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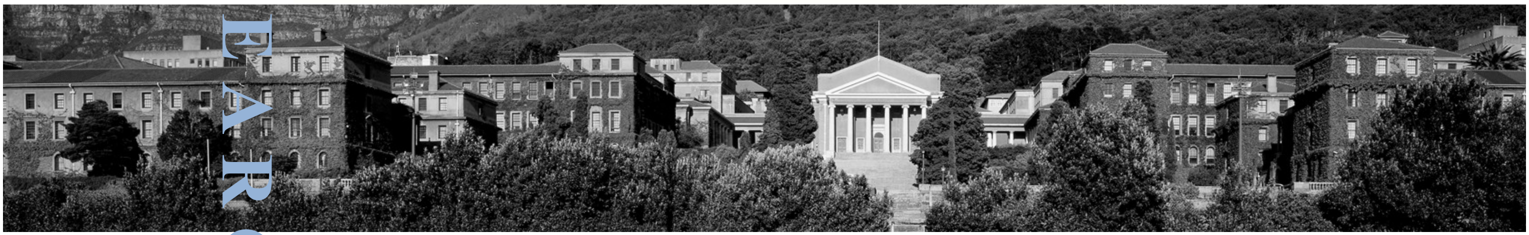

South Africa's proposed nuclear build plan: An analysis of the potential socioeconomic risks

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Introduction

The Integrated Resource Plan 2010 forced a full fleet of 9.6GW of nuclear power into the final build plan (DoE, 2011). The South African Department of Energy has since made several statements firmly committing the country to the procurement of a fleet of nuclear power plants. However, the risks and uncertainties specific to a nuclear fleet, as well as those implicit in long-term electricity sector planning, have yet to be quantified. This study therefore aims to understand the potential effects on the South African economy of the government's stated commitment to invest in 9.6GW of nuclear power (DoE, 2011).

The study is a technical analysis of the potential risks and uncertainties of the commitment to a proposed nuclear build plan in South Africa. The study aims to review the commitment in comparison to a more flexible planning approach that aims to minimise costs. It includes three main tiers of analysis: the first builds two alternative futures, so that we can understand the implications of different investment strategies in uncertain future worlds; the second models the socioeconomic impacts of the commitment to nuclear power versus a flexible planning approach in each of these futures (i.e. committed nuclear versus least-cost investment plans in different futures); the third estimates the risks of an increase in the electricity price to the South African economy and consumers.

Research questions:

1. Given the high level of uncertainty inherent in long-term electricity planning, how does the commitment to 9.6GW of nuclear power by 2030 compare to a more flexible planning approach in meeting government's stated objectives of economic growth, job creation, and poverty alleviation (measured as household welfare)?
2. What are the risks of electricity price increases associated with the commitment?

Our methodology combines a Monte Carlo analysis of 1000 different energy futures with the development of two detailed illustrative futures, modelled using an energy model and an economy-wide model. The Monte Carlo allows us to understand the likely effect of different assumptions on the electricity price in a given year. That is, in 1000 different energy futures comprised of different assumptions and comparing the nuclear build schedule in the IRP2010 versus other options, we analyse the effect on the electricity price. We furthermore analyse in detail the impact of higher electricity prices on the South African economy for two of the possible futures. The illustrative worlds are able to highlight the potential effects of the nuclear fleet under different sets of key assumptions. Our results highlight the effect of the nuclear decision on key issues: the electricity build plan, the GDP growth rate, the investment required in the electricity sector, electricity prices, direct and indirect employment for different skilled groups, and household welfare.

We find that under specific conditions the nuclear decision is not likely to have a negative impact on the South African economy. When we assume low costs for nuclear, high costs of renewables and no gas or hydro alternatives, and high electricity demand, then the investment in nuclear has similar socioeconomic effects as alternative investment paths. There is no impact on growth and a slight improvement on job creation from increased investment in the economy and the oversupply of affordable electricity.

If, however, other conditions materialise (such as lower electricity demand, higher nuclear costs, and competitive and available alternatives), the negative effect of the nuclear decision will be significant. Compared to a more flexible planning approach, electricity prices will be 20% higher in 2040, economic growth will decrease, up to 75 000 jobs could be lost and household consumption could decrease.

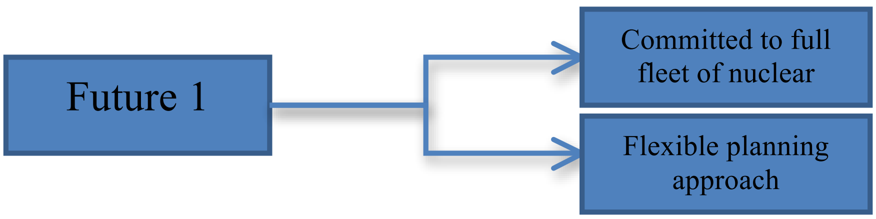
While it is impossible to know which future will unfold – our scenarios are only two possible cases of potentially many – it is possible to analyse the factors that affect the likelihood of particular conditions materialising. For this we modelled 1000 energy futures. In undertaking such an analysis we find that a future in which the nuclear fleet is built, as scheduled in the IRP2010, is likely to result in a higher electricity price than a future where flexible planning takes place. Indeed, there is a greater than 90% likelihood that, when the nuclear policy decision is made, electricity prices will be higher in 2030 and for a period lasting up to 15 years.[1]

Scenarios

We started with two potential futures for South Africa, each with specific conditions. The differences in each future related to parameters such as economic growth assumptions (because higher economic growth typically leads to increased electricity demand), technology costs (nuclear power versus renewable energy technologies) and the costs and availability of other sources of power, such as domestic gas and regional hydropower. In each of these futures, we then modelled the commitment to the nuclear fleet and compared this against a flexible planning scenario. In short, we model the policy decision to commit to nuclear or to undertake flexible planning in two possible futures, giving us four cases.

This allowed us to compare the effects of the nuclear fleet under conditions of future uncertainty – because we do not know which future will materialise, it was important to understand the potential supply options and the impacts of those supply choices for different, uncertain futures. Whichever future materialises, we can compare the socioeconomic impacts of the committed nuclear build against a build plan that includes a diversity of supply options.

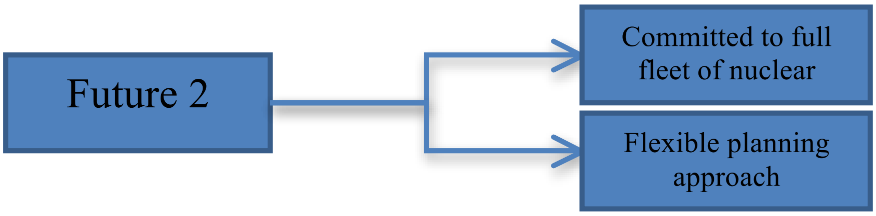
By flexible planning, we mean that we run scenarios that aim to build an electricity capacity expansion plan – as in the integrated resource plan – that minimises overall costs while meeting demand. The flexible scenarios are thus 'least-cost' and can be compared against scenarios with the nuclear commitment in each potential future. Given the uncertainties around economic growth, electricity demand, and costs, investment in large-scale, expensive electricity generation technology is always accompanied by some degree of risk and uncertainty. Steyn (2001: 31) outlines the literature on investing under conditions of uncertainty; he defines inflexible technologies as technologies characterised by long construction lead times, large unit sizes, high capital intensity, dependence on dedicated infrastructure, non-incremental development strategies, and limited substitutability. These characteristics limit learning as well as responsiveness to changes in external conditions, and increase the costliness of errors. A flexible approach thus aims to ensure 'least-cost' planning and to reduce the risks inherent in inflexible decision-making. Each future is described in more detail below.



Future 1 can be understood as the 'best case' for nuclear power: it is a future world in which conditions are optimal for nuclear. In this future, South Africa experiences higher levels of growth between 2015 and 2040, averaging 3.6% per year. The assumed costs of nuclear power are lower, the decline in costs of renewable energy is assumed to be slower (i.e. renewable energy options are comparatively more expensive), and there are limited alternative options to nuclear power such as domestic gas resources and regional hydropower. Future 2, on the other hand, can be understood as a 'worst case' for nuclear power. South Africa's economic growth rate is lower (2.7% per year) and electricity demand is therefore lower; nuclear power costs are

[1] However, this does not mean that nuclear should not be considered at all. There are certain conditions that would favour nuclear in the longer term, but the commitment to a fleet is not yet required by South Africa and is difficult to justify.

higher, renewable energy technologies are cheaper, and there are domestic gas and regional hydro options that can compete with nuclear power.



The detailed parameters used as inputs into the modelling can be seen in Table 1:[2]

Table 1: Parameters for future scenarios

Uncertainty parameter compared in each future	*Future 1 (Best case for nuclear)*	*Future 2 (Worst case for nuclear)*
Average economic growth 2015-2040	~3,6%	~2,7%
Nuclear parameters: Overnight cost ($\$/kW_{net}$) Lead/construction time (years) Availability	*Optimistic* Lower (~5100) Shorter (6) Higher (90%)	*Pessimistic* Higher (~7000) Longer (12) Lower (75%)
Renewable energy parameters: (overnight cost reduction 2040:2015) PV (incl. rooftop and centralised) CSP (all storage levels) Wind	*Pessimistic* -37% *-25%* *-1%*	*Optimistic* -45% *-34%* *-10%*
Cost and source of natural gas	Liquefied natural gas at $12/MBtu	Domestic gas at $9.5/MBtu
New hydro imports from the region incl. 2 phases of Inga	no	yes

Results

The results are reported for each future as a comparison of the case where South Africa commits to 9.6GW of nuclear power versus the case where there is flexible planning in the electricity sector. Given that the two futures are premised on different underlying assumptions, they should not be compared with each other directly but rather contrasted as two distinct possible futures, in each of which the nuclear policy decision could be taken or an alternative plan could be the basis for generation-expansion planning. What is important for this analysis is to understand the macro-economic impact of forcing the nuclear build plan versus adopting flexible planning in each distinct future.

2 A full explanation for each of the parameters is available in the technical report that accompanies this condensed results report (ERC, 2015).

We outline below the results of the nuclear commitment versus flexible planning in each future, and analyse the impact of the nuclear policy decision. Key results include the mix of generation capacity in response to the assumptions for economic growth and imposed nuclear share, the resulting electricity price and investment paths and the socioeconomic impacts of these outcomes.

Future 1 results: Best case for nuclear

Here we compare the results of committed nuclear investment versus flexible planning in Future 1.

Electricity build plan

As can be seen in Figure 1, peak demand for both scenarios is similar, at 57GW in 2030 and 77GW in 2040.[3] There are slightly higher levels of installed capacity in the flexible scenarios, however, because of higher penetration of renewable energy technologies.

In Future 1, when the flexible planning approach is adopted, we see only around 4GW of new nuclear capacity by 2030, with the rest of the new capacity coming in the form of wind, natural gas-fired plants (using imported liquefied natural gas) and solar PV. This is in contrast to a forced commitment of 9.6GW of nuclear, which replaces wind and gas capacity in particular by 2030. By 2040, however, we observe similar levels of new capacity for nuclear even in the flexible plan. The flexible scenario has 17.8GW of nuclear by 2040; and the forced nuclear has 20.6GW.

It is important to note the difference in 2030 between these scenarios, both of which assume the best conditions for nuclear; in the least cost scenario, however, significantly less nuclear capacity is built by 2030 than in a flexible plan, i.e. a plan that aims to minimise costs. By 2040, the large nuclear capacity being built is a result of the assumptions about higher electricity demand, limitations on new coal capacity, and the relative prices of different supply options (lower nuclear costs and higher renewable energy and gas).

[3] Future 1 has substantially higher installed capacity by 2040 than Future 2 does – this is in response to a higher demand forecast driven by an assumption of higher economic growth over the period 2015–2040.

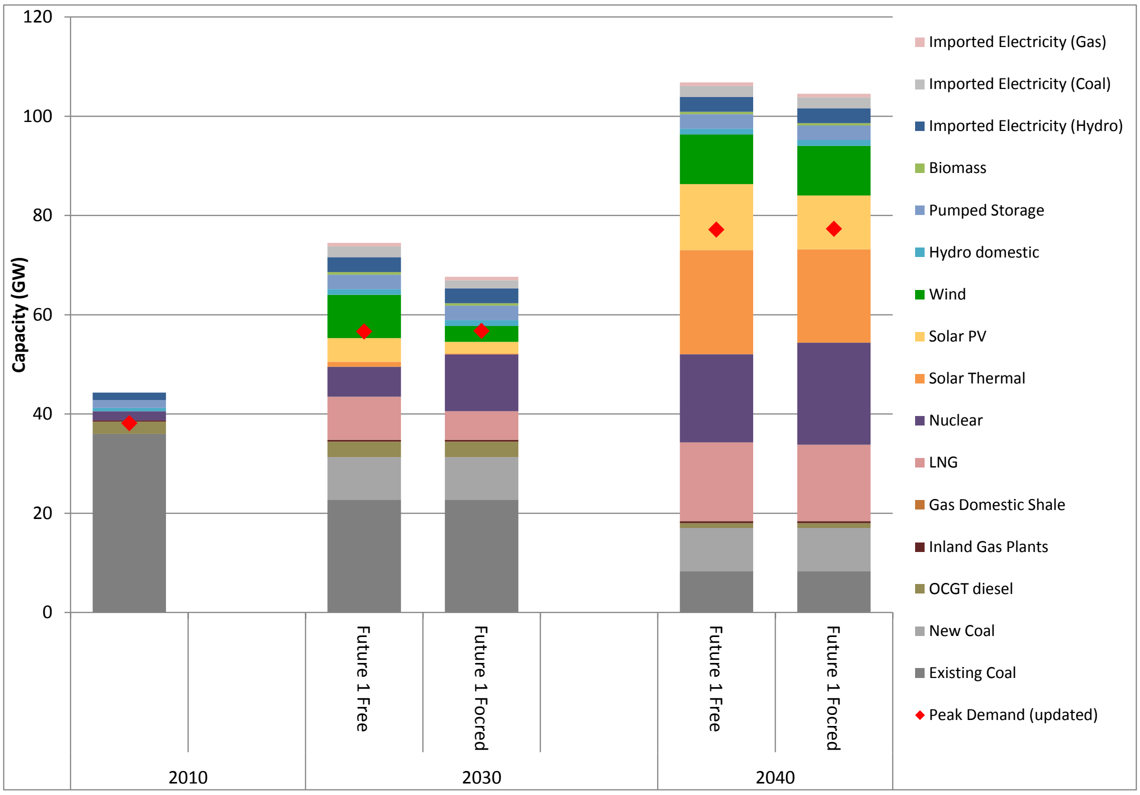


Figure 1: Electricity sector installed capacity in 2010, 2030 and 2040 for Future 1

Investment levels and electricity prices

Figure 2 illustrates the annual investment required for a flexible plan versus the forced nuclear scenario, and the resultant electricity price increases. The high growth in electricity demand in Future 1 leads to new installed capacity of 25.2GW and 24.2GW (between 2015 and 2040) for the flexible planning approach and the committed nuclear build cases respectively. Given the low capital cost of nuclear assumed in Future 1, there is no significant difference between the total investment required for each case. A total investment of approximately R4.4 trillion for the electricity sector from 2015 to 2040 is required for both the flexible scenario and the nuclear commitment.

There is also no significant difference in the electricity price between the scenarios, each ending with an electricity price of R1.34 per kWh (2015 Rands) in 2040.

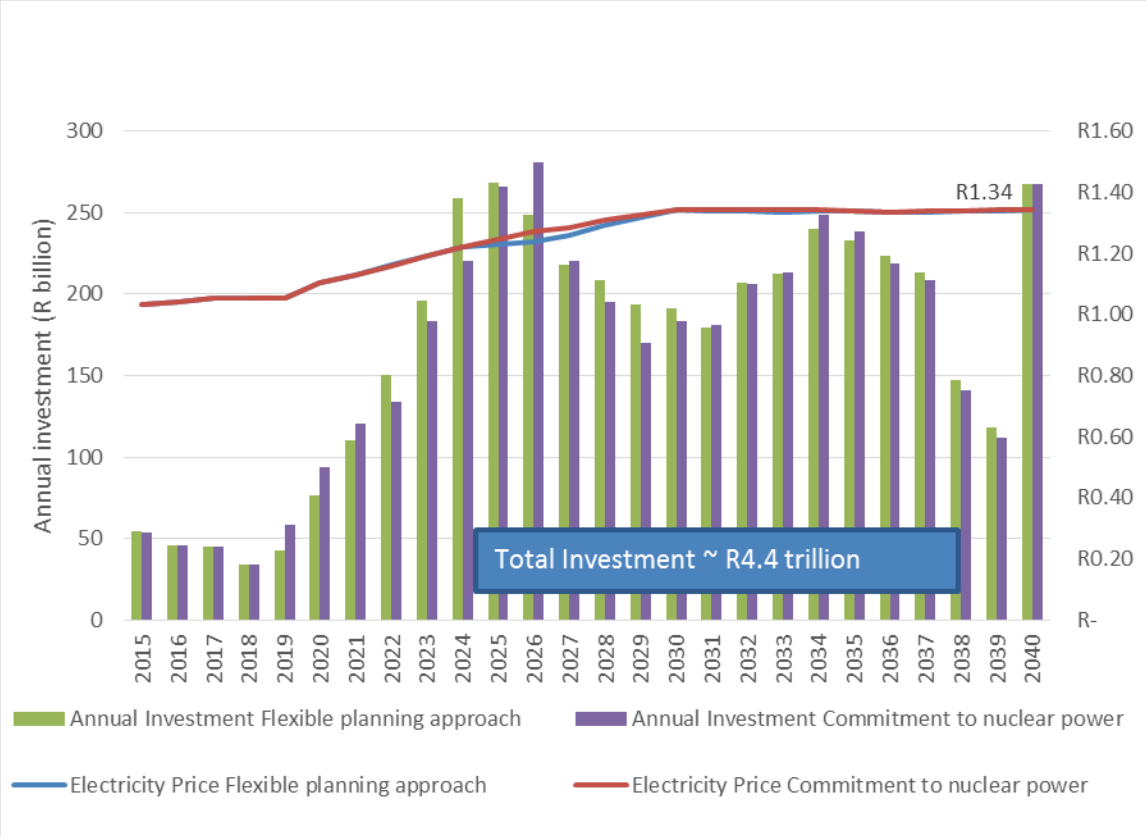


Figure 2: Comparison of investment and electricity price for committed nuclear versus flexible planning in Future 1

Growth and employment

Figure 3 shows the deviation in GDP growth and employment between the committed nuclear scenario and a flexible plan. As can be seen, there is a slight decrease in GDP between 2020 and 2024 and then a slight increase in GDP between 2024 and 2035 in the case of the committed nuclear fleet. The deviation has two main causes: firstly, since a commitment to nuclear power would require construction of the plants between 2019 and 2030 (due to the six-year lead time), this leads to a reduction in the investment available to other sectors of the economy between these years. This has a small negative impact on GDP between 2020 and 2025, after which the nuclear power plants come online and there are returns on these investments. Secondly, there is also a marginal price impact that can be seen in Figure 2 and Figure 3 between 2024 and 2030 as demand sectors react to slightly higher electricity prices.

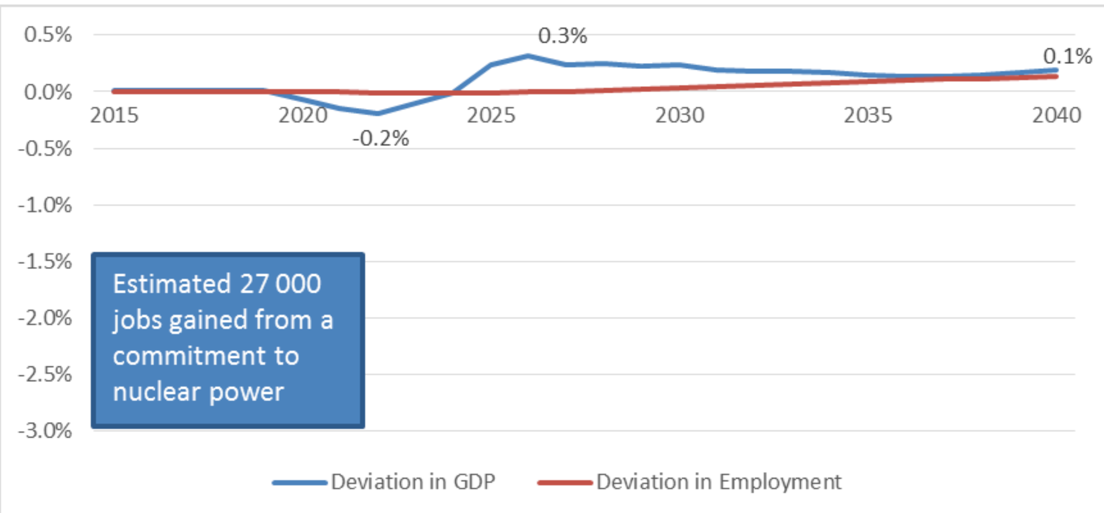


Figure 3: Impact on GDP and employment of the nuclear commitment versus flexible planning approach in Future 1

The result was an oversupply of affordable electricity, incentivising growth from 2025 onwards. It is essential to understand that this is not a technology-specific outcome, but rather the outcome of an overinvestment in electricity supply capacity in an economy with high enough GDP growth to absorb the excess electricity supply (this would not be the case with lower levels of GDP growth and the result would be a larger negative impact on GDP (see Figure 7 on GDP in Future 2).

Employment effects by labour category

With an estimated 25% unemployment level in South Africa, any potential negative impact on employment is of concern. Table 2 shows total employment (by level of education) and the potential impact on jobs of the commitment to nuclear power compared to the case where South Africa follows a flexible planning approach. In Future 1, because of the higher growth rate assumed, the effect on employment is marginally positive for all sectors and labour categories.

Table 2: Employment effects of committed nuclear versus flexible planning in Future 1

	Number of employed workers (thousands)			*Number of jobs created/(lost) with nuclear commitment*	*Number of jobs created/(lost) with nuclear commitment as a percentage of employed workers*
	2010	*Flexible policy in 2040*	*Nuclear commitment in 2040*		
Labour	**12 369**	**20 813**	**20 840**	**27 298**	**0.1%**
Unskilled labour	**5 731**	**11 081**	**11 108**	**27 298**	**0.2%**
Primary	1 942	3 712	3 721	9 030	0.2%
Middle	3 789	7 368	7 387	18 269	0.2%
Skilled labour	6 639	9 732	9 732	-	-
Secondary	3 645	5 697	5 697	-	-
Tertiary	2 994	4 036	4 036	-	-
Electricity sector	**37**	**81**	**79**	**-1 460**	**-1.8%**

Welfare

The potential impact of the scenarios on welfare in South Africa is also of concern, given South Africa's development imperatives. Households in South Africa are affected through two main channels, either directly through the price of electricity or indirectly through job losses. The results have shown that, by committing to the nuclear build plan, there is less investment available for other sectors, which leads to a slight contraction of the economy in the early 2020s. Some of these sectors that are the main 'losers' of investment are also employment-intensive sectors, not only for unskilled, but also for semi-skilled and skilled workers. The pass through of the loss in employment and resulting decrease in wage rates is reflected by the decrease in household income that is found in the results.

In Future 1, once the electricity supply is available from 2023 onwards, there is a small positive impact on all households, (low-, middle- and high-income) (Figure 4). This is an intuitive result because of the higher growth that is assumed in this case and the slight increase in employment caused by the higher growth.

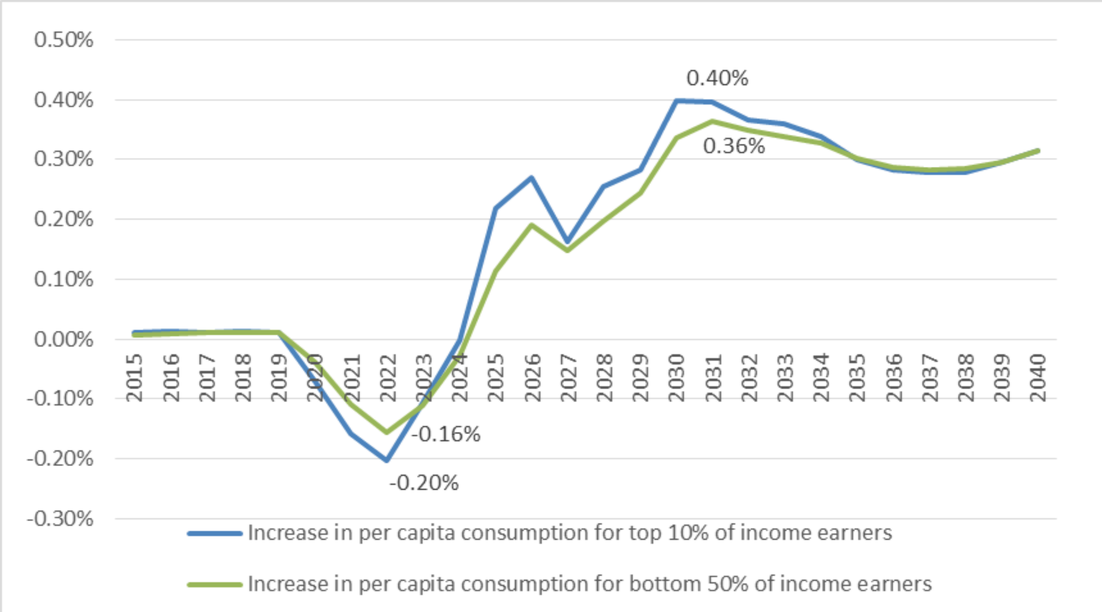


Figure 4: Impacts on household consumption of committed nuclear versus flexible scenario in Future 1

Future 2 results: worst case for nuclear

Electricity build plan

In Future 2, with flexible planning, peak demand in 2030 is 51GW and 61GW in 2040. For committed nuclear, 2030 peak demand is 50GW. By 2040, this has increased to 58GW. The discrepancy can be explained by the difference in the electricity price by 2040; in response to higher prices, demand slows slightly when the nuclear capacity is forced into Future 2 (see Figure 2 and Figure 6 to compare electricity prices for each future). Peak demand and installed capacity is slightly higher in the flexible planning scenario in both 2030 and 2040 versus the committed nuclear scenario.

In Future 2, we see no new nuclear by 2030, as in this scenario the first committed nuclear unit appears only in 2031 (a result of an assumed lead time of 12 years). By 2040, we see no new nuclear when the flexible planning approach is adopted, with nuclear being replaced by shale gas, concentrating solar thermal, PV, wind and imported hydro. This is due to a combination of lower demand (versus Future 1), higher nuclear costs; lower costs and availability of alternative options.

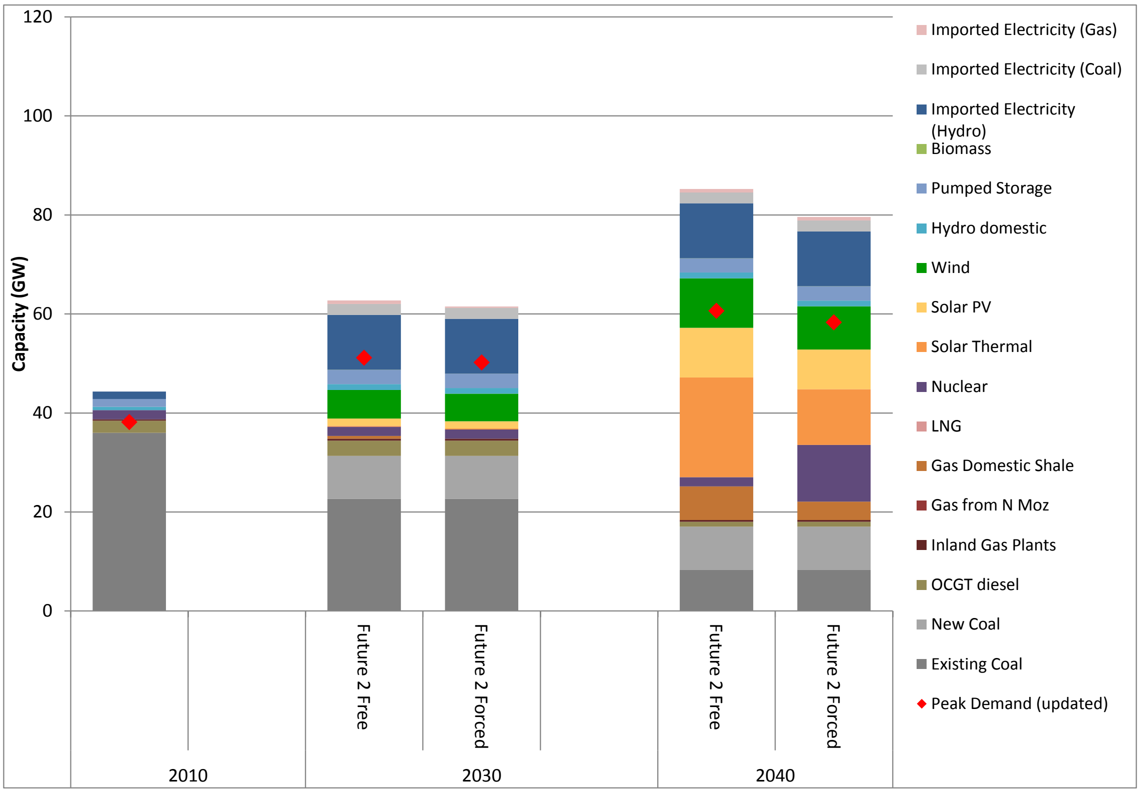


Figure 5: Electricity sector installed capacity in 2010, 2030 and 2040 for Future 2

Investment levels and electricity prices

In Future 2, the scenario with lower growth, the electricity price from a commitment to nuclear power is significantly higher than that of a flexible planning approach that produces the lowest electricity system cost. Despite a lower generation capacity requirement, due to lower electricity demand in this scenario, the electricity price increases to R1.38 when nuclear power is forced into the build plan. The significant price difference (23 cents/kWh by 2040) is expected since the cost of nuclear is higher ($7000/kW) and does not compare favourably with alternative options. This and the longer lead time in this case increase the investment requirement by R0.4 trillion from 2015 to 2040. That is, the commitment to nuclear results in investment costs of R0.4 trillion more when compared to a flexible planning approach. To put this investment into perspective, the additional investment requirement for nuclear power is R102 billion more than the already high investment requirement of R121 billion in 2027 (when annual electricity investment peaks).

Under the best case for nuclear (Future 1), there is no price difference between the commitment to the fleet and flexible planning; but if demand were lower and prices higher, as in Future 2, the difference in the electricity price would be substantial, with a sustained difference from 2030–2040, and totalling 20% higher prices by 2040. Table 3 shows the absolute and percentage divergence in the electricity price under the committed nuclear scenario.

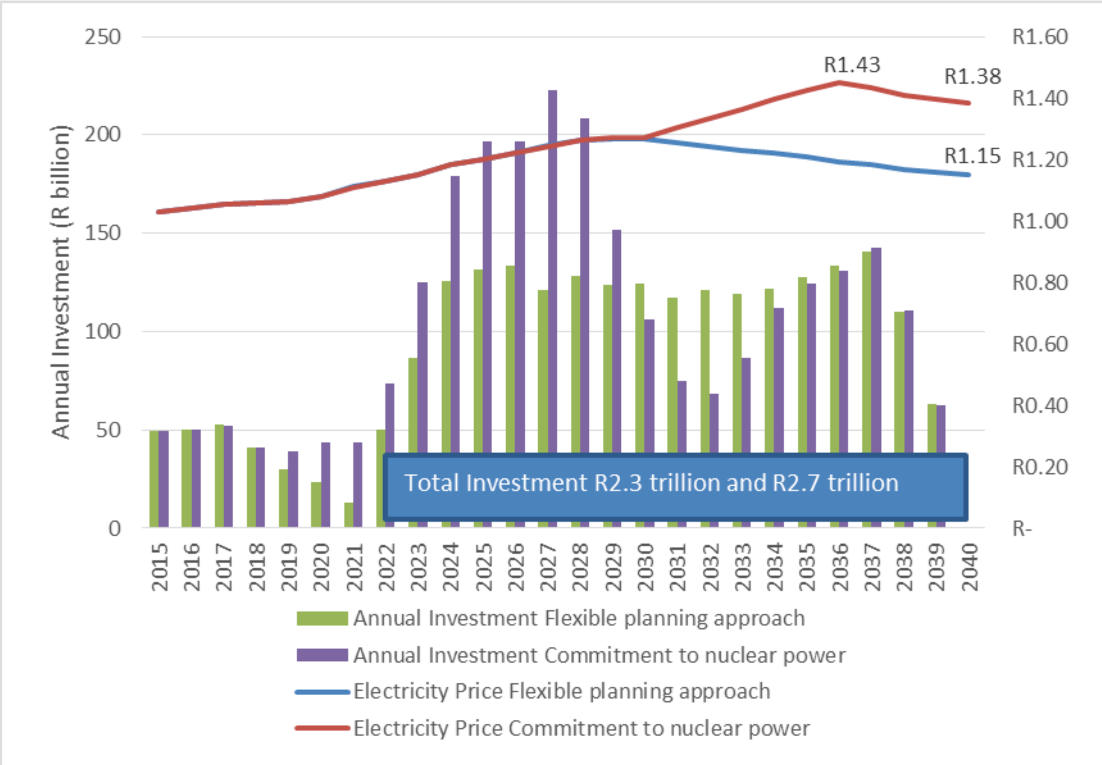


Figure 6: Comparison of investment and electricity price for committed nuclear versus flexible planning in Future 2

Table 3: Comparison of electricity price divergence between committed nuclear and flexible planning in Future 2

	Electricity price with flexible planning approach (R 2015)	*Electricity price with committed nuclear (R 2015)*	*% Increase in electricity price with a commitment to nuclear power*
2030	1.27	1.27	0%
2031	1.26	1.30	4%
2032	1.24	1.33	7%
2033	1.23	1.36	11%
2034	1.22	1.40	14%
2035	1.21	1.43	18%
2036	1.19	1.45	22%
2037	1.18	1.44	21%
2038	1.17	1.41	21%
2039	1.16	1.40	20%
2040	1.15	1.38	20%

Growth and employment

As can be seen in Figure 7, the deviation in GDP and employment between the committed nuclear and the flexible planning scenario is substantial. The large effect on GDP is caused by the demand for capital from the electricity sector limiting capital available for investment in other sectors between 2020 and 2030 (since we assumed a longer lead time, construction starts by 2020 even though the first unit only comes online by 2031). From 2030 onwards, the higher electricity price caused by the nuclear policy decision has some negative effects on GDP.

Thus, if South Africa follows a low-growth path (average of 2.7% per annum to 2040) and all the conditions are in place for nuclear power to be the worst option for South Africa, there is a substantial negative impact on the economy. The impact of an increased electricity price has a sustained negative impact on GDP, peaking at 2.1% decrease in 2030 and easing slightly to an annual loss of approximately 1.3% per annum after the units are commissioned. Sectors are unable to absorb the electricity price hikes and begin to contract due to decreased competitiveness. In this case, the sectors that are the biggest 'losers' are the electricity sector (-0.48% per annum), non-ferrous metals (-0.44% per annum), iron and steel (-0.21% per annum) and metals (-0.17% per annum).

The price impact, as well as the impact of less investment available for other more profitable sectors, has a significant negative impact on employment, with approximately 75 000 jobs lost if South Africa remains committed to an investment in nuclear power. The next section unpacks this result and provides more detail on labour market implications.

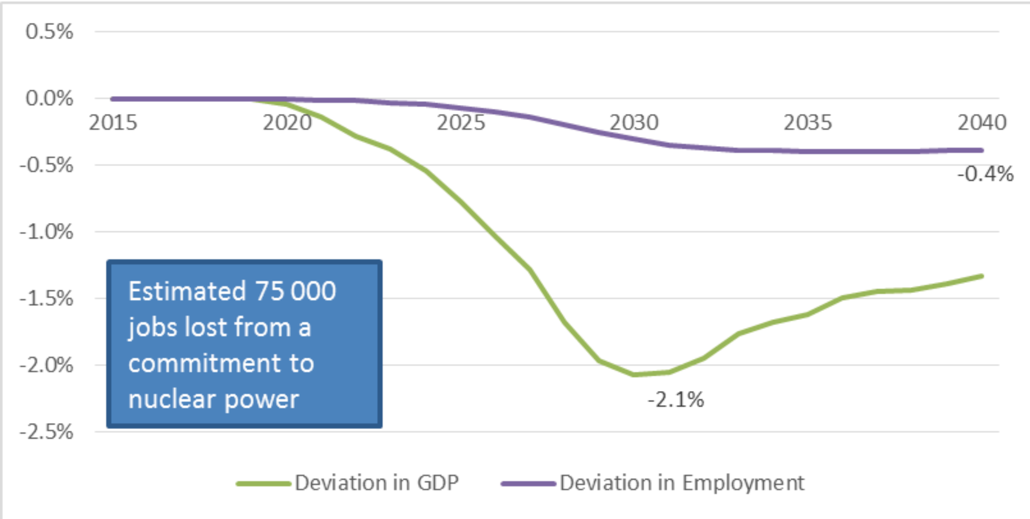


Figure 7: Impact on GDP and employment of the nuclear commitment versus flexible planning approach in Future 2

Employment effects by labour category

Table 4 below shows the impact of the forced nuclear against a flexible approach for Future 2. As can be seen, the employment effects are significant, and impact unskilled workers in particular (since high-skilled workers are assumed to be fully employed and able to move between sectors). The highest impact is felt on workers who have not completed Matric, with 50 000 jobs potentially lost.

Table 4: Employment effects of committed nuclear versus flexible planning in 2040 for Future 2

	Number of employed workers (thousands)			*Number of jobs created/(lost) with nuclear commitment*	*Number of jobs created/(lost) with nuclear commitment as a percentage of employed workers*
	2010	*Flexible policy in 2040*	*Nuclear commitment in 2040*		
Labour	**12 369**	**19 282**	**19 207**	**(74 663)**	**(0.4%)**
Unskilled labour	5 731	9 549	9 475	(74 663)	(0.8%)
Primary	1 942	3 204	3 180	(24 393)	(0.8%)
No matric	3 789	6 345	6 295	(50 270)	(0.8%)
Skilled labour	6 639	9 732	9 732	-	-
Secondary	3 645	5 697	5 697	-	-
Tertiary	2 994	4 036	4 036	-	-
Electricity sector	**37**	**66**	**59**	**(7 066)**	**(10.7%)**

Welfare

In Future 2, with lower growth rates and a commitment to the nuclear fleet, a significant increase in the electricity price results in the contraction of a number of key sectors in South Africa and decreases employment. There is therefore a negative impact on welfare. Household income is lower for households of all income levels. Figure 8 shows the impact on household consumption of the nuclear commitment against the flexible plan. As can be seen, consumption of the richest 10% of households falls by up to 2.24% against the flexible scenario. Consumption for the poorest 50% of households falls by up to 1.92%.

A key message from this result is that all consumers are likely to be burdened from the commitment to nuclear power. If consumers are unable to substitute electricity for more affordable energy options, they are likely to have to spend more on electricity and have to forgo the consumption of other goods. This is of particular concern for low-income earners. Although the percentage impact is smaller than for wealthier consumers, poorer households already spend a significant portion of their income on basic energy services, and forgoing other consumption can have serious impacts on welfare.

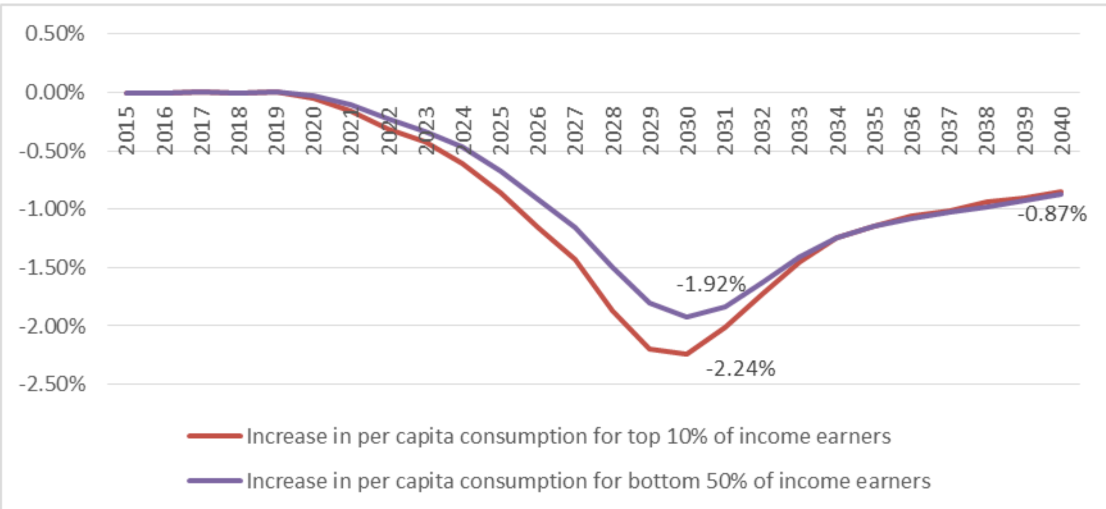


Figure 8: Impacts on household consumption of committed nuclear versus flexible scenario in Future 2

Quantifying the risks of a higher electricity price using Monte Carlo Analysis

In reality, the future is likely to fall somewhere in between the two extreme cases considered above. In the second part of the analysis we move away from the two specific cases (Futures 1 and 2) to one where we simulate, in a Monte Carlo fashion, a thousand scenarios and in each scenario 'draw' an internally consistent set of assumptions from a distribution for each of the uncertain parameters. What this means is that we assess the probability of a particular outcome using probabilities of all the uncertain parameters – and that under different combinations of these parameters (growth, technology costs, fuel prices and lead times) we can assess the likelihood of different possible outcomes. [4]

The 1000 different combinations are tested comparing a flexible planning approach and the IRP 2010 commitment to 9.6GW of nuclear power. In each case the electricity price is compared over the modelling horizon. While it is not possible to report on all of these futures, by focusing on a key outcome (an increase in the electricity price) we are able to quantify the risks of the IRP 2010 commitment to nuclear power compared to a flexible planning approach. We focused on the electricity price, because this potentially highlights negative impacts on consumers and the South African economy.

In doing so, we found that, regardless of the combination of parameters (i.e. assumptions used), in almost all cases the nuclear policy decision does not compare favourably against a flexible planning approach in terms of electricity prices.[5] The analysis above has shown the detail of two possible futures, but in reality there are multiple uncertainties and therefore many possible futures

Figure 9 shows the difference in electricity price for all 1000 scenarios in absolute (R/kWh) and in percentage terms. The green line is the median, starting off at around 10c/kWh in 2030 (10%) and dropping over time as the 'committed build' gets absorbed in the system. The blue lines show the 80% confidence interval, which stays above the zero line until 2040. The red-line shows the 95% confidence interval. As can be seen in the figures below, the price difference decreases over time in absolute as well as percentage terms. This result is consistent with the findings in future one and future two.

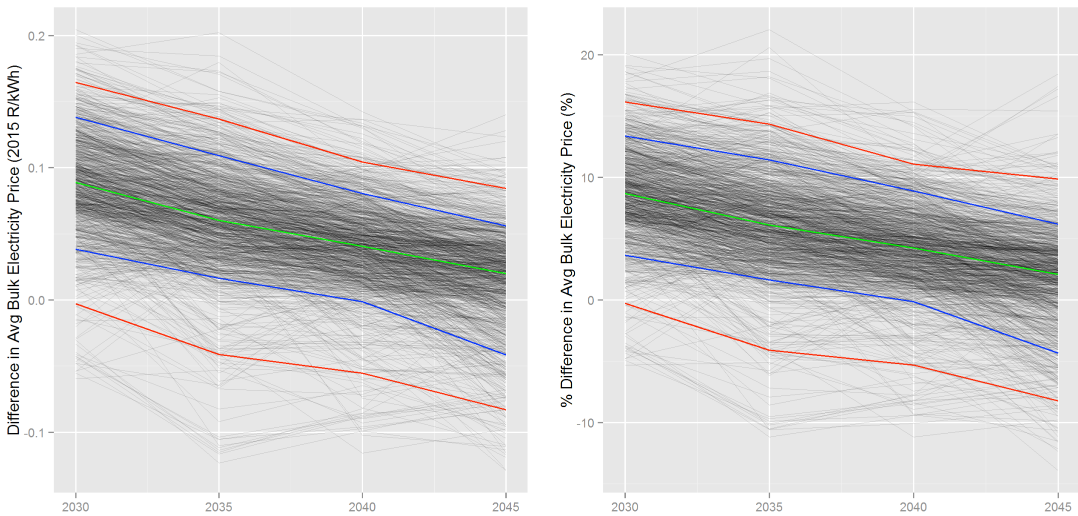


Figure 9: difference in the electricity price between committed nuclear and flexible planning in absolute and percentage terms, 2030–2045

4 A full explanation of the parameters is given in Merven and Durbach (2015).

5 For the full analysis and explanation of the Monte Carlo analysis please refer to the technical report (ERC, 2015).

The results show that, in 2030, if South Africa commits to a full fleet of nuclear, there is a 94% chance that electricity prices will be higher than if we were to adopt a flexible planning approach. While the electricity price difference drops over time, there is a significant risk of sustained higher electricity prices with the nuclear build.

In addition, there is a 20% chance of the price in 2030 being more than 10% higher with the commitment to nuclear. By combining the knowledge gained in the first part of the analysis and the distribution for the electricity price obtained here, one can infer fairly robustly that the risks of a negative impact on the economy of the large commitment being contemplated are high.

Implications of the results

This analysis aimed to explore the economic impacts of committing to nuclear power under conditions of uncertainty. The results show several effects, summarised briefly below.

If economic growth is high and the costs of nuclear are low, then the negative impact of building nuclear versus other capacity is negligible. In this future, higher demand requires higher installed capacity, and if we are optimistic about nuclear and pessimistic about alternatives, then committing to nuclear power will not negatively impact the electricity price or investment required compared to a flexible approach (since the capacity will be required and the forced nuclear is relatively cheap). More explicitly, an overinvestment in electricity capacity before 2030 could lead to favourable outcomes for the economy, if the economy is already experiencing higher growth. When there is higher growth there are marginal positive benefits from the commitment to nuclear power, although these effects are driven directly by the supply of electricity and not by the decision to invest in nuclear power per se. Thus the 27 000 jobs that are created across a number of sectors in the economy are driven by higher GDP growth and not directly by the investment in nuclear power.

Under the conditions of Future 1, there is no negative impact from a forced nuclear commitment, and household consumption, dropping briefly when the investment starts, recovers once capacity comes online.

If economic growth is lower, and nuclear costs are high, the impacts of a committed fleet of nuclear plants are substantial, and negative. Electricity prices will be higher over the period 2030–2040 and 20% higher in 2040 when compared to a flexible planning approach; similarly, GDP growth will be lower in 2040. The investment required will be significant, with impacts on investment in other sectors and the electricity price. This leads to substantial job losses if the nuclear commitment goes ahead compared to a flexible planning approach, with up to 75 000 jobs lost as the economy contracts in response to higher electricity prices. Given high levels of unemployment amongst unskilled workers, they are most likely to face the worst impacts of growing unemployment. In turn, household consumption will drop for all consumer groups, with potentially serious ramification on welfare.

Furthermore, the results show that in 2030 if South Africa commits to a full fleet of nuclear there is a 94% chance that electricity prices will be higher than if we adopted a flexible planning approach. The Monte Carlo analysis has used as input a spread of outcomes (distribution) for the key parameters that affect the price of electricity. We then modelled 1000 scenarios based on these different parameters. The evidence shows that several of the conditions that we assumed in Future 2 are more likely, particularly higher nuclear costs, longer lead times, optimistic renewable costs, and the availability of affordable alternative options. Thus, while the exact future we have outlined in Future 2 may not unfold, the likelihood is that the assumptions in Future 2 that result in higher electricity prices are more likely than the assumptions in Future 1. It is the finding of this study, therefore, that the nuclear commitment will result in higher electricity prices. And as shown in the detailed analysis of Future 2, the negative effects of this are significant.

Our results show that an investment of this magnitude could have significant impacts on the South African economy and the lock-in associated with an investment in the full fleet will result in South Africa foregoing investment in other, more cost-effective electricity generation technology options. Should the world outlined in Future 1 unfold, there is no cost or benefit to nuclear versus flexible planning. But should the conditions of Future 2 hold, then the negative effects on the South African economy of a commitment to the nuclear fleet would be substantial. Given the risks inherent in long-term electricity planning, the government must, if it chooses to procure nuclear power, do so in a way that minimises risks and minimises the negative effects of the procurement on the economy and on consumers. Given that the potential risks will burden the fiscus and all consumers in South Africa, the procurement of nuclear power should be done in a transparent manner, with all costs, risks and contractual details made known to the public and available for critical assessment.

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