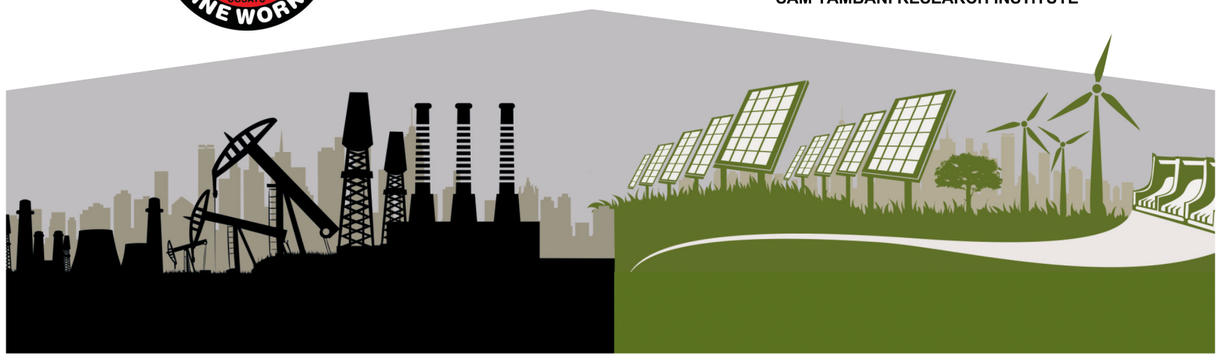

Energy Mix Choices And The Protection Of Workers' Interests In South Africa

Discussion Paper: NUM Central Committee

June 2017

SATRI
SAM TAMBANI RESEARCH INSTITUTE

No 3 Rissik Street, Cnr Albert Street
Alris Building, 2nd Floor, Johannesburg 2000
Po Box 32202, Braamfontein 2017
Tel: 010 593 7238 * Fax: 011 442 0814
Email: leratom@satri.org.za
Website: www.satri.org.za

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1 Introduction

In March 2011, the South African Government through the Department of Energy (DoE) published the Integrated Resource Plan (IRP) 2010-30. The plan, according to DoE, was aimed at ensuring 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. However, since the IRP release, a number of changes have taken place in the energy sectors, including changes pertaining demands and use of energy, hence the government has invited public comment and input to the IRP.

The recent power shortages and subsequent load shedding experienced by the country, on one hand, and the increasing recognition of the climate change problem have brought home the fact that the South Africa requires a mix of all possible energy sources to meet its energy demand. Moreover, it has to do so while cutting down on its carbon dioxide emissions, emanating especially from coal burning power generation and whilst ensuring that the price of power remains affordable.

Due to an increase in the consumption of electricity, which is expected to be twice the current levels by 2030, the country faces the challenge of establishing sustainable energy systems in the face of climate change (Kiratu, 2010). These pressures imply not only generating more electricity, but ensuring that energy efforts are steered towards a lower carbon future and underpinned by attention to issues of equity and justice.

This discussion paper describes the current energy situation in South Africa, existing and emerging challenges and opportunities from labour perspective. It attempts to bring together available information on the current employment trends, health and safety implications, the costs and linkages to other sectors of different energy sources. The purpose of this paper is not to propose particular choices or solutions, but rather to make available to the National Union of Mineworkers some background information and analysis on the energy choices confronting South Africa and the possible effect to workers of specific choices.

This paper's information is drawn mainly from the presentations and discussions that took place at the NUM/SATRI Energy Symposium that took place in May 2017. Although the Symposium raised a very wide range of influences and pressures on energy choices, the paper maintains a focus on the more factual labour-focused issues underpinned by pursuing energy sources, not only for greater energy security and or environmental considerations, but also for the socio-economic development. The employment dimension of the energy sector is given ample attention.

1.1 Purpose of the paper

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 industry closures. It is the working class that lose stable, quality jobs and mostly forced into insecure jobs, early retirement or long-term unemployment when the structure of an economy changes. These negative impacts to jobs are likely to be felt in South Africa where majority of workers are unskilled, and many rely on energy sector as their employer, with the planned transition to a clean energy economy.

The National Union of Mineworkers is aware that the transition from coal fired power stations to other power generation sources has been identified as fundamental to achieving emissions reduction targets. But there are no plan of action on part of government on how to manage potential job losses, transitioning of workers in the coal-fired electricity sector into other secure employment and\or create new industries in coal mining regions and communities such that they do not become ghost towns.

The National Union of Mineworkers had previously taken a position against nuclear energy inclusion in the energy mix based on the above concerns. The decision at the time was not supported by prior research to gather the prerequisite factual information. Questions are being raised now whether the NUM position on nuclear energy production in the country should be maintained and whether the reasons behind the positon are still relevant.

The union recognises that moving to a low carbon economy will require huge financial and technical resources, which will consequently affect workers and especially the poor. So it is vital that this is done in equitable ways which seek to create jobs, new industries and which are more sustainable. For the NUM a 'Just Transition' should involve a comprehensive effort to support coal communities and workers as the country shifts away from greatly relying on coal-fired electricity to one that is more sustainable and equitable.

The 'Just Transition' requires careful consideration of the wider effects to society of each energy source. With this recognition, the NUM in its 2016 Central Committee took a resolution, and mandated the union to conduct research that will inform its position on nuclear energy among other energy sources. Following the 2016 CC Resolution, a team comprised of NUM National Office Bearers, Sector Coordinator, the Branch Chairperson and, Fulltime Shop Stewards based at Koeberg Power Station, National Youth Forum Representations, Energy Task Team Member and COSATU Representatives was formed to action the resolution.

The team undertook a three-day study tour in July 2016 to the Department of Energy, NECSA in Phelindaba, Koberg Power Station in Western Cape and to nuclear waste disposal site at Springbok, Northern Cape that focussed on nuclear energy generation. This study tour was just the first step taken by the Union in understanding performance dynamics pertaining to different types of energy sources and their implications on employment, cost, environment and safety in the workplace. Other study tours targeting renewable energy and fossil fuel energy are to follow.

This discussion paper is part of the broader initiatives to action the 2006 Central Committee Resolution on energy issue. Its purpose is to contribute to the debate on whether NUM position on energy choices of the country, as a whole, need to be maintained or revised in the medium to long term given the new development happening in the country's energy sector.

1.2 Current energy situation in South Africa

According to the Department of Energy, 92% of South Africa's electricity is generated from coal, with the remainder generated from nuclear energy (5%) and other sources (3%). This has led to the country accounting for 39% of emissions on the continent. (Inglesi-Lotz & Blignaut, 2011).

Since the 2008 energy crisis, the government has started taking renewable energies seriously and has put more effort in enhancing the promotion of energy efficiency so as to meet the energy demand, at the same time reducing carbon emissions and creating jobs. However, there is still a long way to go in meeting the renewable energy targets.

The government emphasizes that there is no intention of doing away with coal as the source of energy, however it is determined to find cleaner technologies for the benefit of the environment. The government's long term master plan in terms of energy include gas, petroleum, nuclear, hydropower and other sources as part of the energy mix. According to government, job creation will be central to its future energy mix plans.

It is important to note that efforts to increase and stabilise energy supply have produced positive results. The first unit of Medupi became operational in 2015, adding 800 MW to the grid. Other notable achievements include the commercial operation of the SERE wind farm in the Western Cape, which saw 100 megawatts added to the grid.

South Africa has also embarked on diversifying its electricity supply with the success of its renewables independent power producers programme. The 2014 United Nations Environment Programme (UNEP) put SA among the top 10 countries for renewable energy investments. Private sector investment in clean energy will see 4000 megawatts added to the national grid. The government has also commenced with the procurement of 2400 megawatts coal fired energy from the private sector.

1.3 Energy mix of the future

The South African government has already set important targets for the country future energy mix and its composition. The IRP states that, 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.

If the term 'security' is broadly defined, there are indeed many trends and developments that make the South African energy problems seem complex and unpredictable. They include the

recent power shortages, employment and job creation as well as health and safety of the people. The employment trends vary widely across various energy sources.

The renewable energy sector as a whole has been identified as a sector that could significantly create jobs. It is estimated that about 36,400 to 78,000 new direct jobs as well as about 462,000 indirect jobs could be generated depending on the time frame and the level of renewable energy and its energy-efficient technology penetration (DOE, 2015). Sound information on renewable energy employment is essential to enable informed policy choices. It is however important to note that there is a need to go into details on these impacts. Furthermore, there is a need for high quality data to support the union in identifying the benefits of these energy source to the wider labour movement with reliable facts and figures.

The employment analysis shows that although South Africa will gain in employment overall from a switch to a low carbon energy supply, it is likely to experience job losses in coal mining in a carbon constrained world. The enhanced manufacturing scenario demonstrates that employment in renewable technology manufacturing has the potential to exceed the jobs lost from declining coal exports.

According to Greenpeace, jobs in the coal industries are going to be unreliable whether or not South Africa takes strong action to reduce greenhouse emissions. This would be mainly because the rest of the world is likely to abide to the carbon footprint constraints, thereby affecting the export jobs which accounts for more than 15% of the jobs in the energy sector. Despite the job losses in the coal industries, Greenpeace however believes that there will be more jobs created from the renewable energy sector if South Africa implement strong policies in support of renewable energy industries.

It is important to emphasise that assertion of Greenpeace on coal sector employment have not been verified independently. In fact they are not verifiable at moment as they are just speculations about the future. What is true though is that whereas job losses in the coal sector will be real, those expected from the renewable energy are hypothetical. Hence organised labour need to not buy in into the rhetoric that the renewable energy sector will create more jobs than those currently existing in the coal sector.

The following section focuses the specific characteristics of the different energy sources in the mix especially on those aspects that have a bearing on the interests of workers.

2 Characteristics of different energy sources in the energy mix and their relationship with workers interests

2.1 The coal energy sector

2.1.1 Coal energy supply

South Africa's electricity supply is dominated by coal-based electricity through Eskom. Eskom supplies about 95% of South Africa's electricity. The largest portion of Eskom's generation mix is coal-fired base load power (IEA, 2016). The South Africa's energy needs are heavily depended on coal generated electricity. Coal has traditionally dominated the energy supply

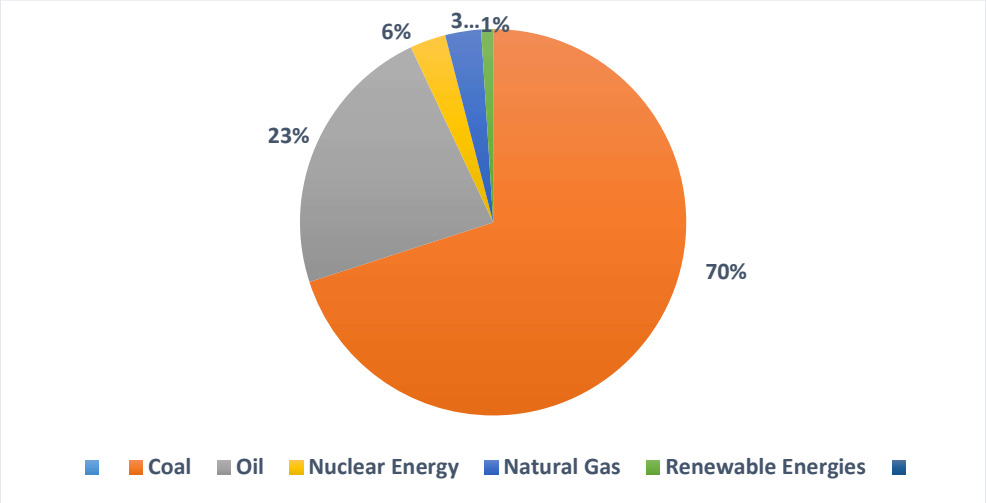
sector in South Africa, from as early as 1880 when coal from the Vereeniging area was supplied to the Kimberly diamond fields. Currently, about 77% of South Africa's primary energy needs are provided by coal (Eskom, 2017; TIPS, 2017). This trend is unlikely to change significantly in the next decade, due to the relative lack of suitable alternatives to coal as an energy source (Eskom, 2015; IEA, 2014). Coal is the essence of the South African economy. The crucial role played by the coal reserves in the economy is illustrated by the fact that Eskom is the 7th largest electricity generator in the world, and Sasol the largest coal-to-chemicals producer. South Africa's coal reserves are estimated at 53 billion tonnes. Thus, with the present production rate there should be almost 200 years of coal supply left.

Furthermore, coal-based electricity is expected to grow in megawatt of generation capacity, due to the fact that construction of the two large-scale Medupi and Kusile power plants are nearing completion. Similarly, coal-based electricity generation is planned to increase over the 2010-2030 period from 235 gigawatt-hour (GWh) to 295 GWh per annum over the 2010-2030 period (DoE, 2011).

South Africa has abundant coal reserves. In addition, it has been established that the coal-fired power stations are reliable. South Africa's infrastructure to generate electricity from coal is also well established. Some have argued that burning coal is the most cost-effective and energy efficient way of generating electricity in the country. There is a down side for power generation through burning coal. These form the basis for the need to change energy mix. The coal has the most waste difficulties of all energy sources in South Africa. The waste includes sulphur and nitrogen oxides, organic compounds, heavy metals, radioactive elements, greenhouse gases and a lot of ash. More so, the construction of coal-fired power station is viewed to be expensive process (IEA, 2014; Greenpeace, 2016).

Internationally though, coal is still the most widely used primary fuel, accounting for approximately 36% of the world's electricity production. This situation is likely to remain until at least 2020 (Eskom, 2016). In line with the global picture, coal based electricity contribute more on energy consumption mix in South Africa as presented in Figure 1.

Figure 1: Primary Energy Consumption in South Africa



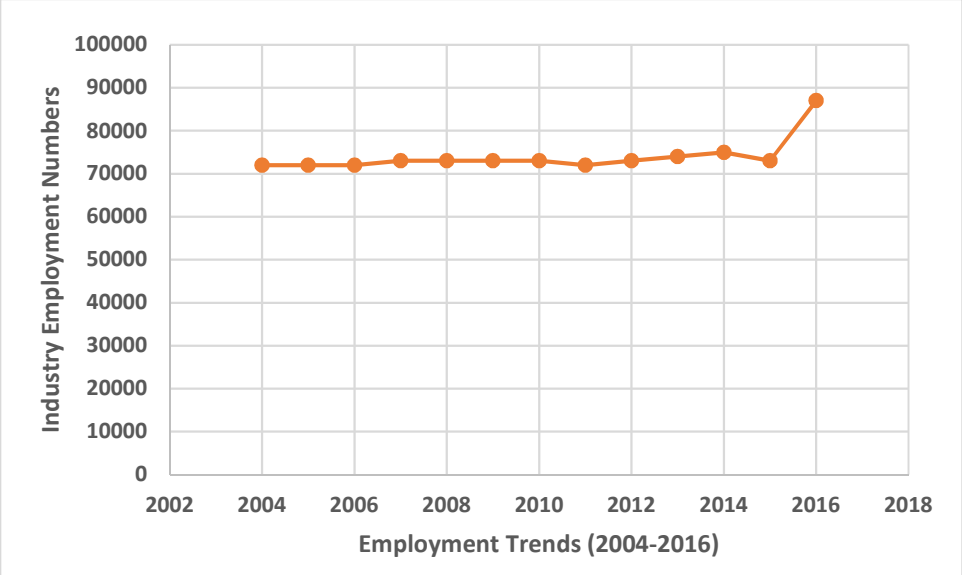
Source: DMR, 2015

2.1.2 Coal sector employment

South Africa is regarded to be the emerging economy. However, it is facing number of socio-economic problems. There is high unemployment, inequality and persistent poverty. As such, these challenges makes job creation a critical priority for the country. The government's '5 million jobs' target highlight the importance of job creation.

The energy sector is an important employer, providing a total of 250 000 jobs in South Africa while electricity employs around 45 205 (StatsSA, 2015; Rutovitz, 2010).Coal sector only employs some 87,500 people. It is the third largest employer in the mining sector after gold and platinum group metals (Chamber of Mines, 2016). In addition, there has been small gains for 'coal and lignite' for new 6000 jobs that were created recently (StatsSA, 2017). Figure 3 summarises the overall employment trend in coal mining sector from 2004 to 2016.

Figure 2: Coal Industry Employment (2004-2016)



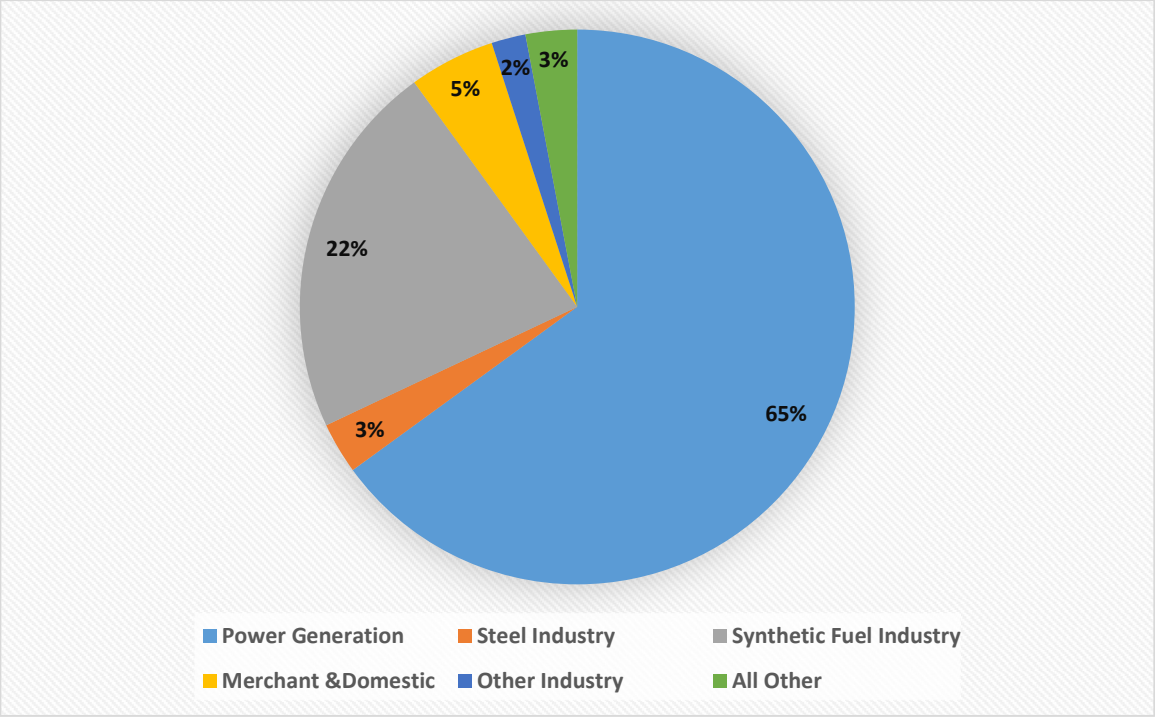
Source: Chamber of Mines Statistics (2016)

Globally, there is a trend for decreasing employment in coal mining (Greenpeace, 2009). Employment per ton in coal mining has fallen sharply over the last twenty years in South Africa too, with an average decline of 5% per year. This pattern is repeated in the whole world, and is projected to continue during the next two decades, irrespective of which energy path is followed (Rutovitz, 2010). In addition, world demand for coal over the next decades will be determined by international agreements on climate change. This is crucial for coal sector. In which case it may result in action proportionate with that required by science to stop catastrophic climate change.

World demand for coal may be expected to decline significantly (Rutovitz, 2010). If this happens, it will means that jobs in the coal sector in South Africa may be lost. Some jobs in the sector may be saved as long as the domestic demand for coal remain steady (Refer to Figure 4). The threat is that many jobs could be lost when demand for coal drop remains though. The situation could be exacerbated by the actions of Eskom domestically. The media

reports revealed that Eskom planned to decommission more than four power stations (Moneyweb, 2017). It has been reported that the power utility will be 'phasing out' the Kriel, Camden, Hendrina and Komati power stations in Mpumalanga over the next five years – possibly putting thousands of jobs at risk. The unions organising in energy and mining such as NUM, NUMSA, made an emphatic call that they oppose the move as thousands of jobs will be lost (Moneyweb, 2017; Citizen, 2017; TimesLive, 2017).

Figure 3: Domestic Coal Consumption in South Africa



Source: DMR 2015

2.1.3 Coal-fired Power Station vs Climate Change

Climate change is possibly the greatest threat the planet faces. Efforts are been bolstered to respond to the problem. Overall, the increased concentration of greenhouse gases (including CO2) in the earth's atmosphere, due to human industrial activities and coal power generation contribute to the climate change. South Africa's heavy coal usage makes it the highest CO2 emitter on the African continent. Equally so, the emissions could be on a sharp upward trajectory due to the building of Medupi and Kusile coal power stations (IEA, 2010). This implies that the country contributes excessively to climate change.

Currently, South Africa's greenhouse gas emissions are still high with more than 90% of the country's electricity coming from coal, no change maybe in the nearer (DOE, 2010). Under these circumstances, the country is caught up in two realities that is meeting its energy needs while also complying to cutting the greenhouse gases.

2.1.4 International Lessons: China

In China, coal plays critical role for its energy needs. This is similar to South Africa. Coal supplied the majority (nearly 66%) of China's total energy consumption in 2012. Although China has made an effort to diversify its energy supplies, hydroelectric sources (8%), natural gas (5%), nuclear power (nearly 1%), and other renewables (more than 1%) still account for relatively small shares of China's energy consumption (IEA, 2016; US EIA, 2015).

According to Energy Information Administration (EIA), the Chinese government plans to cap coal use to 62% of total primary energy consumption by 2020 in an effort to reduce heavy air pollution that has afflicted certain areas of the country in recent years (EIA, 2015). China energy sector is dominated by coal-fired electricity similar to South Africa. However, China is not expected to eradicate coal-fired power from its energy mix overnight. In essence, China is greening its coal fleet. Clean Coal Technologies are seen as the way towards greening coal energy. The country has been steadily shutting down the nation's older, low-efficiency, and high-emissions plants to replace them with new, lower-emitting coal plants that are more efficient. Approximately 19% new plants use ultra-supercritical technology, 25% use supercritical technology, and 56% use ultra-supercritical technologies (CAP, 2017).

2.1.5 Threat to Jobs in Coal Sector

China employs more than 6 million people in the coal business. However, the industry is expected to cut 1.3 million jobs in the coal mining due to government announcement of shutting more coal mines and avoiding to approve new coal mines (Mining, 2016; Bloomberg, 2016). As the operations in coal power stations, become high tech, they become cleaner and more efficient, and the jobs decrease as well. For this reason, it is expected that coal sector will lay off 1.3 million workers from 2016 to 2020. Chinese government view renewable energy as a much more dependable employment generator; they expect the nation's renewable sectors to generate 13 million new jobs by 2020 due to China's energy employment shifts (CAP, 2017).

Ultimately, a deeper research on how China is dealing with challenges pertaining to coal energy generation taking into account the specific difference between South Africa and China would be useful in guiding organised labour how to maintain employment in the sector while at the same time managing climate change concerns.

2.2 Nuclear Energy sector

Historically, the construction of Koeberg started in 1976 and Unit 1 was synchronised to the grid on 4 April 1984, with Unit 2 following suit on 25 July 1985 (Eskom, 2015). In general, Koeberg is the only nuclear power station in Africa and it has pressurised water reactor (PWR) design. It boasts of the largest turbine generators in the Southern Hemisphere and is the most southerly-situated nuclear power station in the world. Koeberg ranks amongst the safest of the world's top ranking PWR's of its vintage and is the most reliable Eskom power station.

Koeberg Nuclear Power Station is contributing approximately 6% of South Africa's electricity generation (DOE, 2010). The station has been vital for grid in the Cape, having operated for more than 25 years. The demand for energy is increasing in South Africa with the growing population and growing economy. Nuclear energy is therefore seen as also one of the solutions to meet increasing demand of energy in the country.

2.2.1 Employment Trends in the nuclear energy sector

According to Eskom, there are approximately 1 200 employees at the nuclear station. However, there is on-going opposition to the roll out of nuclear energy plan. The opposing views to nuclear generation have been gaining momentum. The alternative being suggested is that of renewable energy generation. On the other hand though, the commitment to the construction of the nuclear power stations was made by the country based on government policy guided by the need to reduce risk exposure to future fuel and renewable costs. It is project that the nuclear energy comes in as a base-load option from 2023 (IRP, 2010).

The job creation projections made by the Russian nuclear company, Rosatom, which is bidding for South Africa's nuclear build project, is high but data on specifics of the jobs to be created is sketchy. There is a likelihood that the job projections indicated by Rosatom may be exaggerated.

Table 1: Nuclear Plant Construction Jobs Prospects

Project Level	Job creation Estimates	Year of estimates
Through Procurement	15, 000	2013
Supporting Industries	100,000	2013
New Estimates: Project Level	Job Creation Estimates	Year
Direct jobs	5 760	2017
Supporting Industries	70,000	2017

Source: Alternative Information &Development Centre (AIDC) 2017

It is contended that nuclear power plants do not create many jobs. International experience reveal that 10 000 people or more may be employed during the temporary construction phase of a nuclear power plant though. During the operational phase, only a small number of mainly highly-paid, skilled workers get employed (Table 1). This observation may not hold for South Africa. The South African experience indicate that the operation phase of nuclear power generation can still utilise low skilled workers. NUM, for example, organizes more than 700 members in the nuclear power plants in South Africa and not all these jobs are high skilled jobs.

It is a fact, nonetheless that South Africa is facing high unemployment rate, as such, the concern that nuclear energy generation may not create significant employment opportunities remains. It is undisputable that nuclear power plants are not labour intensive. The reality is that nuclear energy has a potential to contribute to the country's energy security putting job creation concerns aside.

2.2.2 Nuclear Energy Debate

South Africa is currently embroiled in heated debate in the public discourse about nuclear energy roll out programme. On April 26, 2017, the High Court ruled that government's nuclear plans were invalid (Moneyweb, 2017). This was a victory for those opposing the nuclear power plants but a terrible blow to the government nuclear aspirations. The South African government considers nuclear power as critical for the energy mix in the country. But the on-going debate on whether nuclear power is the right solution for South Africa's energy needs has stalled government's intentions. To some nuclear industry experts, this is the wrong question to ask. The Nuclear Industry Association of South Africa (NIASA) asserts that; "Nobody in nuclear is saying that we should only be focusing on nuclear; we are saying that South Africa needs an energy mix where nuclear forms part of that mix. In that diversified portfolio of energy assets, 17.8GW has been allocated to renewables and only 9.6GW will be allocated to nuclear. We are saying that South Africa needs an optimum mix'' which must include nuclear energy (Africa Energy Indaba, 2016).

There is no consensus on either nuclear energy programme will rescue the country from energy problems or not. Opponents of the nuclear energy suggest it is going to indebt the country, and no more meaningful jobs will be created. However, proponents of nuclear energy believe that the energy will create jobs based on the assumption that 70% of the nuclear build programme inputs will be sourced locally in value. The local sourcing will bolster the nuclear industry role in the overall domestic economy, boost skills, lead to construction of new industries and consequently create employment (Nuclear Industry Association of South Africa (2016). Accordingly, South Africa's energy generation mix by 2030 is expected to include: 48% of coal 13.4% of nuclear, 6.5% hydro, 14.5% other renewables and 11% peaking open cycle gas turbine (IRP, 2010). In this regard, nuclear energy contribution to energy generation in South Africa will be increased from its current 6% to 13.4 % by 2030.

2.2.3 Labour position on nuclear power

The labour movement under Cosatu opposed the government plans to build nuclear power stations. COSATU clearly reiterated concerns the National Union of Mineworkers raises in relation to nuclear energy programme. The first is related to the exorbitant costs associated with construction of nuclear power plants. The process of generating nuclear energy is capital intensive. It is estimated that the new nuclear reactors may cost the country close to R600b (Eskom, 2017); other sources claim that the figure may be as high as R1trillion. It is also pointed out that nuclear energy will create a number of health and environmental risks for the working class. Last but not least, nuclear waste remains radioactive for a number of years (Cosatu, 2015). Following the nuclear accident in Fukushima, Japan in 2011, many are sceptical of further development of nuclear energy fearing it puts lives at risks.

The safety of nuclear energy and waste management is a point of debate though. Proponents of nuclear energy argue that nuclear stations operate under strict regulations and safety

measures agreed upon internationally. The Nuclear Energy Act of 1999 of South Africa gives responsibility to the Minister of Minerals & Energy for nuclear power generation, management of radioactive wastes and ensuring safety of workers. In that case, South African Nuclear Energy Corporation (Necsa) is a government corporation established from the AEC under the Act, and is solely responsible for most nuclear energy matters including wastes and safeguards, but not the power generation (World Nuclear Association, 2017).

Despite strong regulation through international treaties, organised labour still argue that workers get exposed to radiation, suffer occupational diseases and that there is a possibility of under reporting safety bleaches in the sector. In all, organised labour is still not convinced about the appropriateness of nuclear energy for South Africa.

2.3 Renewable Energy in South Africa

According to Petrie (2013) improving energy access through sustainable energy choices will create jobs, not emissions in the South African economy. This means that, contrary to popular belief, greening the South African economy is far more likely to benefit than to slow down socio-economic local development. One way of greening South Africa's economy is to reduce its dependence on high polluting coal. Coal contributes about 65.7% of the country's primary energy and more than 90 percent of its electricity, followed by approximately crude oil 21.6%, 7.6% renewables and less than 1% of South Africa's electricity comes from renewables, and wastes, 2.8% gas, 0.4% Nuclear and 01% Hydro (Energypedia, 2015).

The energy industry is changing, so embracing and accessing available renewable energies, clean resources among others wind and solar power and improving use of biomass will create additional sources of energy for the industry and households alike. This will also build demand for new skills, jobs and enterprises. South Africa is in dire need of more energy and the poorest households tend to be the poorest in terms of energy access, too. To meet its energy needs, South Africa has to use the energy available to it, in different proportions.

With the building of coal-fired power plants such as Medupi and Kusile, the South African government emphasizes that they have no intention of doing away with coal as the source of energy. The government is determined to find cleaner technologies for the benefit of the environment. Its long term master plan in terms of energy include gas, petroleum, nuclear, hydropower and other sources as part of the energy mix.

2.3.1 Progress in use of renewable energy sources

Since the 2008 energy crisis, the South African government has started taking renewable energy sources seriously and has put more effort in enhancing the promotion of energy efficiency so as to meet the energy demand, at the same time reducing carbon dioxide emissions and creating jobs. The South African government has developed a long-term plan to ensure that the country's future energy needs are met through the provision of an energy mix. There has been some progress over the past few years, since the promulgation of the

Integrated Resource Plan for Electricity (IRP) 2010, in executing the renewable energy programmes identified in the plan (DoE, 2013).

In 2009, South Africa created its world leading Renewable Energy Independent Power Producer Procurement Programme (REIPPPP), which put in place a target of 10 000 gigawatt hours of renewable energy; targeting onshore wind, concentrated solar thermal, solar photovoltaic, biomass solid, biogas, landfill gas and small hydro power plants. By May 2012, the government had approved 19 wind, solar and hydropower proposals worth R73-million to help boost clean energy.

Since 2011, the Department of Energy had procured the renewable electricity in bid windows 1 to 4 of the REIPPPP and connected 37 projects, with a capacity of 1 827MW, to the national grid. On average, 15% of this energy was delivered to the power system during system peak periods, alleviating pressure on the power system. The Department of Energy envisaged the energy contribution to grow to approximately 7 000 gigawatt hours a year with the first 47 renewable energy independent power producers fully operational and producing at full capacity by mid-2016 (DoE, 2013).

By April 2015, the Department of Energy had approved 79 REIPPPP projects with 5 243MW being added to a national grid desperately in need of power, at a capital cost of R168-billion. The project winners had to supply their own capital. About 40% of the capital spend was on local content and thousands of jobs have been created (Brand South Africa. 2016).

South Africa is succeeding in diversifying its energy mix through its renewables Independent Power Producers programme. Private sector investment in clean energy has seen more than 6000MW of renewable energy projects awarded under the government's REIPPP. Thus far, 1800MW of renewable energy power has already been connected to the national grid. Further determinations for the rollout of renewable energy will see an additional 6300MW being procured as well as new determinations for gas to power, co-generation and coal based load (Brand South Africa, 2016).

As a result, more significant investment is needed for renewable energy and energy efficiency because the energy mix is what South Africa currently needs. It is fortunate that the country is in better position in terms of the availability of resources. There is however still a long way to go in meeting the renewable energy targets and large-scale power plants as well as technologies such as solar roof-top photovoltaic and biogas, which has not been fully tapped into (Energypedia, 2015). Moreover there are shortcomings to renewable energy pertaining to its base-load capacity. Its base load capacity is still very low compared to non-renewable energy sources. In order for renewable energy to replace coal-fired electricity in the country, there must be large scale investment in the renewable energy projects, the extent of which has not been authoritatively established. At moment renewable energy generation lacks base- load capacity to replace coal-generated energy.

2.3.2 Green Jobs

Energy-poor locations in South Africa are also job poor and those with no or low incomes cannot always afford monthly electricity bills. Energy poverty is due to limited access to the national electricity grid, an inability to pay, or both. The implementation of rural, sustainable energy access projects in the poorer regions of South Africa can create jobs, while also reducing carbon emissions. These projects demonstrates that communities can make their own energy choices, attract investments and open up job and enterprise opportunities to support their energy choices (Petrie, 2013).

Moreover, manufacturing can seldom be localised, but jobs can be created in installation, maintenance, sourcing resources and delivering spare parts. Solar water heaters, for example, require electrical and plumbing skills for installation and repair, and generally require annual maintenance (One World Sustainable Investments, 2010). On the other hand Rutovitz (2010) indicates that, at a theoretical level, local jobs can be created from decentralised energy projects. But because South Africa's electricity supply is almost 100 per cent centralised, this theory may not apply.

A study conducted by AGAMA (2003) of the long-term job potential created in South Africa through implementation of solar, wind and bioenergy for electricity and energy services compared job opportunities to the job creation potential in the conventional energy sectors. The study found that if an additional 62 TWh was generated by new coal-fired plants, around 43,000 new jobs would be created. But if it were generated by the renewable energy technologies alone, around 57,000 new direct jobs would result.

AGAMA (2003) further reveals that with just 15% of South Africa's generation of total electricity use through renewable energy technologies in 2020, South Africa will be able to create 36,400 new direct jobs with no retrenchment from the coal-based electricity. If a portion of South Africa's total energy needs, including fuels, were obtained with renewable energy technologies, over 1.2 million direct and indirect jobs would be created. This is because generating electricity from renewable energy technologies is more intense and requires more people compared to generating electricity from conventional energy sources. Also because generating electricity from renewable energy technologies is not limited to only highly skilled people as in the case of conventional energy generation. Since renewable energy is not regionalized, there is even bigger opportunities for job creation in rural areas where unemployment and poverty rates are very high.

The Department of Energy (2015) shares the same sentiments as AGAMA, that the renewable energy sector as a whole has been identified as a sector that could significantly create jobs. It is estimated that about 36,400 to 78,000 new direct jobs as well as about 462,000 indirect jobs could be generated depending on the time frame and the level of renewable energy and its energy-efficient technology penetration. However, the challenge in South Africa is that the country is short of approximately 12,600 industrial and mechanical engineers and technologists, 5,000 electricians and 7,000 specialist managers. Professionals in the training and development as well as the human resources sector also lacks. It is therefore the responsibility of the public and private sector to develop these skills to workers in order to realise the potential of the renewable energy sector.

Earthlife (2009) supports AGAMA and the Department of Energy that renewable energy sources have the potential to create significant jobs in South Africa. Below is a table of estimated job creation through renewable energy technologies in South Africa by 2020.

Table 2: Direct and indirect jobs from renewable sources in 2020

Technology	Direct Jobs	Indirect Jobs	Total Jobs
Solar thermal	8 288	24 864	33 152
Solar Photovoltaic	2 475	7 425	9 900
Wind	22 400	67 200	89 600
Biomass	1 308	3 924	5 232
Landfill	1 902	5 706	7 608
Biogas	1 150	2 850	4 000
Solar Water Heaters	118 400	236 800	355 200
Biofuels	350 000	350 000	700 000
TOTAL	**505 923**	**698 769**	**1 204 692**

Source: (Earthlife, 2009)

However, other commentators suggest that although some renewable energy policy frameworks are in place and some work has been done to analyse the jobs, enterprises and skills needed to integrate renewables into the economy, no formal policies exist that specifically and exclusively address green jobs and green skills. The reliance on market drivers is proving to be inadequate and if renewable energy options are going to help with growing energy demand then a more attentive approach to integrating this emerging industry into South Africa's social and political economies is what is needed.

The commentators admit that references to green jobs have recently begun to emerge in policy. But the different policy frameworks are not well aligned, either between sectors and ministries or between national, provincial and local government policies and practices. Therefore, it is very difficult, for example, to see the links between the Industrial Policy Action Plan, which is all about industrial development for job creation, and the Integrated Resource Plan, which in turn is about ensuring energy for development.

Petrie (2013) adds by suggesting that unless attention is focused on skilling communities up to access the large and small-scale energy options available to them, directly or indirectly, these will be lost opportunities and unemployment figures will continue to rise. In that case policy alignment is critical to achieving this. Alignment between the Industrial Policy Action Plan and the Integrated Resource Plan and government job creation policies under South Africa's industrial policy is recommended.

SCIELO (2013) echoes Petrie (2013) sentiments that green economy is not all about positive outcomes, some people will gain while others will lose. Those in fossil-fuel based industries are the ones bound to lose due to the minimization of the industries' activities that emits greenhouse gases. It is therefore important that the balance between job losses in

environmentally unfriendly industries and job opportunities in green industries be considered when calculating the net effect. Another factor that is important to consider is the time frame of green job growth. This is because many jobs may be created in the short term in the construction, manufacturing and installation phases of different green technologies.

It should be pointed out that some research suggest that renewable energy has potential to create many sustainable jobs but on condition that there is huge deployment of financial resources towards expansion of renewable energy. Currently, the support for renewable jobs is based solely on projections and international comparisons. In South Africa, the coal sector still employ more workers than any other energy sources.

2.3.3 Cost of renewables energies

Numerous studies and analyses have been done in South Africa to calculate and analyse the cost of energy generation through various renewable energy technologies.

Most notably, after only five years of government support, renewable energy technologies have proved increasingly cost-competitive, reaching levels, similar to, if not lower than, coal-fired power plants (Department of Energy, 2016).

According to World Wide Fund for Nature (2014), from 2011 to 2014 wind and solar PV reached pricing parity with supply from new coal-fired power stations from a levelised cost of electricity (LCOE) perspective. LCOE represents the cost per kilowatt hour of constructing and operating a power plant over a specified lifecycle, taking into account factors including cost of capital and the anticipated plant load factor. Then in terms of the REIPPPP, it is reflected by the bid tariff, which recovers plant cost over a 20 year Power Purchase Agreement (PPA) period.

In August 2013 bidding window 3, the average tariffs bid for wind and solar PV were R0,66/kWh and R0.88/kWh respectively, well below the estimates of R1.05/kWh for supply from the coal-fired Medupi and Kusile power stations (Papapetrou 2014). The average levelised cost of electricity supplied to the grid was R0.82/kWh in 2013. That means wind-generated power achieved pricing parity with the grid.

In addition, a study conducted by the University of Pretoria assessed what quantity of renewables could be purchased if it were possible to shift the external costs of investing in Kusile Power Plant which is a coal-fired power plant to renewables instead. Using the capital costs associated with various renewable options, as listed in the Integrated Resource Plan 2010-2030, the amount of renewable power generation that could be purchased was calculated. At its worst, the study found that it would be possible to develop no less than 500% of Kusile's proposed power generation capacity, assuming that renewable electricity generation capacity was funded from only 30% of Kusile's external costs.

The study went on to look at the length of time that it would take to equal Kusile's output using renewables with the money from the calculated true cost of the plant. Two estimates of the impacts of the opportunity cost of Kusile were calculated (Table 3), for a full estimate,

based on the full external and an extremely conservative estimate, based on 30% of external costs.

This means that if the South African government would shift investments to renewable energy, it would likely be able to recouple from the damage cost of Kusile within three and a half years, but at worst within 10 years if costs from water impacts were excluded. In other words, over its lifespan, the opportunity cost of Kusile is, at its most conservative, an installed capacity of 24 000 MW, but could be as high as 68 600 MW.

Table 3: Opportunity cost of Kusile Power Station

	MW capacity and MWh generated that would equal a total annual cost of:		Time it would take to equal Kusile's output	MW capacity and MWh generated that would equal a total annual cost of:		Time it would take to equal Kusile's output
	R31 174 million			R60 594 million		
	MW	MWh	Number of years	MW	MWh	Number of years
Wind	9 881	25 100 975	1.3	19 206	48 790 295	0.7
Concentrated photovoltaic (PV)	3 923	9 209 235	3.5	7 625	17 900 550	1.8
PV (crystalline silicon)	7 135	12 125 835	2.7	13 869	23 569 724	1.4
Forest residue biomass	3 967	29 540 823	1.1	13 869	57 420 298	0.6
Municipal solid waste	1 919	14 290 024	2.3	3 730	27 776 390	1.2
Concentrated solar power, parabolic trough with nine hours storage	2 882	11 032 313	2.9	5 602	21 444 178	1.5

Source: Greenpeace, (2008)

In a country with high energy demand like South Africa, renewables present a saving opportunity. This is a radical departure from conventional energy sources, which are more expensive source of energy (World Wide Fund for Nature, 2014)

It should be pointed out though that there is a gap in literature pertaining research on health and safety of renewables, their technology acquisition and management costs in South Africa. Hence the good story about renewable energies compared with coal generated energy has to be qualified in some cases.

Regarding overall comparative energy costing, the energy industry uses a standard model called the "levelised cost of electricity" to compare the costs of different energy sources. This is defined as the current cost of producing one kilowatt-hour of electricity from any given energy source (nuclear, coal or renewable energy). Currently, it is still cheaper to produce

coal-fired electricity in South Africa, compared to renewable and nuclear energy (DoE, 2016). Information on cost of generating energy from different sources is contested. Proponents of each energy source tend to claim that the particular energy source that they support is either cheaper to generate or will be becoming cheaper in the near future.

2.3.4 Energy from natural gas energy

Natural gas can be an energy source in a number of ways. These include electricity production, as distributed gas, as an alternate fuel supply to industry, or as a direct energy supply to the automotive industry. The South Africa natural gas energy source accounts for 3% of the energy mix (DMR 2015). It is however, important to note that recent development of regional gas-fields are expected to promote natural gas into becoming a more significant fuel in South Africa.

In the South African, the natural gas industry is still at a very early stage of development. However, there are several production and exploration projects underway as government seeks to exploit natural gas reserves (Jeffrey 2015). Unlike in the past, where coal was the most preferred choice of energy generation, due to its clean burning nature, natural gas has become a very popular fuel for the generation of electricity in some countries. However the practise of hydraulic fracturing otherwise known as fracking is a sensitive matter, and has affected natural gas energy generation progress.

2.3.5 Natural gas and employment

Proponents of natural gas argue that the development of a natural gas industry in South Africa has the potential to support a wide range of business segments in South Africa (Jeffrey 2005). He points out that natural gas industry can impact both upstream and downstream, along with adjacent industries. While total coal mining employment has declined globally since 2009 (Greenpeace 2009), it is believed that exploiting South Africa' gas reserves would result in significant job opportunities and contribute to the GDP.

Available information is not specific enough to allow for a complete comparison of the employment potential of the natural gas industry, but international experience does provide some insight. A detailed analysis of the potential employment of natural gas energy extraction was undertaken in California by means of an analysis of nineteen permit applications for proposed natural gas fired power plants. The study came to the conclusion that the number of jobs in a natural gas plant's construction, installation and operation phases would be reasonable.

In South Africa, not all the gas brought to land from the Kudu and Ibhubesi gas fields will be utilised in electrical generation plants. There are three categories of activities in which jobs may be created as part of natural gas exploration: a) drilling and testing of gas wells, b) developing of gas delivery system and c) the development of commercial markets ((AGAMMA, 2003).

However, in its discussion paper on fracking COSATU cautioned that proponents of natural gas as energy, usually heighten the potential employment. The discussion paper highlights a study in the USA that found that supporters of fracking have exaggerated the job benefits of horizontal drilling in the Marcellus and Utica Shale. While the industry has created jobs, particularly in Pennsylvania and West Virginia, the shale-related jobs numbers are far below what the industry claims (COSATU, 2014).

3 Issues of contention for labour regarding energy choices and way forward:

3.1 Nuclear energy

The position of organised labour under Cosatu is that it does not support energy generation from nuclear although some unions within Cosatu have expressed support for nuclear energy in their individual capacity. The Cosatu position is based on concerns on cost, health and safety, local job creation potential and to some extent who would be tasked to undertake such a massive undertaking.

There are, however, other factors that are not considered. For example, that South Africa has uranium as a natural resource. Hence, the use of uranium to generate energy would be a form of local natural resource beneficiation. Otherwise, the country will be condemned to be perpetually an exporter of uranium, which is vulnerable to price fluctuation that characterises unprocessed natural resources exports.

Second, proponents of nuclear energy indicate that for each of the identified areas of concerns – cost, health and safety, job creation, there are solutions. Where the exact solutions are not available, the risks involved can be reduced to minimal and comparable to other conventional energy sources.

Against this background, organised labour has to carefully engage with the question of the country generating energy from nuclear sources after careful consideration of advantages and disadvantages in both the short and long term. At the end of the day, organised labour has to decide whether its current stance of not supporting nuclear energy would be for ever, or whether if its concerns on nuclear energy production are addressed satisfactory, it can and would change its position on nuclear energy.

3.2 Renewable energy sources

The employment creation potential of renewable energy is questionable. Despite studies by some institutions such as Council for Scientific and Industrial Research (CSIR) that project potential employment in the renewable energy sector to be as high as 500,000 people by 2050; these estimates are questionable. The basis of questioning these projections lies in the fact that the existing renewable energy activities currently underway have not been major employers. If job creation by the existing renewable energy projects has been minimal, why should future projections of sector employment be significant? This is a contradiction that the

labour constituency has to be convinced about if it is to unconditionally support the renewable energy sector growth.

The second concern regarding the renewable energy sector relates to its job displacement effect to the coal sector through its competition with the coal-generated energy. It is a documented fact that the sourcing of energy from independent power producers that are predominantly in the renewable energy generation business can lead to job losses in the coal sector. These job losses can extend to other sectors that supply services to the coal sector such as commercial heavy transport sector. In March 2017, for example, Eskom announced plans to close four power stations in order to accommodate renewable independent power producers (IPPs). The stations were Kriel, Komati, Hendrina and Camden power station, all in Mpumalanga. Had it not been for pressure from organised labour, especially National Union of Mineworkers (NUM) and coal truck drivers, up to 50,000 direct and indirect jobs were at a risk of being lost. In this regard, organised labour need to remain vigilant about developments in the energy sector to ensure that its growth does not lead to job displacement rather the creation of alternative jobs.

Lastly is the issue of skills transferability between renewable energies and the coal sector. It is important to explore the possibility of skills transferability between the coal sector and renewable energy. The extent to which this can happen lessen the displacement in employment in the coal sector employment as a result of growth in the renewable energy sector. Organised labour needs to go further to establish whether there are any interventions, such as training, that could enable this transferability.

3.3 Coal power generation

COSATU acknowledged the effects on climate and potential negative effects to the environment of coal power generation. COSATU resolved at its 2009 Congress that “climate change is one of the greatest threats to our planet and our people.” It noted that “it is the working class, the poor and developing countries that will be adversely affected by climate change.” In August 2011, the Cosatu Central Executive Committee adopted a Policy Framework on Climate Change, with 15 principles. It said that the “fundamental cause of the climate crisis is the expansionist logic of the capitalist system.” It called for “a just transition to a low-carbon and climate resilient economy” and defined what is meant by that.

But coal remains a strategic national resource for South Africa, providing a means of living to more than 500,000 people. As a natural resource, it cannot just be discarded because it affects the environment or because of the climate change concerns. The effect to the national economy of stopping to use coal to generate energy are very dire. Unfortunately little effort has been put in quantifying this opportunity cost of a coal-rich country migrating to using renewable energies.

For a win-win situation, it has been suggested that instead of replacing coal energy generation, the country should rather focus on acquiring and using technology that makes the energy generation through burning coal clean. This is an important area that has to be researched and explored further. But from the outset, one has to be mindful of who owns the

clean technology that a country like South Africa can use in its coal power stations. Under what conditions will this technology be acquired? Will it not create a dependence situation that could be used in future to disadvantage the country's development aspirations? For an informed position on the way forward, these questions have to be objectively answered.

Going forward, local study tours on the different energy sources that started with the nuclear energy should be continued so that more comprehensive and factual information on each energy source is gathered. For completeness, this should be supplemented by country studies, focusing on those countries that have excelled in each energy source. Close collaboration with trade unions in the selected countries and neutral international bodies active in the energy research area should also be concurrently pursued. Lastly, organising of platforms and events where developments in the local energy sector are shared and discussed, like the NUM-FES-SATRI Symposium held in May 2017, should be continued.

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