. This is in line with Minister Brown's sentiments that: 'The income levels for Koeberg's employees are above the industry average in South Africa, which points to the highly skilled nature of the job opportunities available at Koeberg.' Table 1 below categories the nature of the jobs at Koeberg Power Station.

Table 1: The nature of the jobs in Koeberg Power Station

Category	Jobs
High skilled	• engineers • scientists • operators and technicians
Semi-skilled	• Human Resources • Administrators • specialised researchers
Low skilled	• artisans • Specialist steel welders • Plumbers • Trainees

The study found that every year, the Koeberg Nuclear Power Plant trains 300 individuals at the power station training centre. The training centre is internationally accredited. At times, companies from Abu Dhabi poach the trainees and other workers at the plant. The individuals that have gone through Koeberg artisan training are able to move easily to more technical jobs. This is because at Koeberg, safety is regarded highly and so everyone is trained to be able to deal effectively with issues should they arise. As such, skills are easily transferable because of the safety factor of the plant. As an example, the emergency and evacuation plans execution requires six people on stand-by so for this reason, the plant trains additional people. The plant offers a rotation programme for its staff.

5.2.3 Workers Safety

Safety is a top priority at Koeberg Nuclear Plant. The operation risks of nuclear power plants are quantitatively analysed by Probabilistic Safety Analysis (PSA). Level 1 is the first part of PSA. It determines the accident sequences leading to core damage and estimates their probability. Level 2 is the second part of PSA. It analyses the amount, probability, and timing of a release of radioactive substances from the containment to the environment. Level 3 is the third part of PSA. It analyses the risk to people and the environment caused by releases of radioactive substances. Koeberg Nuclear Power Plant is on level 2 regarding its safety control.

The plant adheres to international security standards. The plant is programmed to shut down in 2 minutes in case of emergency. It is also mentioned that in case of natural disasters, the plant will just vibrate but will never erupt.

7. Renewable Energy

South Africa has experienced increasing problems in meeting the expanding energy demands of its industrial development and its growing population. The government has attempted to mitigate these energy constraints by introducing environmentally friendly means to meet the demands. One of the most innovative mechanisms that government has established has been to introduce renewable energy into the South African market by developing the Renewable Energy Independent Power Producer Procurement Programme (REIPPPP). The REIPPPP is intended to serve two main purposes. Firstly, it is intended to increase energy security in the country through the procurement of additional electricity generating capacity and, secondly, it is intended to stimulate Economic Development (ED) through various criteria that have to be met by the IPPs.

The IPP Office was established in 2010 by the Department of Energy (DoE), National Treasury, and the Development Bank of Southern Africa (DBSA). The IPP office has a mandate of delivering on the IPP procurement objectives.

IPPs are judged on two broad components: the first is the price of producing the technology, and the second is their contribution towards the development of the communities surrounding their operations. The main evaluation criterion for the bid selection process is pricing, with a 70% weighting; however, there is a 30% weighting for Economic Development (ED) (Tait et al., 2013).

7.1 Job Creation

The job creation criterion comprises a substantial 25% of the final ED scorecard. The sub-elements of this criterion are summarised in the table below:

Table 2: Sub-elements of the job creation criterion

Description	Threshold	Target
RSA based employees who are citizens	50%	80%
RSA based employees who are black people	30%	50%
Skilled employees who are black people	18%	30%
RSA based employees who are citizens and from local communities	12%	20%

Source: (Eberhard & Naude, 2017)

A certain percentage of South African employees in the project should come from the local community where the power plant is situated - both the threshold of 12% and target of 20% have remained unchanged from Bid Window (BW) 1 to 4.

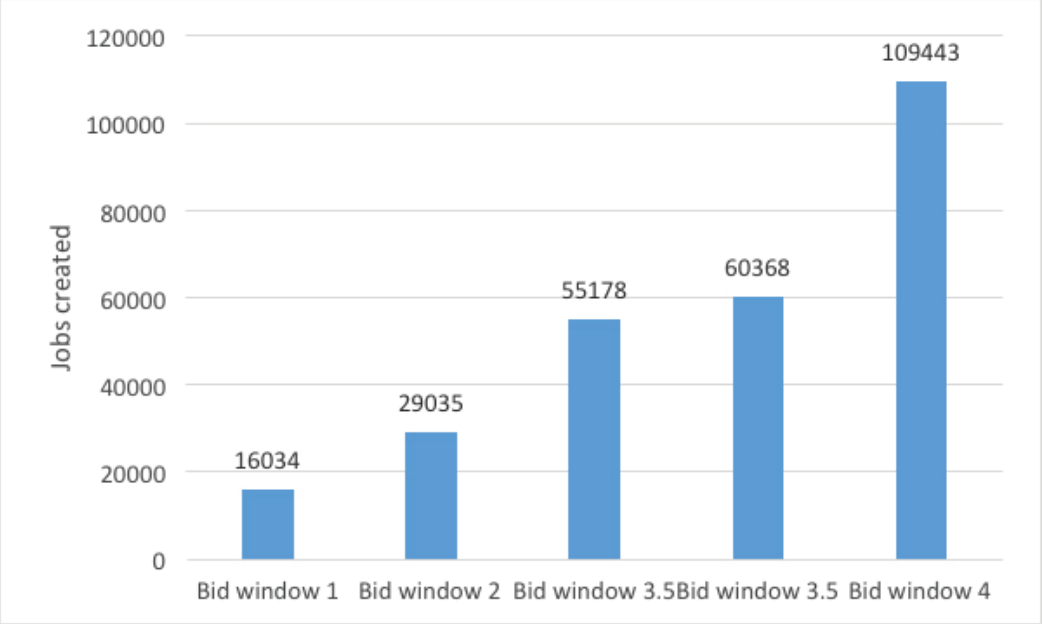
However, the job procurement document does not provide the objective and the vision of job creation. Moreover, it does not provide reference to the nature of the work in terms of longevity of green economy employment opportunities. More importantly, it does not provide a comprehensive monitoring and evaluation (M&E) framework against which one could measure impact. Trialogue (2014) emphasises the importance of an M&E framework, stating that 'the process of developing an M&E framework in itself helps to ensure that all project partners have the same objectives and are in agreement on how to measure success.' The project partners should also include the beneficiaries throughout the monitoring process.

In addition, another complication in government job related data regarding IPPs is that it is provided in job-years. The term 'job-year' refers to one person's employment for one year. For example, 40 job years could mean two people employed for twenty years each, or four people employed for 10 years each; so attempting to count the exact number of jobs created by the IPPs becomes difficult.

Similarly, another difficulty in counting the number of jobs in the renewable energy industry is the distinction between direct, indirect, and induced jobs. Direct jobs are those which are directly related to the power plant. For example, workers employed during construction, or during the operations of the power plant, namely power plant operators, other technical personnel, as well as cleaners and administrative support. Indirect jobs are associated with activities related to the power plant. Examples include the manufacturing of power plant components, or with construction related activities such as cement manufacturing or transporting of components to construction sites. Induced jobs are a category of jobs which arise from economic activity in an area but which are not directly related to the renewable energy industry. For example, an increase in family income due to employment at a renewable energy plant might mean that families eat out more often. An increase in restaurant staff due to an increase in restaurant bookings could be classified as induced jobs. However, the scope of this paper covers only direct and indirect jobs.

The struggle in attaining an accurate number of jobs created by IPPs has led to many reports using estimates. For instance, the national IPP office report (DoE, 2015) provides a total job estimate of 109 443 job-years for BW 1-4, but this number does not distinguish between construction and operation jobs (Figure 6). The report only provides one job number and it is not clear how many local community members had gained direct or indirect employment from the IPPs. The discrepancies in the job data available from the IPP Office reports as described above simply highlight the difficulty of obtaining accurate job creation data.

Figure 6: Number of Jobs Created by IPPS in Job-Years (BW 1-4)



Source: (DoE, 2015)

However, it was possible to calculate the exact number of local community people who are employed by IPPs, when using the empirical data from a study conducted by McDaid (2016). It was also possible to obtain the number of construction jobs (assuming average construction period of 2 years) and operational jobs for local community members. The McDaid (2016) study focused mostly on the Western Cape, Eastern Cape, and Northern Cape, as they are the three major renewable energy provinces.

Table 3 below shows how the construction and operational jobs for local communities are spread across the three provinces. It is worth noting that the number of operational jobs are very few compared to construction jobs.

Table 3: The REIPPPP Provincial Distribution of Jobs for Local Communities

Province	No. of IPPs (BW 1-4)	No. of local people employed in construction	No. of local people employed in operations
Eastern Cape	17	2 509	348
Northern Cape	48	11 888	1 616
Western Cape	11	1 680	165
Total	76	16 077	2 129

Source: (McDaid, 2016)

McDaid's findings are echoed by the World Wide Fund for Nature - South Africa (WWF-SA) report that the renewable energy industry is not labour intensive and after the construction period has been completed approximately only two per cent of the workforce is retained for operational and maintenance requirements (WWF-SA, 2015). The construction jobs last on average 18 months to two years. In an area rich in renewable resources, a construction job could extend beyond two years if the worker is able to secure employment at a subsequent power plant site.

At the same time, Mulcahey (2012) argues that job creation by IPPs is dependent on successful industrialisation as most jobs are created in the manufacturing side of the renewable energy sector. Contrary to Mulcahey (2012), McDaid (2016) states that manufacturing factories employ workers as contractors for a fixed project although they continue to operate full time following project completion. Therefore, manufacturing factories are dependent on gaining contracts from individual IPPs, and there is only work if the company continues to get the contracts.

8. Findings of the Empirical Research – Renewables (IPP Office)

On the 29th May 2018, a group of SATRI and NUM representatives attended a highly informative meeting at the Renewable Energy Independent Power Producers Procurement Programme (REIPPPP) offices. The aim of the gathering pertained to concerns surrounding renewable energies and the impact on labour. The sharing was supposed to guide the thinking and stance organized labour should adopt concerning renewable energies. It was evident throughout the meeting that inevitably, moving forward, South Africa will have to embrace an energy mix of sorts so as to accommodate the country's increasing energy demands; but to what extent?

8.1 Job Creation

The office of the REIPPPP has embraced various renewable energy programs (solar, wind and hydro) which they have implemented across the country in various municipalities. They, however, raised a couple of concerns primarily around job creation and the sustainability and longevity of those jobs. Despite the fact that the programme creates jobs, the representatives did admit that most of the jobs created by REIPPPPs lack longevity and are thus unsustainable for the communities in the long term. Their calculation of jobs created, in terms of job-years, also created further uncertainty as to how many jobs exactly these IPPs create. A further concern was the inability to accurately establish the contribution of direct and indirect jobs created within this sector. However, the office is involved in upliftment programmes within the communities; examples being infrastructure development of schools and awarding bursaries and training programmes to locals.

8.2 Coal Programme

As an IPP, the office also supports coal programmes and is constantly looking towards cleaner coal technologies. It acknowledged that there are lessons that can be learned from Japan and China in keeping up with global emission demands, but argued that it has not been easy. The technologies are often expensive but there are measures in place to curb emissions where they have imposed a tax regime designed to penalise users who exceed a certain amount of emissions.

Furthermore, the issue of the closure of certain coal powered power stations by Eskom (Hendrina, Camden, Kriel and Komati - all in Mpumalanga) was raised. The REIPPPP argued that this closure has nothing to do with accommodating renewable energy alternatives but is due to the fact that coal is running out in Witbank, Mpumalanga. The office further argued that renewables only produce about 3% of energy in the country and their role cannot be attributed to job losses in other sectors, especially coal. There was no plan in place that the office was aware of on how job losses would be accommodated in this sector; but a suggestion was put forth that coal workers can be migrated to the gas industry. This implied that the other sector had to be established so as to transfer skills from one sector to another.

8.3 Gas

Concerning fracking as a renewable energy source, the office highlighted that they have not yet themselves pursued gas but believe that before considering fracking the country should attempt to establish a gas market first. One suggestion was that the country explores exportation of gas from Mozambique through a pipeline into Mpumalanga and attempt to push towards purchases at rand prices and not the US dollar. The other suggestion was that liquefied gas be brought into the country through Richards Bay and then into the Gauteng Province. It is understandable that there is a lack of understanding of the gas market and before even going to frack the Karoo, the suggestion is that the country should establish a market for the resource first, and establish its viability.

9. Clean Coal Technologies: Carbon Capture and Storage (CCS)

Coal is a very important fossil fuel and plays an important role in the energy sector. There is an on-going sense that new clean coal technologies will lead to high efficiency in cutting emissions moving forward. A number of countries that have coal reserves - such as China, US and Canada - are rapidly implementing new coal technologies, and that includes CCS and other technologies.

The International Energy Agency (IEA) maintains that coal remains the fossil fuel of choice for electrical power generation and other industrial applications in both developed and developing economies because of its supply security and competitive cost. As a result, there is a growing need to accelerate the development and deployment of technologies that will reduce the emissions from the use of coal (IEA, 2008). The Energy Policy Strategy and Investment Model need to take into account the long term efficiency of clean coal technologies, and national interests.

A developing country such as South Africa will have to be careful in implementing CCS as the cost projections are huge. According to the South African Centre for Carbon Capture and Storage (SACCCS), the deployment of CCS infrastructure capable of capturing 20 Mt/a CO_2 from CTL facilities in South Africa would require an outlay of approximately R61 billion over a minimum period of 24 years (2022-2045). The expenditure for capturing 80 Mt/a CO_2 from both coal-fired power stations as well as CTL facilities over the same period is estimated at R523 billion (SACCCS, 2013).

9.1 What are Clean Coal Technologies?

Clean Coal Technologies (CCTs) use coal for power generation in more environmentally acceptable and economically viable ways. They include processes that can be applied before, during and after utilisation. There are two basic approaches when it comes to developing clean coal technologies. The first is to develop more thermally efficient systems that use less coal to generate the same amount of power, with an associated reduction in emissions. This has the advantage of reducing the extent of the flue gas cleaning required. The other is to enhance and develop new methods to effectively clean the emissions in an affordable manner. However, the cost of developing these technologies is too high, but it is a worthwhile investment.

CCS is a technology that can capture up to 90% of the carbon dioxide emissions produced from the use of fossil fuels in electricity generation and industrial processes, preventing the carbon dioxide from entering the atmosphere. Furthermore, the use of CCS with renewable biomass is one of the few carbon abatement technologies that can be used in a 'carbon-negative' mode and actually taking carbon dioxide out of the atmosphere (Di Gianfrancesco, 2017).

The CCS sequence consists of three important parts:
- Capturing and separation of the carbon dioxide;
- Compression and transporting the carbon dioxide;
- Securely storing the carbon dioxide emissions underground in depleted oil and gas fields or deep saline aquifer formations.

9.2 Lessons from Canada's Clean Energy Transition Experience for South Africa

Although Canada has one of the most developed economies, it has huge coal reserves which are used for domestic use and also exported to other countries. In the case of Canada, only 10% of electricity is generated through coal-fired-plants and plans are afoot for the phasing out of coal-fired power generation by the Government of Canada. Consequently, the energy produced by coal will be eliminated by 2030 but coal will still be used for metallurgical processes. The other major sources of electricity in the country include hydroelectricity, natural gas and the renewables such as wind power. In Canada the Carbon Capture Storage (CCS) technology is operational on a large scale. The few lessons that can be learnt from the Canada energy transition experience are as follows:

- Canada developed comprehensive research and took stock of levels of CCS implementation across the world and successfully implemented the technology on the commercial stage.
- Canada saw huge investments from both private and government on clean energy projects.
- In 2015, there was a launch of the Quest Project in Canada to capture the carbon from coal-fired power stations. This was meant to ensure coal-fired electricity generation remains part of the energy mix.
- The country is investing reasonably in competitive clean energy technologies year-on-year and Canada's companies have capacity to undertake cutting-edge energy research. The country is fostering a favourable business environment for investments in innovative clean technologies.
- Canada took gradual steps in ensuring the feasibility of implementing the clean coal technologies, guarding national energy priorities.
- As the transition to clean growth and climate change takes place, the country works in collaboration with indigenous peoples, guarding jobs through skilling.
- There is an energy strategy for Canada's provinces and territories which ensures that each region use its resources (such as wind or solar capacities) for meeting its energy needs.

It seems from Canada's experience that moving from fossil energy sources to renewable energy sources requires planning and gradual implementation of other clean energy sources while still meeting the country's energy needs.

10. Key Recommendations for NUM

A number of years have passed since NUM took a position on South Africa's energy policy and direction. Many developments have since taken place. It is important, therefore, for the Union to re-visit its position on the country's energy policy and planned transition, given the latest information at its disposal. From this research study, the following recommendations are put forward for consideration by the Union:

1. *Nuclear Energy:* The previous position held by NUM was that the Union could not support the country taking a nuclear energy direction. This position was based on costs and safety considerations regarding nuclear energy generation. If the cost, safety and other process are addressed, nuclear energy can prove an important stimuli to the economy of South Africa. As such, nuclear energy needs to be part of the energy mix for South Africa. However, more research still needs to be done and factual information sought on how to address costs and safety issues of nuclear energy before the Union endorses it unconditionally.
2. *Coal Energy Generation:* Given the number of South Africans who directly and indirectly depend on coal mining and coal for energy generation, NUM should advocate the continuation of coal energy generation. However, to deal with the climate concerns pertaining thereto, the Union should lobby that resources are channelled towards the application of Clean Coal Technologies in coal-energy generation.
3. *Renewable Energies:* In general, NUM should cautiously support renewable energy as part of the country's energy mix as they are environmentally friendly. However, the interest of workers and communities should not be compromised by the introduction of renewable energies. In this regard, renewable energies should be supported in cases where they do not substitute but rather complement other energy sources that are sustaining jobs. Specific to wind energy, it is recommended that it should be encouraged in areas with high wind speed and where it is sustainable and cheap.

Overall, energy transition in South Africa needs not to be rushed. The country should set its own timeframes based on domestic circumstances and aspirations. There should be a deliberate effort to make sure that the transition does not threaten the survival of citizens whose livelihoods are dependent on the existing energy sector setup.

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