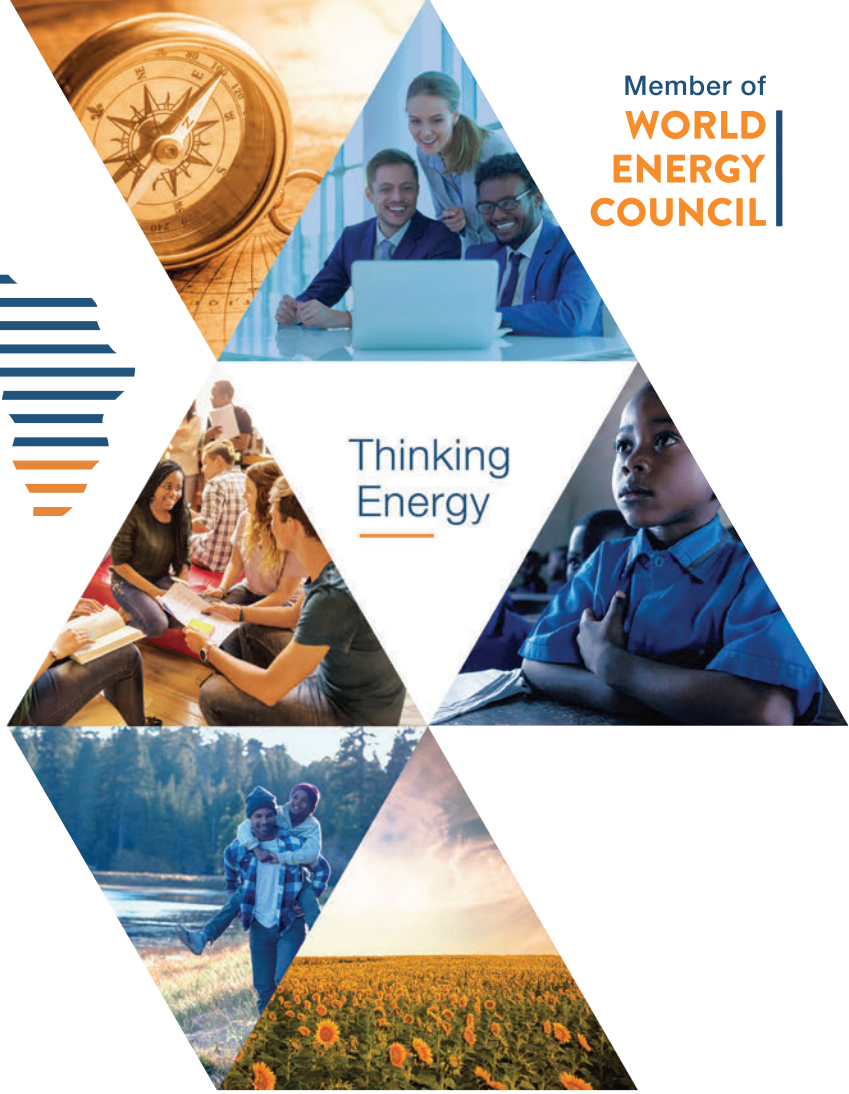


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SOUTH AFRICAN ENERGY RISK REPORT 2020

SUMMARY FOR DECISION MAKERS
“South Africa’s new gold rush”



EXECUTIVE SUMMARY

The South African National Energy Agency (SANEA), a member of the World Energy Council (WEC) embarked on a process in 2018 to unpack the energy risks facing South Africa at a country and industry level. This is SANEA's third South African Energy Risk Report and each year we refine and evolve our methodology, to ensure that the final product is of use to decision makers.

The **definition of risk is the impact of uncertainty on the achievement of objectives**, but too often we see uncertainty in only a negative light, and while that is oftentimes the case, it can also bring new opportunity. This is key – how the uncertainty is dealt with defines the outcome. The objectives used in this report are those as outlined in the National Development Plan (NDP) for energy and the uncertainties identified are those that SANEA identified as having the potential to impact on the achievement of those objectives, positively or negatively.

To move towards identification of emerging risks and provide a more forward-looking view, the focus for this year was therefore on the uncertainties that drive risk and ultimately impact on our energy objectives. For example, although the Integrated Resource Plan was released in 2019, the global pandemic of COVID-19 has impacted negatively on our ability to implement this plan, resulting in South Africa having a low readiness for the energy transition to a lower carbon electricity sector and high uncertainty as to future demand patterns. In addition, the country's credit rating has been further downgraded and prospects for future investments in the energy sector have declined. COVID-19 has also highlighted or amplified the uncertainties that contribute to low economic growth and inadequate infrastructure.

This could mean that the changed energy landscape over the next decade will of necessity increase innovation by investors, governments and consumers. The energy transition trajectory is shaped by the risk appetite. "South Africa's **new gold rush**" is the theme of this report. It accurately describes the new opportunities of the changing energy risk landscape in South Africa.

To ensure a comprehensive view key uncertainties were analysed through various lenses. Based on the **insights gained** through this analysis, SANEA concluded the following:

- Global forces are not within our control but there are opportunities and unique resources for enabling a complete redesign of the energy system that could leapfrog South Africa's global market share in the new energy system.
- The major drivers of the current energy system in South Africa are mostly issues that are in our control to influence in a positive or negative direction. Although some of these drivers are global in nature, such as technology developments, the climate framework and global pandemics, the way we respond to these global uncertainties is within our control and innovation will be essential.
- Traditional ways of stimulating economic growth (infrastructure development) are being limited by investor confidence and lack of government funds. A redesign of infrastructure plans and new business models are now needed to attract the capital required to make the changes.
- Timely implementation of policy is critical to drive the just energy transition and build investor confidence.

- Energy supply options are offering better consumer choice and affordability, in addition, the roll out of the 4th Industrial Revolution (4IR) infrastructure and capability is a key enabler to allow all equal participation.
- People are central to decision making and implementation of plans and policy. The human aspect of uncertainty forms a major driver and pivot, or change agent, of South Africa’s energy sector. There does however appear to be a misalignment between some stakeholder groupings and government on the best way forward. New mind-sets are therefore required for these opportunities to be realised and the disruption to be positively steered.
- The country needs to take a broad view of the energy and associated sectors to identify opportunities along the entire value chain for local beneficiation to access global markets and to participate in the emerging technologies that support the energy transition, particularly batteries and hydrogen.
- Building in and developing resilience and agility is critical in managing these uncertainties. These can be built through having contingency plans in place and by on-going and detailed tracking of trends.

Based on these conclusions, SANEA makes the following **recommendations for action** to deal with uncertainty and to ensure that positive risks are maximised, and negative risks minimised as far as possible. The framework used is People and the 4 I’s. People are at the centre of all decisions and so they form the heart of the recommendations. The 4 I’s are critical recommendations that will drive change and are: Implementation; Innovation; Impact and Integration.

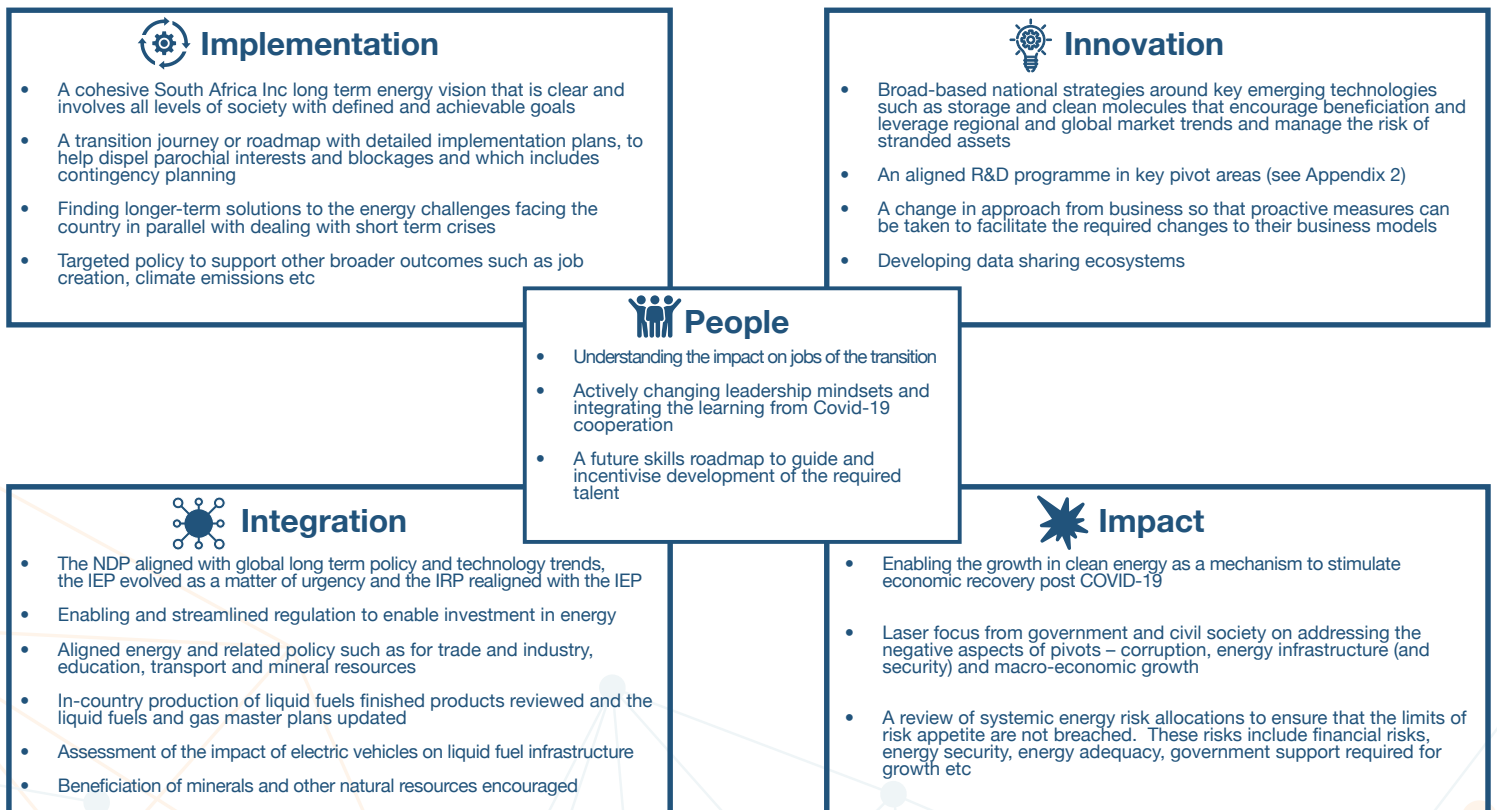


Figure 1: Recommendations to reduce negative and amplify positive risks in the Energy Sector in South Africa

The recommendations made above are interconnected in some cases, in other words it is essential that the people aspect and all the 4I's are simultaneously addressed for maximum benefit at a national level.

The **risks that could materialise because the uncertainties are not managed** include:

- **Economic growth will continue to decline** if South Africa's unique natural resources of solar insolation, mineral resources are not leveraged
- **Energy demand will not be met** due to the economic losses suffered by energy producers and suppliers and capacity risks affecting primary energy supply (notably coal). This includes addressing the effective integration of variable renewable energy from new geographic sources into the transmission system, and municipal distribution failure
- The **ability of energy actors to raise capital will be severely limited** for new energy plant such as power plants, oil refineries, new coal supplies, upgraded municipal distribution, etc.
- Goods exported from South Africa may be adversely impacted by **potential border taxes** due to their high carbon intensity
- A **deficit of the required talent** will mean that South Africa in the public and private sectors will not be able to plan and execute energy projects, costs will escalate, and the mismanagement of energy will impact significantly on economic growth
- Activism and **civil disobedience will escalate**, and decision paralysis will grow

This is not the energy future that South Africa needs, but by taking proactive action to influence the direction of key uncertainties, the negative risks can be managed and opportunities identified. These opportunities can be implemented to ensure that energy objectives are met for the benefit of all our citizens. The world is poised for a new wave of innovation into **storage and clean molecules** such as hydrogen. The opportunities that these recommendations will enable, will **enhance South Africa's ability to take advantage of these innovations and boost future competitive edge. This fundamentally shifts South Africa's energy transition trajectory** and will be the equivalent of finding gold in South Africa over a hundred years ago, with the resultant economic and social benefits it brought. This "**New Gold Rush**" needs to be carefully managed to ensure maximum national benefit. Success means realisation of these positive risks:

- Clean energy as **an active driver of economic recovery post COVID-19**
- **A reduction in South Africa's emissions** (Carbon as well as Sulphur Dioxide, Nitrous oxide etc)
- **Beneficiation and localisation of energy value chains by leveraging local resources** (solar insolation, minerals required for batteries, hydrogen production etc) and expertise nationally and in SADC
- **Improved economic growth and new job creation** with social upliftment of our people
- **Positioning of South Africa as a leader** in new and emerging markets
- An **aligned and coordinated policy framework** that promotes broad based national strategies
- **Improved investor confidence** due to a clear vision and aligned policy

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1. INTRODUCTION

The South African National Energy Association (SANEA), a member of the World Energy Council (WEC) embarked on a process in 2018 to unpack the energy risks facing South Africa at a country and industry level. In the first 2018 report, SANEA undertook to continue to track the energy risks for South Africa as well as evolve the debate and go deeper into risks that will fundamentally impact the energy sector. It is envisaged that this will be an on-going journey given the rapid pace of change and uncertainty in the world today.

This is SANEA's third South African Energy Risk Report and the report has begun to evolve, mature and track the progress made in the energy sector in terms of the objectives in the NDP and the overall energy transition. Each year we refine and evolve our methodology, to ensure that the final product is of use to decision makers.

To bring in a more forward-looking view, this year we have focussed on the uncertainties that drive risk and whether the outcome of that uncertainty impacts on our objectives positively or negatively. **The definition of risk is the impact of uncertainty on the achievement of objectives**, but too often we see uncertainty in only a negative light, and while that is oftentimes the case, it can also bring new opportunity. This is key as how the uncertainty is dealt with, defines the outcome and level of success. The theme of this report highlights the opportunities that come with the changing energy landscape: opportunities for South Africa to harness its natural resources to capture global market share in technologies and processes that support the energy transition. The theme underpins the objectives used in this report, which are those outlined in the NDP for energy, particularly that of economic growth and development through adequate investment in energy(-related) infrastructure. The uncertainties reviewed are those that SANEA identified as having the potential to impact on the achievement of those objectives, positively or negatively.



2. 2020 CONTEXT

A global trend towards environmental concerns and the impact on climate has resulted in a move to transition the energy sector. Energy transition readiness, as defined by the World Economic Forum, is broad in nature and is an overall indication of the inability or ability of a country to shift the energy sector towards cleaner, more efficient use. This includes the availability of investment and capital to make the change, together with effective regulation and political commitment, stable institutions and governance. Having an innovative business environment with supportive infrastructure and skilled human capital, all contribute to the ability of the current energy system to accommodate change. In South Africa's context, this must include consideration of the social impacts of change, both positive and negative. The various uncertainties that underpin such objectives form part of the local energy risk landscape, as South Africa's energy transition readiness remains low in global terms.

The impact of COVID-19

The emergence of the COVID-19 virus has also fundamentally shifted the world and thus the energy landscape in South Africa. COVID-19's emergence means that the risk landscape for the next few years will be shaped by a different set of drivers as the world adjusts to this new normal. COVID-19 has emphasised the inherent weaknesses in the South African system. Therefore building resilience is more important than ever and the COVID 19 disruption and related uncertainty means that there are opportunities to not bounce back to where we were, but to capitalise on new opportunities to reset to an improved position – this is **true agility**.

The electricity sector is one of the key industries in the South African energy sector and is a large emitter of CO². Some certainty has been achieved with the release of the Integrated Resource Plan (IRP) in 2019 and decisive action from government and business in terms of addressing corruption. Energy does however remain a key risk in any economy and particularly in the South African economy due to its energy intensive nature and low readiness for the energy transition. The credit rating of the country has also been further downgraded and prospects from an investment perspective, have declined. South Africa is therefore at a crossroads and this report aims to outline how opportunity for South Africa can be gained by “designing for uncertainty”. A similar term, “designing for disruption” was coined by the World Energy Council (WEC) which epitomises the approach and mind-sets required to steer South Africa towards achieving its energy objectives. In keeping with the theme of this report, this means that South Africa needs to seize the available opportunities that could provide the “**new gold rush**” and fundamentally change the energy landscape.



3. APPROACH

At the launch of the 2019 report, the feedback received prompted SANEA to change the approach to the way in which the risk report is produced and how the analysis of the risks is conducted. These included that the report needs to identify more future looking or emerging risks so that risks can be anticipated and proactively responded to and that as an energy community, we need to make recommendations on treatment plans to head off future risks or, if an opportunity, to take advantage of it. SANEA therefore embarked on a new approach for the 2020 report.

Firstly, uncertainties rather than risks were identified, as the definition of risk is the impact of an uncertainty on an objective. Impacts can be both positive and negative, depending on the outcome of the uncertainty and thus an uncertainty can be influenced (or in some cases not) in one direction or another. This approach meant there were no preconceived solutions provided, but rather, options on how to manage the uncertainty. To identify these uncertainties, tools that have been developed by WEC were again employed. In previous reports, WEC tools such as the country ranking tool defined in the Energy Trilemma Report and the Energy Scenarios have been utilised. In this 2020 report detailed use was also made of the WEC annual Issues Monitor Report and the data they collect from South African participants to uncover the top uncertainties for analysis.



4. NDP OBJECTIVES AND TOP ENERGY UNCERTAINTIES FOR SOUTH AFRICA

The National Development Plan of 2012, outlines the following objectives for the energy sector: “South Africa will have an energy sector that promotes:

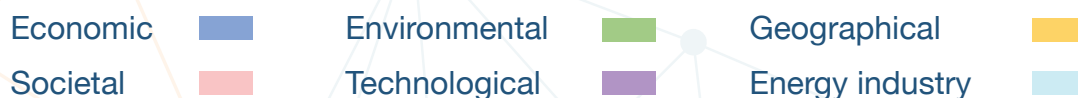
- Economic growth and development through adequate investment in energy infrastructure. The sector should provide reliable and efficient energy service at competitive rates, while supporting economic growth through job creation.
- Social Equity through expanded access to energy at affordable tariffs and through targeted, sustainable subsidies for needy households.
- Environmental sustainability through efforts to reduce pollution and mitigate the effects of climate change.”

Progress against the NDP energy objectives was reviewed in 2018, but the overall objectives did not change. The table below details in alphabetical order the top uncertainties that the Energy Experts (see Appendix 3 for members of the Energy Experts Group) felt needed to be addressed by the country in 2020 to meet these objectives. They have been categorised into 6 major categories, in alignment with the Institute of Risk Management in SA (IRMSA) classification methodology and highlighting specific energy industry uncertainties.



TABLE 1: Top Energy Uncertainties for South Africa in 2020

NO	UNCERTAINTY	DESCRIPTOR
1	Activism and civil disobedience	The extent of activism and civil disobedience including strikes and actions aimed at catalysing political or social change
2	Appropriate policy	The approval and implementation of energy sector and related policy to support investment certainty, flexibility and agility to be able to respond to rapid change
3	Capital markets	Access to capital and the ability to attract capital for energy infrastructure, in a context of high political, market and technology risks within South Africa
4	Climate framework	The acceptance and adoption of international policies such as the UNFCCC dealing with GHG adaptation and mitigation efforts, leading to an energy transition
5	Corruption	The extent of corruption in any part of the energy value chain or spheres of government, impacting confidence in the energy system
6	Country level development	
7	Decentralised systems	New business models that incorporate new technologies and services and the resultant rate of change in the century old energy system
8	Decision paralysis	The existence of multiple views and objectives resulting in sub-optimal decision making including not making any decisions or delaying decisions
9	Economic growth	The effects of economic growth (or lack thereof) on energy markets
10	Energy affordability	Energy price levels which impact on country competitiveness to drive economic growth, and impact on the ability of the poor to access modern energy forms
11	Energy data availability and confidence	The widespread availability of a consistent, transparent energy data set for planning and short- and long-term decision making
12	Energy price volatility and uncertainty	Uncertainty due to rapid and sudden price changes for energy and related commodities including key minerals such as lithium and cobalt as well as coal, oil and gas prices
13	Energy-water nexus	Competition for water resources and water availability due to changing weather patterns and its effects on energy production and supply as well as food production
14	Global pandemics	The rapid expansion of an infectious disease of humans that is easily spread across more than one continent
15	Investor confidence	Investors' willingness to invest in South Africa
16	IOT/Blockchain	The rate of implementation of systems that allow direct and low-cost transactions, the availability of smart appliances driven by smart contracts, smart grid, supply chain tracing and labelling
17	Long term vision	The existence of a clear long-term energy vision which guides the energy sector, provides direction for future investment and boosts investor confidence
18	Macroeconomic performance	Exchange rate fluctuations and currency devaluation which impact on energy operations and investments
19	Market design and energy governance	The availability of innovative market designs and policies to enable renewables integration, secure back-up and storage capacity in natural gas and electricity markets
20	Parochial interests	The extent to which energy players are driving narrow interests, not in the collective interest and impacting on the ability to reach consensus and have quality of decision making
21	Renewable energies	Existence of country policies to encourage the use of renewable energies
22	Strong grid	Whether the transmission and distribution grids enable the changing market structure and business models or delay their implementation
23	Sustainable cities	Whether there is serious consideration of delivering resource-efficient urbanisation at scale; related to how the management of waste, water, energy and transportation is directed
24	Talent	The availability of people with the necessary skills, qualifications, credibility and experience at all levels (including leadership) required in the energy industry



5. ANALYSIS OF THE UNCERTAINTIES

It is critical when doing a risk analysis to ensure that an holistic approach is taken that allows analysis of the complexity of the energy system, as well as to assess it across various timeframes. In today’s complex world it is a rarity that one issue or uncertainty drives the risk system. SANEA utilised various tools to look at the South African Energy Risk System by assessing the “uncertainty landscape” through various lenses as detailed in Figure 2 below, using the NDP as the country level objectives against which the risks were assessed. The full detail and methodology are detailed in Appendix 1.

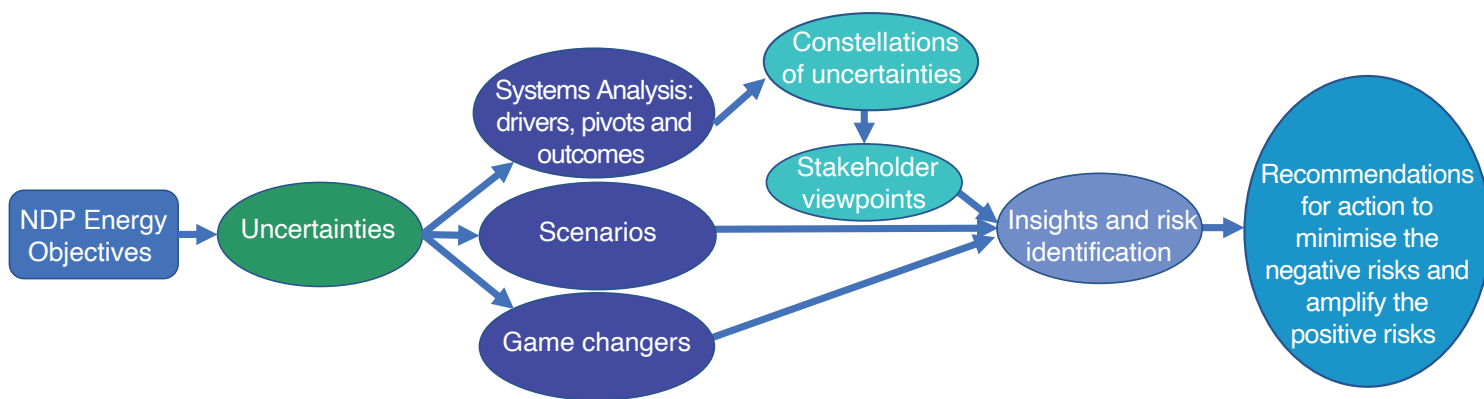





Figure 2: The “lenses” through which the energy uncertainty landscape in South Africa was assessed


5.1 Systems Analysis: Drivers Pivots and Outcomes

A system analysis allows the interconnectedness to be identified as well as which uncertainties are drivers (active), outcomes (passive) or pivots where if they change the whole system changes. All these uncertainties need to be managed but categorising them allows their relative importance to be differentiated, leading to the strategies to treat them, and importantly, where to focus action first. This analysis revealed four major insights:

- 

The major drivers of the current energy system in South Africa are **mostly issues that are in our control to influence in a positive or negative direction**. Some of these drivers are global, such as the climate framework and global pandemics, but the way we respond to these uncertainties is within our control.
- 

Electrification towards lower carbon options will **drive a change in business models and energy supply chains**
- 

The **“soft” side of uncertainty are the major drivers and pivots** in other words the human and social issues are prominent uncertainties not just technological ones
- 

People are critical to all of this – as evidenced in the enterprise effect (Appendix 1)



As we move into the “new energy system”, technology uncertainties are key pivots and South Africa needs to develop broad-based strategies around **key emerging technologies** such as electricity storage and new molecules such as **hydrogen**

5.1.1. Constellations of Uncertainty

When multiple things happen at the same time, significant risks and shifts in systems occur, and a “perfect storm” may result. The product of the systems analysis and identification of the drivers, pivots and outcomes was used to identify the constellations. The Energy Experts Group identified three major constellations that are impacting South Africa’s energy sector namely:

- **Bringing up the rear** – Global drivers are shaping the energy transition and South Africa’s low transition readiness is hampering our national competitiveness and energy affordability
- **Going nowhere slowly** –The lack of a long-term energy vision, with appropriate and coordinated policy, results in high levels of uncertainty, low levels of social cohesion and decision paralysis
- **Open for business?** – Low levels of confidence and lack of transparency, exacerbated by corruption, infrastructure issues and the slow economy, impact investor confidence and economic growth. On the opportunity side, South Africa is endowed with large volumes of natural resources. If these are effectively harnessed, they can play a significant role in the “new energy” system globally, linking in with local beneficiation of minerals, commercialisation of research and leading the transition to cleaner energy

The following insights emerged from analysing the constellations:



Global forces are happening whether we like it or not but there are **opportunities for completely redesigning our energy system** as South Africa has several enablers or strengths to build on. However, South Africa’s **ability to restructure the energy sector is unclear**.



New mind-sets are required for opportunities to be realised and the disruption to be positively steered.



Traditional ways of stimulating economic growth (infrastructure development) are being limited by low investor confidence and lack of government money and a redesign of infrastructure and new business models are needed to attract capital.



Demand for energy is shifting more towards **consumer choice and need** but South Africa has not adapted its regulatory environment enough to support this resulting in lower socio-economic benefits and a tension between customer expectation and government. The **transition from the old to the new needs to be managed** including how parochial interests can be addressed.



Payment for infrastructure is a challenge in South Africa and can be driven by parochial interests. The **heavy level of debt is impacting on price and the risk of stranded assets**. Additional costs for reducing environmental impacts such as local air pollution adds significantly to the debt burden.



A **cohesive South Africa Inc. long term vision** that is clear and involves all levels of society is required, rather than parochial interests driving the agenda. This should include the transition journey or roadmap, to help dispel parochial interests and blockages

5.1.2 Stakeholder views

Different groups or individuals have different risk appetites, views, and parochial interests. The constellations of uncertainties were therefore viewed through the eyes of four different stakeholder groupings. These groupings were: policy decision makers; energy actors; consumers and/or prosumers and the youth. The following insights emerged:



People are shifting closer together in terms of positions but there appears to be a **misalignment between other stakeholder groupings and government**



Technology choices will be key in moving the energy sector forward and capitalising on new opportunities



The implementation of a vision for the South African energy sector requires firstly finding solutions to the energy challenges facing the country and then the **use of targeted and coordinated policy to support other broader outcomes** such as job creation, climate emissions etc. This will require greater alignment between government departments towards a common set of goals



The country needs to take a **holistic view** of the energy sector (and associated sectors) to identify **opportunities along the entire value chain** for local beneficiation to access global markets

5.2 Scenarios

The world in which uncertainties will play out is not easily predicted. The use of a scenario-based approach to understand how the movement of a specific uncertainty might change in different futures assists in a better understanding and more robust decision making. WEC have developed 3 long-term scenarios that were used as the basis for the analysis. The insights that emerged were:



Some uncertainties play out in all three scenarios:

- **Fiscal constraints** will exist, and will these increase
- The **availability of new skills** required and where these will be found
- The need for **decentralised generation**, whether only in rural or in urban and rural communities

- **Fossil fuels and their role** in energy supply in the future – especially in the sectors of electricity, transport and heating
- How the **roll out of the Internet of things** will allow equal participation and include local communities
- Possibility of **civil unrest** should there be uneven distribution of energy
- **Data availability and confidence** in its validity



Future trends are:

- Strong desire to have **electrification of more end uses**, supplied by innovative, green technologies
- Increased **policy push for community involvement with local content and development**
- **Energy security** will remain of prime concern
- **Global trends will be followed** in terms of technology choice and energy switching
- There will be **no change from the current energy framework if the sectors are still siloed** with large parochial interests and local focus only. This will impact negatively on country competitiveness and economic growth
- **Correct, timeous data is key** to moving on from current challenges with energy
- A focus on **addressing the negative aspects of corruption, outdated energy infrastructure and low economic growth can have a marked difference in outcome**

5.3 Game Changers

A game changer is generally defined as an event, idea, or procedure that effects a significant shift in the current way of doing or thinking about something that causes a fundamental change in the status quo. The Energy Experts Group defined a set of potential game changers which are a different and more detailed set of uncertainties, which if they occur, will shift the South African energy sector. The insights that emerged as a result of analysing these game changers were:



Building in and **developing resilience is critical in managing uncertainties**



Agility in responding to some of these uncertainties can be built through having **contingency plans in place and by on-going and detailed tracking of trends**

6. CONCLUSION

The energy risk environment in South Africa remains one of rapid change and therefore, high uncertainty. For example, some certainty has been achieved in the electricity industry with the release of the Integrated Resource Plan (IRP) in 2019 and decisive action from government and business in terms of addressing corruption. However, COVID-19 has brought with it a new level of uncertainty, in terms of energy demand patterns, financial status of energy players and new ways of work – but also an opportunity to do things differently going forward.

Two major shifts in the way in which the 2020 report was developed allowed new insights. These shifts were firstly to look at risk from an uncertainty perspective to understand those that are important to influence to ensure that key objectives are addressed and secondly to view those uncertainties using a variety of different tools so that insights and recommendations could be made. If all the insights are viewed collectively, then the following conclusions can be drawn:

- Global forces are not within our control but there are opportunities and unique resources for enabling a complete redesign of the energy system that could leapfrog South Africa's global market share in the new energy system
- The major drivers of the current energy system in South Africa are mostly issues that are in our control to influence in a positive or negative direction. Although some of these drivers are global in nature, such as technology developments, the climate framework and global pandemics, the way we respond to these global uncertainties is within our control and innovation will be essential
- Traditional ways of stimulating economic growth (infrastructure development) are being limited by low investor confidence and lack of government funds. A redesign of infrastructure plans and new business models are now needed to attract the capital required to make the changes
- Timeous implementation of policy is critical to drive the just energy transition and build investor confidence
- Energy supply options are offering better consumer choice and affordability, but the roll out of 4IR infrastructure and capability is a key enabler to allow equal participation
- People are central to decision making and implementation of plans and policy. The human aspect of uncertainty forms a major driver and pivot, or change agent, of South Africa's energy sector. There does however appear to be a misalignment between some stakeholder groupings and government on the best way forward. New mind-sets are therefore required for these opportunities to be realised and the disruption to be positively steered
- The country needs to take a broad view of the energy and associated sectors to identify opportunities along the entire value chain for local beneficiation to access global markets and to participate in the emerging technologies that support the energy transition, particularly batteries and hydrogen
- Building in and developing resilience and agility is critical in managing these uncertainties. These can be built through having contingency plans in place and by on-going and detailed tracking of trends

7. 2020 RECOMMENDATIONS TO REDUCE NEGATIVE AND AMPLIFY POSITIVE RISKS

The following recommendations are made to influence the level of uncertainty and to ensure that positive risks are maximised, and negative risks minimised as far as possible. The framework used is People and the 4 I's. People are at the centre of all decisions and so they form the heart of the recommendations. The 4 I's are Implementation, Innovation (see Appendix 2 for more detail), Impact and Integration.

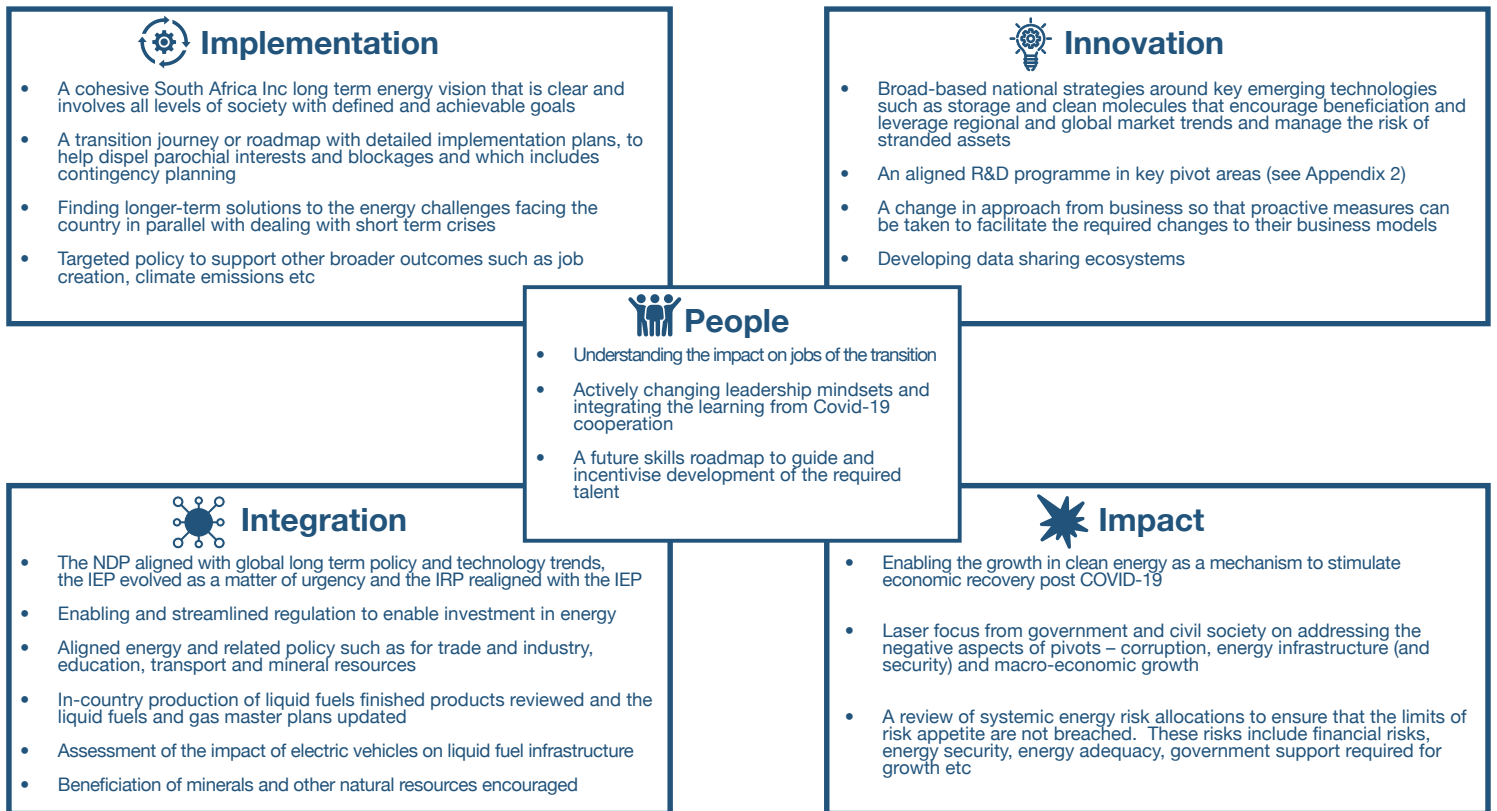


Figure 3: Recommendations to maximise positive and minimise negatives risks in the energy sector

The recommendations made above are interconnected in some cases, in other words it is essential that the People aspect and all the 4I's are simultaneously addressed for maximum benefit at a national level.

The **risks that could materialise because the uncertainties are not managed** include:

- **Economic growth will continue** to decline if South Africa's unique natural resources of solar insolation, mineral resources are not leveraged
- **Energy demand will not be met** due to the economic losses suffered by energy producers and suppliers and capacity risks affecting primary energy supply (notably coal). This includes addressing the effective integration of variable renewable energy from new geographic sources into the transmission system, and municipal distribution failure.
- The **ability of energy actors to raise capital will be severely limited** for new energy plant such as power plants, oil refineries, new coal supplies, upgraded municipal distribution, etc.

- Goods exported from South Africa may be adversely impacted by **potential border taxes** due to their high carbon intensity
- The **ability of energy actors to raise capital will be severely limited** for new energy plant such as power plants, oil refineries, new coal supplies, upgraded municipal distribution, etc.
- A **deficit of the required talent** will mean that South Africa in the public and private sectors will not be able to plan and execute energy projects, costs will escalate, and the mismanagement of energy will impact significantly on economic growth
- Activism and **civil disobedience will escalate**, and decision paralysis will grow

This is not the energy future that South Africa needs, but by taking proactive action to influence the direction of key uncertainties, the negative risks can be managed and opportunities identified. These opportunities can be implemented to ensure that energy objectives are met for the benefit of all our citizens. The world is poised for a new wave of innovation into **storage and clean molecules** such as hydrogen. The opportunities that these recommendations will enable, will **enhance South Africa's ability to take advantage of these innovations and boost future competitive edge**. This **fundamentally shifts South Africa's energy transition trajectory** and will be the equivalent of finding gold in South Africa over a hundred years ago, with the resultant economic and social benefits it brought. This "**New Gold Rush**" needs to be carefully managed to ensure maximum national benefit. Success means realisation of these positive risks:

- Clean energy as **an active driver of economic recovery post COVID-19**
- **A reduction in South Africa's emissions** (Carbon as well as Sulphur Dioxide, Nitrous Oxide etc)
- **Beneficiation and localisation of energy value chains by leveraging local resources** (solar insolation, minerals required for batteries, hydrogen production etc) and expertise nationally and in SADC
- **Improved economic growth and new job creation** with social upliftment of our people
- **Positioning of South Africa as a leader** in new and emerging markets
- An **aligned and coordinated policy framework** that promotes broad based national strategies
- **Improved investor confidence** due to a clear vision and aligned policy



8. APPENDIX 1 – DETAILED METHODOLOGY

8.1 Systems Analysis: Drivers, Outcomes and Pivots

WHY USE THIS ANALYSIS ?

System Analysis helps identify the holistic picture of uncertainties and how they relate to each other. By identifying how uncertainties relate to each-other, those issues that drive the system (active issues), those that are pivots, (if they change the whole system is affected) and those that are outcomes (passive issues) can be identified.

To understand where to place effort in dealing effectively with uncertainty in the energy sector, a systems diagram was developed using the list of top uncertainties and an active and passive analysis was carried out to identify drivers, pivots and outcomes.

A pivot uncertainty(s) is often an appropriate area of focus when managing uncertainty and risk, given that changing a pivot often enables system change.

The figure below shows how this analysis resulted in the categorisation of the uncertainties into drivers, pivots and outcomes:

Table 2: Outcomes of the systems and active/passive analysis of the top uncertainties

Drivers	Pivot	Outcome
Appropriate policy Climate framework Data availability and confidence Long term vision Market design and energy governance Parochial interests Talent	Activism and civil disobedience Corruption Decentralised system Energy storage Energy transport infrastructure Energy-water nexus IOT/Blockchain Macro-economic indicators Price volatility and uncertainty Renewable energies Social cohesion Global pandemics	Capital markets Country level development Decision paralysis Energy affordability Investor confidence Sustainable cities

8.1.1 Constellations of Uncertainties

WHY USE THIS ANALYSIS ?

It is critical to understand how elements of a system of uncertainty can “cluster” together, to form a “**constellation of uncertainty**”. The risks that emerge when single uncertainties are assessed, is quite different to those when clusters are analysed. These clusters can either amplify the impact or disruption or reduce it.

WEC has produced a report in collaboration with Accenture on constellations of disruption entitled Designing for Disruption.

The methodology used in the WEC report was adapted for use in this report, as significant risks and shifts in systems occur when multiple things happen at the same time and can create a “perfect storm”. The product of the systems analysis and identification of the drivers, pivots and outcomes was used to identify the constellations.

The Energy Experts Group identified three major constellations that are impacting South Africa’s energy sector namely:

- **Bringing up the rear** – The global drivers of change are shaping the energy transition and South Africa’s low energy transition readiness is hampering our national competitiveness and the affordability of our energy provision
- **Going nowhere slowly** – This constellation highlights that the lack of a long-term national vision supported by appropriate and coordinated policy is resulting in higher levels of uncertainty, lower levels of social cohesion and decision paralysis. This constellation is the most impacted by COVID-19
- **Open for business?** – The low levels of confidence and lack of transparency in some cases, exacerbated by corruption, infrastructure issues and the slow economy are impacting investor confidence and economic growth

Table 3: How the drivers, pivots and outcome uncertainties group in three constellations

Constellation of disruption	Driver	Pivot	Outcome
Bringing up the rear	Climate framework Market design and energy governance Talent	Decentralised systems Energy storage IOT/Blockchain Energy-water nexus Renewable energies	Energy affordability Sustainable cities
Going nowhere slowly	Appropriate policy Long term vision Parochial interests Global pandemics	Activism and civil disobedience Price volatility and uncertainty Social cohesion	Decision paralysis
Open for business?	Data availability and confidence	Corruption Energy infrastructure Macro-economic performance	Capital markets Country level development Investor confidence

8.1.2 Different Stakeholder Views

WHY USE THIS ANALYSIS ?

Different **stakeholder groupings** view uncertainty in vastly different ways and thus different perspectives allow new insights and opportunities to emerge. Given the risks as a result of high levels of parochial interests, understanding the stakeholder landscape is critical.

The framework detailed below from the Human Systems Dynamic institute was utilised to look at the constellations through the lens of four different stakeholder groupings:

- Policy decision makers
- Energy actors
- Consumers and/or prosumers
- Youth

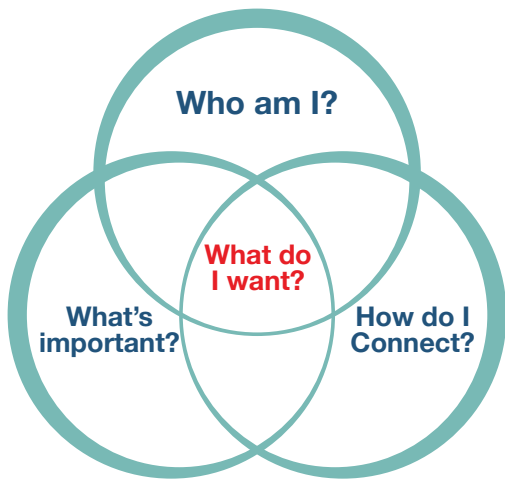


Figure 4: Framework from the Human Systems Dynamic institute utilised to identify different stakeholder perspectives on the constellations.

An extract from this analysis is included below to illustrate the various views identified when the central question of “what do I want” was asked.

(<https://www.hsdinstitute.org/resources/radical-inquiry.html>)

Table 4: Extract of the analysis on stakeholder responses on the question “What do I want?” was asked in reference to the constellations

Constellation	Policy decision makers	Consumers and/or Prosumers	Youth	Energy actor
Bringing up the rear	A sustainable energy solution that is built on consensus, trust, engagement and technical soundness that meets the needs of industry and party politics	Parochial interests reduced and this drives innovation South Africa keeps pace with changing energy landscape and trends while driving affordability and sustainability	Inclusion in large energy projects and option to lead Affordable electricity to alleviate poverty. Jobs in the energy sector for the youth	Clarity on what is important and the connections in place National competitiveness high to avoid trade barriers
Going nowhere slowly	An energy solution which maximises stakeholder benefits Recognition for effort Minimal risk Manageable change even though the energy environment has changed dramatically	Long term direction and vision for energy Broaden the scope for sector influence on key issues Stability in political governance and decision making Sound investment climate	A plan and leadership structure that can be trusted. Something that can stand the test of the next 50 years and continue to thrive Strong repercussions for all who step out of moral, ethical and legal bounds	Policy certainty together with timeous decision making to enable decision making Access to capital
Open for business?	A prosperous South Africa with reducing debt burden A sustainable, stable energy supply Honest conversation about the future cost of energy	Increased scope of participation for local business Economic growth in all sectors to underpin energy demand and investment bankability Free and open commercial processes	Ease of opening a business Training, business incubators, and mentorship without having to give up shareholding Access to venture capital	Reduced levels of policy and regulation Open and competitive markets



8.2 Scenarios

WHY USE THIS ANALYSIS ?

Scenarios expand thinking, aid in the identification of positive and negative risk and can be used to test the level of “future proofing” of a strategy. Scenarios are also a good communication tool to aid in discussions about possible and plausible futures and to help chart a robust path forward, across a range of uncertainties and timeframes.

Identifying energy uncertainty is the beginning of a process. Managing these risks is the ultimate goal, to be undertaken by a range of role players. There are however many options and scenarios help to assess options and how they will play out. WEC developed a set of three long-term scenarios as detailed in the diagram below.

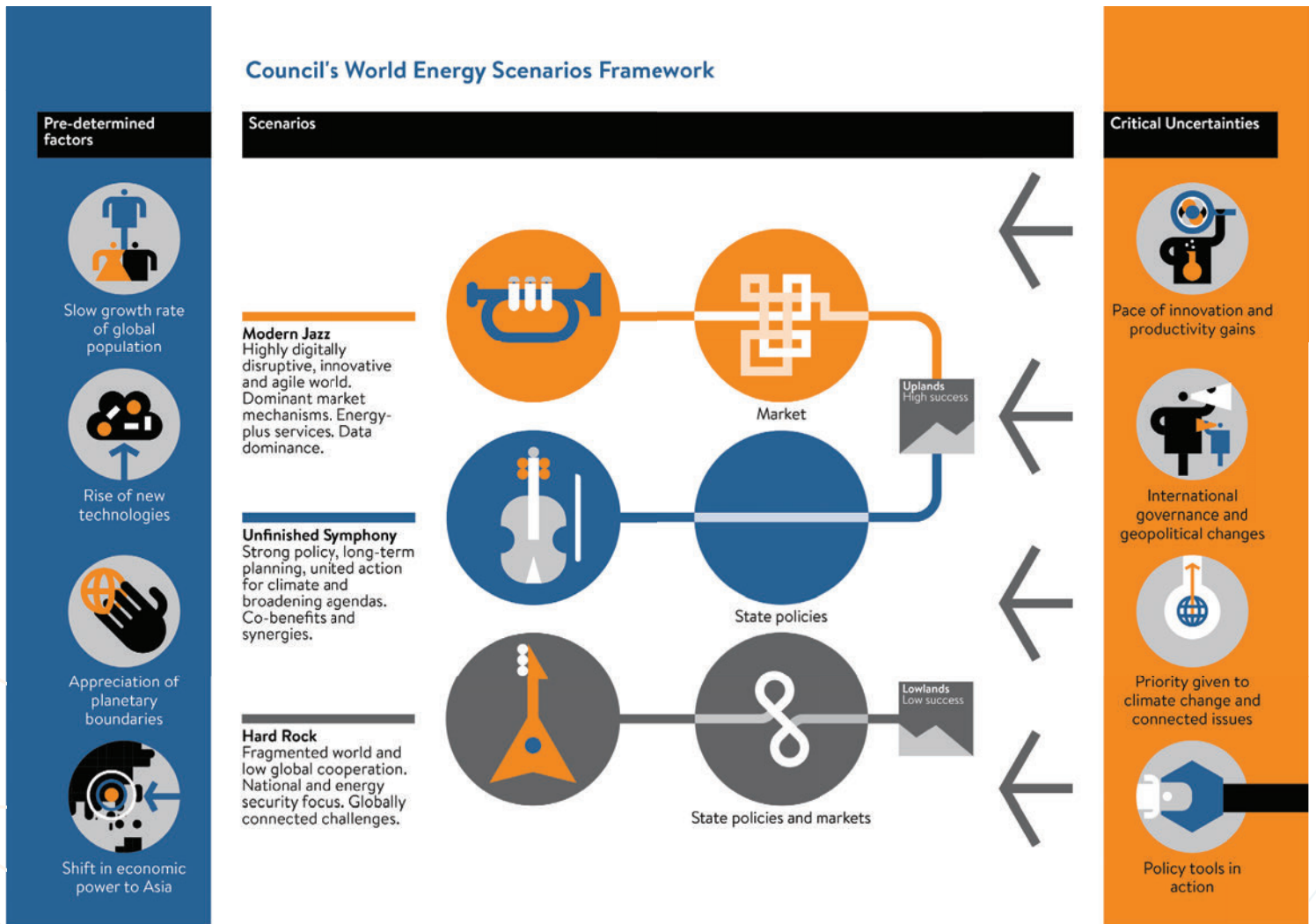


Figure 5: WEC Energy Scenarios

Table 5: Additional detail on the three WEC Scenarios

Modern Jazz	Unfinished symphony	Hard Rock
<p>A market-led, digitally disrupted world with faster-paced and more uneven growth. Recent signals suggest that this entrepreneurial future might accelerate clean energy access on both global and local scales, whilst presenting new systems integration, cyber security and data privacy challenges.</p>	<p>A strong, coordinated, policy-led world, with long-term planning and united global action to address connected challenges, including inequitable access and affordable decarbonisation. Recent signals suggest increased activism and commitment to addressing climate change at the sub-national level, and an expansion of the focus from climate change mitigation to a broader, socially inclusive and economically affordable sustainable development agenda.</p>	<p>A fragmented world with inward-looking policies, lower growth and less global cooperation. Recent signals, such as the rise of populist leaders and uncertainty about the outlook for international cooperation, imply that this scenario is also evolving into a story of regionally firmer security foundations rather than total fragmentation and “harder rocks.”</p>
<p>Modern Jazz is a world of increasing speed of innovation, uneven but high productivity growth, and an ever-present potential for new shocks. In this world clean energy abundance increases rapidly, and there is a faster-than-expected acceleration of end-use electrification in mobility and manufacturing. It is a story of exponential growth opportunities brought about by data-empowered consumers, falling energy prices and increasing speed to global market. This is a consumer-driven, digitally transparent and flexible world of much greater energy efficiency in which new investments in innovation are monetized quickly.</p>	<p>In Unfinished Symphony, most governments are keenly aware of four major risks:</p> <ul style="list-style-type: none"> (1) climate change and its associated environmental and social disruptions including mass migration; (2) systemic vulnerabilities due to digitalisation (such as cyber attacks) and infrastructure development struggling to keep up with new energy sources; (3) the need to balance carbon policies with energy security, availability and cost; and (4) the challenge of allocating the costs of whole energy systems transitions in a socially acceptable way. <p>To mitigate these risks, national governments are challenged to overcome policy silos and develop innovative policy solutions to address connected challenges of energy security, equity and affordability and environmental sustainability.</p>	<p>In Hard Rock, citizens throughout the world become more and more dissatisfied with their traditional political classes and increasing bureaucracy, on the one hand, and with the ravages of global market forces on the other populists and nationalistic candidates win surprising victories in many western countries and insist on going their own way in an increasingly #MeFirst world. The global economy is more volatile, with the two decades marked by several recessions. This volatility leads to a more sluggish average real growth. Global investment flows are reduced in a world of slow growth and high cost of capital. Regional constraints also contribute to the constrictions of finance and data, leading nations to turn to domestic energy security solutions.</p>



The following table shows how uncertainty change in the different futures:

Table 6: How the various uncertainties play out across the three WEC Scenarios

UNCERTAINTY	WEC Scenario		
	Modern Jazz	Unfinished symphony	Hard Rock
Activism and civil disobedience	Digital technology delivers high productivity and efficiency gains - not always evenly distributed. This can lead to more social unrest	Due to a multi-faceted approach by governments to link jobs, health and community issues, there is little civil disobedience	Communities dissatisfied and an increase in social activism expected
Appropriate policy	Policy barriers are removed	Policies lead the changes in this scenario	Internally focused, with trade limits a barrier for technological progress
Capital markets	Supportive of new investments, especially as they are green	New investment is encouraged due to the policy-led approach	Only investing in trusted markets
Climate framework	Well supported with moves to greener energy and electrification of transport and manufacturing etc	A priority, but balanced with the need for energy security, availability and cost	Local energy security a focus. No concern with global climate issues, mitigation efforts abandoned.
Corruption	Transparency of information and use of digital transacting makes corruption difficult	A strong government-led strategy with clear outcomes reduces the threat of corruption	Localised
Decentralised systems	Increase in number	A collective attempt to develop and commercialise low-emissions technologies increases decentralised capacity	Move back to centralised generation, but decentralised for rural and dispersed populations
Decision paralysis	Availability of data and information facilitates better decision making	Policy changes are slow, but steady	In place as data not transparent or readily available
Economic growth	These improve as productivity improves and efficiency increases. Market is consumer-driven	A better availability and reliability of energy underpins better economics	Volatile energy prices deplete the growth potential
Energy affordability	Through a market approach prices do not rise steeply and new technology prices drop	The transition is slow and expensive. Prices do not decline in the medium term	Prices are volatile, so impact on forward planning and affordability
Energy data availability and confidence	Much improved	Available in silos	Data not transparent or readily available
Energy price volatility and uncertainty	Transparency of data and digitisation - more stable prices	Policy-led change enables stable prices, although not declining	Oil & gas economies exposed to large price volatility
Energy-water nexus	Increased innovation drives efficiencies in energy and related water use	Supportive policy environment aims to balance the transition to cleaner energy with other priorities	Country-level security of supply policies the norm
Global Pandemics	Speed of innovation and better flexibility allow for a measured response that dampens the impact	Takes focus away from the climate debate and places it on affordability	Resistance against government controls, allows for faster spread and greater economic impact
Investor confidence	Rises due to resilience, innovation present in the economy	Hesitant and awaiting outcome of policy implementation	Only in specific pockets where parochial interests make it worthwhile to invest
IOT/Blockchain	Will be a platform for change	IOT will be important for the stimulation of the manufacturing and commercial sectors. Blockchain will be of interest but not a priority	IOT will be reluctantly adopted simply to survive. Blockchain will mostly be ignored

To identify some possible consequences, the WEC Scenarios were used to define what contexts were plausible. Each of the uncertainties were assessed against those scenarios, showing the different outcomes possible.

8.3 Game Changers

WHY USE THIS ANALYSIS ?

Thinking about uncertainties as game changers allows longer term issues to emerge and new opportunities to be identified. Asking the “what if” question is essential in understanding how uncertainties will impact on the risk landscape. Resilience and agility are supported by this type of analysis.

The Energy Experts Group assessed some of the longer-term issues that should be tracked and factored into decision making, even with a high level of uncertainty.

If this is not done, then when risks materialise, there may be no contingency planning in place to deal with them:

The game changers were identified as:

- Super energy efficiency
- Global level cyber attacks
- Digitisation at scale and impacts on jobs
- Non-payment revolution
- Decentralisation and self-determination of everything (3D printing, education, energy production etc) means central systems such as tax and services provision are not sustainable
- Cyber currency and different payment systems/processes ie the democratisation of money and trust around players
- Macro-economic collapse
- Catastrophic climate change at a rate faster than expected
- Extensive gas finds in the region that can be brought to market
- Minerals commodity prices exponentially increases unlocking reserves
- Electric vehicles rolled out extensively over a short period of time – cost of transport, decentralised storage etc
- Impact of the Covid 19 pandemic and its ongoing consequences



9. APPENDIX 2: INNOVATION INSIGHTS

Helping Innovation Work for South Africa

For the electricity sector in South Africa and elsewhere, technological innovation can provide more timely and extensive benefits as we identify the best prospects, support and participate in their development, and apply the technologies effectively. Looking at the sector broadly, two aspects of the technological arena are important today:



**Dr. Michael W. Howard,
Chief Executive Officer,
Electric Power
Research Institute**

- *The pace of technological change is rapid; and*
- *The arena is broadening to include more participation from sectors such as information technology and transportation, among others.*

Collaborating with our members, the Electric Power Research Institute (EPRI) continues to expand our work to provide timely insights supporting strategic decision-making and to accelerate innovation. EPRI believes that this work can inform broad discussions leading to consensus in choosing effective, affordable options to meet growing demand for electricity while decarbonizing its production, delivery.

EPRI's Technology Innovation Program provides key elements of this work, including:

- Strategic analysis, modelling, scouting and incubation focused on emerging issues and high value opportunities;
- Core R&D programs to advance early-stage innovations aligned with the Integrated Energy Network pathway and the technology roadmaps of EPRI's research sectors; and
- Cross-cutting R&D to expand multidisciplinary knowledge and extend technology frontiers supporting a broad spectrum of utility applications.

These highlights illustrate the scope of the programme's research and activities.

- Artificial Intelligence
- Hydrogen
- Synthetic Biology
- Transportation
- The Shared Integrated Grid
- Advanced Energy Communities
- Cyber Security *and use.*





Energy research to drive inclusive growth

The major trends and drivers of the energy system present opportunities for South Africa:







*Dr. Clinton Carter-Brown,
Energy Centre Head,
Council for Scientific and
Industrial Research (CSIR)*

- The energy transition to renewables results in an energy system that is more distributed in nature. The transition will change how energy modelling, planning and operations are currently undertaken; the future system will be smart (ICT driven), thus new expertise is required to plan, design, and operate it:
 - Integration of variable renewable energy generation into the grid
 - Integration of new and disruptive energy technologies
 - Financing for new and pilot energy technologies
- The global decline in the technology cost of variable renewable resources (primarily wind and solar PV) has been experienced locally, thus opening up opportunities to exploit the solar PV and wind resources the country has in abundance
- Many countries have stated that they will not produce fossil fuel vehicles from about 2030. The trend is towards Battery Electric Vehicles (BEVs) and Hydrogen Fuel Cell Vehicles (HFCVs)
- The concept of Carbon Capture and Storage (CCS), once touted as the only way to effect deep cuts in CO2 emissions (if coal-fired power stations continue to be operated), has fallen out of favour. It is too expensive, and recovers no value from the captured CO2. This is what is driving increased interest in Carbon Capture and Utilisation, whereby some value is derived from the CO2 as coupled with green hydrogen produced from renewable based electricity
- The coupling of the power (electricity), transportation and heating sectors presents major opportunities to decarbonise the energy system, with hydrogen and energy storage key to the future opportunities

	Opportunities – a select few	Research and Development agenda
Wind & solar 	<ul style="list-style-type: none"> • Abundant and inexhaustible wind and solar energy resources • Even by 2050, RSA would not have used 10% of its exploitable wind and solar resources • Strategic global competitive advantage (excellent resource and available land) 	<ul style="list-style-type: none"> • Planning and operating a power system with high share of renewables (stability/reliability) • Technology localisation (industry, jobs, SMMEs) • Energy storage (battery development and localisation) – beneficiating local mineral resources
Financing 	<ul style="list-style-type: none"> • Global finance available to decarbonise the energy system and make countries resilient to climate change effects 	<ul style="list-style-type: none"> • Opportunities to address present liquidity challenges (Eskom and municipalities)
Hydrogen economy 	<ul style="list-style-type: none"> • Hydrogen a fuel source of the future • Local energy mix diversity, and possible export opportunity (Europe and Japan) • Reduce RSA balance of payments displacing imported liquid fuels • Platinum beneficiation in fuel cells and electrolysis 	<ul style="list-style-type: none"> • Determining the future role of hydrogen in the RSA energy mix and end use applications and new industries including hydrogen as a feedstock for CO2 utilisation in the production of clean synthetic fuels • Localisation and beneficiation to supply the global hydrogen value chain
Circular economy 	<ul style="list-style-type: none"> • Valuation of waste 	<ul style="list-style-type: none"> • Carbon dioxide utilisation • Fly ash-based geopolymers binders for reduced cost building materials

4IR at the core of industrialisation; Using IoT, Robotics, VR and AI to improve and enhance our way of life (productivity/efficiency)

	Opportunities – a select few	Research and Development agenda
Just Transition 	<ul style="list-style-type: none"> • New jobs in Gas, Storage and Renewables • Renewable energy manufacturing and deployment in coal regions • Net increase in jobs • Localisation and industrialisation of new technologies 	<ul style="list-style-type: none"> • Re-purposing aging coal-fired power stations • Labour migration and social plans • Economic sector diversification in coal regions (e.g. special economic zones) • Skills plans for new industries (new skills and re-skilling)
Consumers Prosumers 	<ul style="list-style-type: none"> • Consumers participate in the provision of electricity (small scale embedded generation) • Off-grid and mini-grid electrification 	<ul style="list-style-type: none"> • New business models for prosumers and the municipal utilities. Financial sustainability of new tariff structures and trajectories • Democratisation of energy and opportunities for SMMEs • New tech for electrification Universal Access
Utility business model 	<ul style="list-style-type: none"> • Change from a vertically integrated power utility business model • Entrance of new players in the Electricity Supply Industry (ESI) 	<ul style="list-style-type: none"> • New energy markets with aggregators • Capacitate infrastructure maintenance and creation • Ensuring the performance of existing (Eskom) fleet
alternative/low-emissions mobility 	<ul style="list-style-type: none"> • Carbon neutral synthetic fuels • Battery and fuel cell Electric Vehicles for domestic and export markets • Reduce dependency on imported liquid fuels 	<ul style="list-style-type: none"> • Electrochemical technologies (batteries, fuel-cells) key to the future transportation system – localisation and industrialisation • Revenue opportunities & increased electricity sales
4IR at the core of industrialisation; Using IoT, Robotics, VR and AI to improve and enhance our way of life (productivity/efficiency)		

South Africa is well-positioned to be among regional and global leaders transitioning the energy system. Therefore, strategic investment in R&D initiatives that speak to technology innovation and industrialisation is paramount:

- Research and develop energy technology solutions along the energy value chain for grid, transportation and stationary applications as used in commercial, industrial and residential sectors
- Create integrated, cross-cutting teams by establishment of national industrial/university/lab consortium focused on energy storage and conversion systems
- Early adoption of hydrogen in niche applications (underground mining, public transportation), Power to X (PtX) and Carbon Capture and Utilisation (CCU)
- Small Scale Embedded Generation (SSEG) and self-generation. Growth in solar PV installation at the commercial and residential level
- Over and above energy security, the energy sector is expected to add value to the SA economy through industrialisation, small business development, socio-economic development and addressing transformation challenges
- Design and operation of a smart energy system to optimise and manage the interplay between variable supply sources, demand and storage. Provide a demonstration platform for programs e.g. Hydrogen production, storage and utilisation. Support the implementation of sustainable renewable energy based micro-grids
- Alignment with the National Development Plan objectives of increasing employment, reducing inequality and eliminating poverty within the energy sector.
- Providing scientific and industrialisation support to the energy industry in order to improve competitiveness and market access opportunities
- Energy storage technologies to support the increasing renewable energy sector is needed and there is an opportunity for the country to invest in developing the South African battery industry, which will in turn reduce the cost of battery cells and improve ease of accessibility of electricity in the African continent

10. APPENDIX 3: MEMBERS OF THE ENERGY EXPERTS GROUP

The following people were members of the 2020 Energy Experts Group. Their contribution is gratefully acknowledged.

Barry MacColl – EPRI
Brian Statham – Brian Statham and Associates
Cathy Laing – Independent Consultant
Christopher Palm – IRMSA
Clinton Carter-Brown – CSIR
Dave Collins - Mac Group
Dave Wright – Independent Consultant
Elizabeth Marabwa – DMRE
Erica Johnson - Standard Bank
Kenneth Robinson - Accenture
Kiren Maharaj – Managing Director Gibb Power and Chair of the SANEA Board
Norman Ndaba - Independent Consultant
Penny Herbst - Africa Greenco
Rosalind dos Santos - Impact
Sashay Ramdharee – CSIR
Wendy Poulton – Independent Consultant and Secretary General of SANEA (Editor)



SANEA

The South African National Energy Association (SANEA), founded in 1924, is the South African Member Committee of the World Energy Council. SANEA represents a hub for objective thought leadership on energy and related matters. In so doing, SANEA stimulates original thinking to catalyse transformation of the South African Energy Sector.

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The third South African Energy Risk Report 2019 has been compiled in collaboration with the Institute of Risk Management South Africa (IRMSA) as a strategic initiative between SANEA and IRMSA. as the main aim of the IRMSA Risk Report is to identify risks facing South Africa and South African industries. IRMSA believes that this will assist leadership, management and risk practitioners in better identifying and managing the risks that their organisations face. This ensures that the reach of the conversations and considerations for energy risk is broadened and deepened within the South African industry and government environments.



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