energy
Department:
Energy
REPUBLIC OF SOUTH AFRICA

Executive Summary of the Draft Integrated Electricity Resource Plan for South Africa - 2010 to 2030

IRP 2010

The Inter Ministerial Committee (IMC) have approved this executive summary of the findings and conclusions drawn from scenario modelling process and the recommended Balanced Scenario which is the basis for the Draft IRP 2010 and that is to be used for public consultation.

Extract

The Balanced scenario provides for a 30% reduction in carbon emissions compared to the least Cost scenario and requiring only 8% additional funding compared to the least Cost scenario. The Balanced scenario also provides for localisation of renewable technologies. However, even the least Carbon scenario requires an additional R790b.

The Low Carbon scenario requires 50% more funding than the Balanced scenario whilst only yielding an additional 10% carbon reduction.

Clearly funding will remain one of the biggest binding constraints for the implementation of this or any future IRP.

03 September 2010

Compiled by the Department of Energy

based on inputs and recommendations by the

Interdepartmental Task Team

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1. EXECUTIVE SUMMARY

Long term planning, whilst essential, is fraught with uncertainty. This is more so today than ever before due to the pace of global change on the political, economic, social, technological and environmental fronts.

The biggest challenge in all long term planning lies in finding a sensible balance between the divergent views and expectations put forward by the different parties involved. These views fall broadly into two categories: desired/wished for (could be) outcomes and must be inputs or outputs, which are subject to various constraints. Such "could be" and "must be" parameters are the interdependent variables of planning.

Scenario planning is an effective tool to find this balance. A scenario is not a plan but rather a glimpse of an extreme future, where a particular outcome or input is amplified in a modelling process to observe the effect this has on the other interdependent variables. The balanced scenario is created by an assessment of all scenarios to establish a balance between desired future outcomes and the realities of known constraints. The balanced scenario is the basis for the ultimate government approved risk/policy adjusted plan.

The primary objective of the Integrated Resource Plan (IRP 2010) is to determine the long term electricity demand and detail how this demand should be met in terms of generating capacity, type, timing and cost. However, the IRP 2010 also serves as input to other planning functions, *inter alia* economic development, funding, environmental and social policy formulation. The accuracy of the IRP 2010 is improved by regular reviews and updates as and when things change or new information becomes available. For this reason all long term plans should be considered as indicative rather than "cast in concrete".

The proposed policy adjusted IRP aims to achieve a balance between an affordable price for electricity to support a globally competitive economy, a move to a more sustainable and efficient economy, a move to create local jobs, the demand on scarce resource such as water and the need to meet nationally appropriate emissions targets in line with global commitments. It supports the development of the Southern and Central African region by stimulating the development of hydro power projects in the region and provides a catalyst for further economic development due to increasing energy security.

The IRP describes the requisite capacity expansion plan for the country. As part of this expansion investment in generation technologies provides an opportunity for the development of local industry and skills. The development of the local industry has several beneficial impacts on:

- Jobs

- Local economy
- Balance of payment and
- Cost of the technology itself

As part of the process in modelling the technology scenarios to support the requisite expansion required, consideration was given to the issue of local potential to supply. While this consideration was not an integral part of the criteria (due to the high degree of unknown variables) it will be an important part of the economic impact modelling being undertaken by National Treasury, Department of Economic Development and the IDC.

The plan supports a GDP growth trajectory of on average 4.6% over the next 20 years. It requires 52248 MW of new capacity in order to meet the projected demand and provide adequate reserves. It assumes at least 3420 MW of demand side management programmes, as well as a gradual reduction in electricity intensity due to increased efficiency and a diversification to secondary and tertiary sectors in the economy. It however still assumes a significant primary sector built on the extraction and beneficiation of natural resources that the country is blessed with.

The scenario evaluation process confirmed that the "Revised Balanced Scenario" represents a fair and acceptable balance considering the divergence in stakeholder expectations and key constraints and risks for example:

- Affordability/Funding availability
- Reducing carbon emissions
- New technology uncertainties such as costs, operability, lead time to build etc
- Water usage
- Job creation
- Security of supply

The IMC is requested to approve the commencement of the last round of public consultation which will be based on the "Revised Balanced Scenario" as set out in this report.

2. THE IRP AND ITS PURPOSE

The Integrated Resource Plan is a 20 year electricity capacity plan. It aims to provide an indication of the country's electricity demand, how this demand will be supplied and what it will cost. It is not a plan that deals with the overall energy needs for the country nor does it deal with the wider infrastructure plan for the country. It is a key input into those plans and it is envisaged that there will be an iterative process in developing these plans. It tries to

cater for a cone of demand and to be flexible within reason to changes in assumptions on demand and supply.

NB: An additional "Medium Term Risk Mitigation" plan must be submitted with IRP 2010 that deals with the immediate medium term serious short fall in supply capacity. The plan's purpose is to ensure avoidance of any form of power supply rationing or curtailment in the anticipated constrained period from 2010 to 2017, by making available sufficient demand side reductions and efficiencies and additional non-Eskom generation.

3. THE IRP DEVELOPMENT PROCESS

The Electricity Regulations on New Generation Capacity states that the process for developing the integrated resource plan shall include:

a) Adoption of the planning assumptions;

b) Determination of the electricity load forecast;

c) Modelling scenarios based on the planning assumptions;

d) Determination of the base plan derived from a least cost generation investment requirement;

e) Risk adjustment of the base plan, which shall be based on:

   i. The most probable scenarios; and

   ii. Government policy objectives for a diverse generation mix, including renewable and alternative energies, demand side management and energy efficiency; and

f) Approval and gazetting of the integrated resource plan.

While the IRP includes current policy imperatives into the planning process, the outputs can and will have an impact on further policy directions and other Ministries' strategies. This impact is particularly evident in the discussion on climate change mitigation strategies. The IRP process is a dynamic and iterative process, subject to ongoing review and update, however the long lead time on expansion means that vacillation on choice will lead to delays in capacity with a subsequent impact on economic growth and jobs.

The IRP development follows three major stages:

- Agreement on input parameters;
- Modelling scenarios and analysis; and
- Development of the IRP based on the outcome of the above analysis.

Consultation and the IRP Development Process

The Department of Energy undertook to launch a proactive Stakeholder consultation process to ensure that critical input could be sourced from a diverse constituency during the development of the plan, rather after the publication of the plan. This process was a 2 phased intervention, including:

- Consultation on input parameters to the IRP modelling; and
- Consultation on the Balanced Scenario and draft IRP.

The final Input Parameter Values that were used in the modelling were based on a consolidation of both government and broader stakeholder desired/wished for outcomes and the must be inputs/outputs as prescribed by legal, physical or moral limitations.

The first output of the modelling process is the Base or "Least Cost" Scenario, which considered only the direct costs of the options considered. It does not consider any externalities.

The additional scenarios considered externalities either as limits or explicitly modelled as additional costs for the affected technologies. The primary externality factor that was considered in IRP 2010 was constraints around carbon emissions.

The Balanced Scenario was developed based on the most probable scenario inputs or outputs: Government policy objectives for a diverse generation mix, including renewable and alternative energies; demand side management; and energy efficiency forecasts.

The Balanced Scenarios seek to achieve a trade-off between:

- Least cost investment;
- Climate change mitigation;
- Localisation and job creation;
- Regional development – i.e. in SADC;
- Diversity of energy sources; and
- Energy efficiency and demand-side management.

Given the inherent uncertainty in long term planning, the scenarios also considered sensitivities such as different demand forecasts.

The scenario outputs were analysed and reviewed by the interdepartmental task team and based on this input the "Balanced Scenario" was developed. Following the public consultation process the IRP 2010 will be finalised considering:

- Unrealistic expansion options;
- Security of supply (Reliability criteria);
- Any limits imposed by the Integrated Energy Plan, such as energy transport infrastructure, are not violated - for example load factors on gas turbines and dam capacities.

The approved final draft IRP 2010 will then be subjected to a full production modelling test to ensure all operational risks have been considered. This must be done because the scenario models are basic and not as precise as the full production model.

An assessment of the plan's anticipated price path and investment requirements will be done. This assessment will also identify whether other policy objectives, not considered specifically in the scenarios, are met, such as competitiveness, social development issues, localisation etc. Furthermore the broader picture for other infrastructure development

such as water, roads and transmission will be considered for each plan to identify potential implementation issues.

4. THE IRP SCENARIOS MODELLED

The Integrated Resource Plan (IRP 2010) modelling has produced a set of scenarios, including the base scenario, that result in a number of "optimised" generation portfolios, i.e. portfolios that meet the scenario objectives while optimising for least (direct) costs under these constraints.

It is important to note that each scenario is a test of input options, in particular policy options, and not a reflection of expected real-world conditions. A scenario is not a plan but rather a glimpse of an extreme future where a particular outcome or input is amplified in a modelling process to observe the effect this has on the other interdependent variables.

The actual IRP 2010 is derived by selecting specific aspects from the various scenarios that best fit the realities of known physical constraints, prescribed specific objectives or desired future conditions.

The inherent plan uncertainties can be reduced (but never eliminated) by repeating the IRP planning process going forward as and when new information becomes available. The scenarios modelled were:

1. Base Case 0.0 – which only considers the direct costs of each technology.
2. Base Case 0.1 – which considers the cancellation of Kusile power station.
3. Base Case 0.2 – which considers a delay in the construction of Medupi and Kusile power stations.
4. Emission Limit 1.0 (EM1) – which imposes an annual emission limit of 275 MT of carbon dioxide.
5. Emission Limit 1.1 – as above with the additional consideration of the cancellation of Kusile power station.
6. Emission Limit 2.0 (EM2) – which imposes an emission limit of 275MT of carbon dioxide by 2025 but allows emissions to go to higher levels prior to 2025.
7. Emission Limit 2.1 – as above with the additional consideration of the cancellation of Kusile power station.
8. Emission Limit 3.0 (EM3) – which imposes a tighter emission limit of 220 MT of carbon dioxide from 2020.
9. Emission Limit 3.1 – as above with the additional consideration of the cancellation of Kusile power station.
10. Carbon Tax 0.0 (CT) – which imposes carbon taxes escalated to 2010 Rands as contained in the LTMS documents.
11. Carbon Tax 0.1 – as above with the additional consideration of the cancellation of Kusile power station.
12. Regional Development 0.0 (RD) – which considers a broader range of regional supply options.
13. Regional Development 0.1 – as above with the additional consideration of the cancellation of Kusile power station.
14. Enhanced DSM 0.0 (EDSM) – which imposes an additional demand side management programme of 6TWhrs by 2015.

15. Enhanced DSM 0.1 – as above with the additional consideration of the cancellation of Kusile power station.
16. Balanced Scenario – based on initial discussions within the Department of Energy
17. Revised Balanced Scenario – based on workshops with the interdepartmental task team.

Appendix AA contains the detailed Scenario Data Tables.

The following is an overview of the results and indicators ensuing from the scenario studies.

4.1. Base Case

The Base Case (with Kusile and Medupi as per the original committed schedule) provides for imported hydro as the first base-load capacity in 2020 (after the committed programmes), followed by combined cycle gas turbines (CCGT) (fuelled by liquefied natural gas, or LNG), then imported coal and fluidised bed combustion (FBC) coal, before pulverised coal which forms the basis of all further base-load capacity. Additional peaking capacity is exclusively provided by open-cycle gas turbines (OCGT), fuelled by diesel.

CO_2 emissions continue to grow (albeit at a lower rate due to more efficient power stations replacing decommissioned older ones) to a level of 381 million tons at the end of the period (2030). Water usage drops from 336 420 million litres in 2010 to 266 721 million litres in 2030 (due to replacing older wet-cooled coal power stations with newer dry-cooled stations).

The cancellation of the Kusile project would require alternative capacity to be built in 2017, in this case FBC coal and CCGT, with additional projects brought on at least a year earlier in each case. This increases the cost to the economy from R789bn to R840bn (in present value terms), *but does not include* the net impact of the cost saving on the cancelled project and penalties relating to this cancellation. The present value (PV) costs indicated do not include capital costs for committed projects.

A delay in building Medupi and Kusile causes some projects to be brought forward, for example an FBC coal unit in 2015 and CCGT units in 2017/18, to cover the reduced capacity over the medium term, but other options are pushed further out in time as the last unit of Kusile is only commissioned by 2020. Security of supply is not dramatically impacted by the delay, as long as the identified mitigating projects can be built in the periods required.

4.2. Emission Limit 1

Imposing a limit on emissions (at 275 million tons of CO_2 throughout the period) shifts the base-load alternatives away from coal (in particular pulverised coal) to nuclear and gas. Wind capacity is also favoured to meet the energy requirements over the period, especially as the emission constraint starts to bite in 2018. As the nuclear programme is restricted in

terms of its build rate (one unit every 18 months starting in 2022), wind is required to reduce emissions in the interim. CCGT provides a strong mid-merit alternative until nuclear is commissioned, especially providing higher load factors than wind with some dispatchability. The total cost to the economy (excluding capital costs of committed projects) is R860bn, compared with R789bn for the base case, but with significantly lower water consumption (241 785 million tons in 2030).

The scenarios including the cancellation of Kusile allow for additional pulverised coal generation to be built later (in 2028) with more wind capacity before 2022. CCGT capacity is brought forward to fill the gap left by the cancellation of Kusile.

4.3. Emission Limit 2

The emission limit is retained at 275 million tons but is only imposed from 2025. Under these conditions the nuclear and wind build is delayed (nuclear by one year, wind by five years). The other capacity is similar to the base case until 2022 when low carbon capacity is required to ensure that the constraint can be met in 2025. Decommissioning of older power stations (6654 MW by 2025) provides an opportunity to return to the constrained level of emissions. The cost to the economy is lower than the Emission Limit 1 scenario at R835bn with a slightly higher average annual emission of 275 million tons (as opposed to 266 million tons).

4.4. Emission Limit 3

The tighter emission limit of 220 million tons is imposed from 2020. This requires a significant amount of wind capacity (17600 MW starting in 2015) and solar capacity (11250 MW commissioned between 2017 and 2021) to meet the constraint. In total 17,6 GW of wind, 11,3 GW of solar and 9,6 GW of nuclear are built, with no coal capacity included. CCGT is constructed as a lower emission mid-merit capacity along with 6,5 GW of OCGT peakers.

The cost to the economy is significantly higher at R1250bn with much lower average annual emissions (235 million tons) and water consumption (218 970 million litres in 2030).

4.5. Carbon Tax

The carbon tax scenario includes a carbon tax at the level of that discussed in the Long Term Mitigation Strategy (LTMS) document, starting at R165/MWh in 2010 Rands, escalating to R332/MWh in 2020 until the end of the period (2030) before escalating again to R995/MWh in 2040. This level of carbon tax causes a switch in generation technology to low carbon emitting technologies, in particular the nuclear fleet (starting in 2022) and wind capacity of 17,6 GW starting in 2020. The remainder is provided by imported hydro (1959 MW), OCGT (4255 MW) and CCGT (4266 MW) with some FBC coal after 2028 (1750 MW).

The cost to the economy (excluding the tax itself, which would be a transfer to the fiscus) arising from the changed generation portfolio is R852bn, with average annual emissions at 269 million tons and water consumption declining to 238 561 million litres in 2030.

4.6. Regional Development

While the base case only includes some import options (Mpanda Nkua, Import Coal and Cahorra Bassa North), the regional development scenario considers all listed projects from the imports parameter input sheet. These additional options provide good alternatives to local supply options at lower generation costs but require additional transmission capacity to transport the energy.

Including these options brings the total cost to the economy (excluding the transmission backbone requirement for these projects) to R783bn (R6bn cheaper than the base case). The imported coal and hydro options are preferred to local options, but imported gas is not preferred to local gas options.

4.7. Enhanced DSM

A test case scenario was run to see what the impact of additional DSM would be on the IRP. For this scenario an additional 6 TWh DSM energy was forced by 2015. The resulting reduction in cost was R12,8bn (R789,5bn of the base case less R776,7bn for the Enhanced DSM scenario) on a PV basis, indicating that if a 6 TWh programme could be run for less than this cost it would be beneficial to the economy.

4.8. Balanced Scenarios

Two balanced scenarios were created considering divergent stakeholder expectations and key constraints and risks. The balanced scenarios represent the best trade-off between least-investment cost, climate change mitigation, diversity of supply, localisation and regional development. The CO_2 emission targets are similar to those in the Emissions 2 scenario.

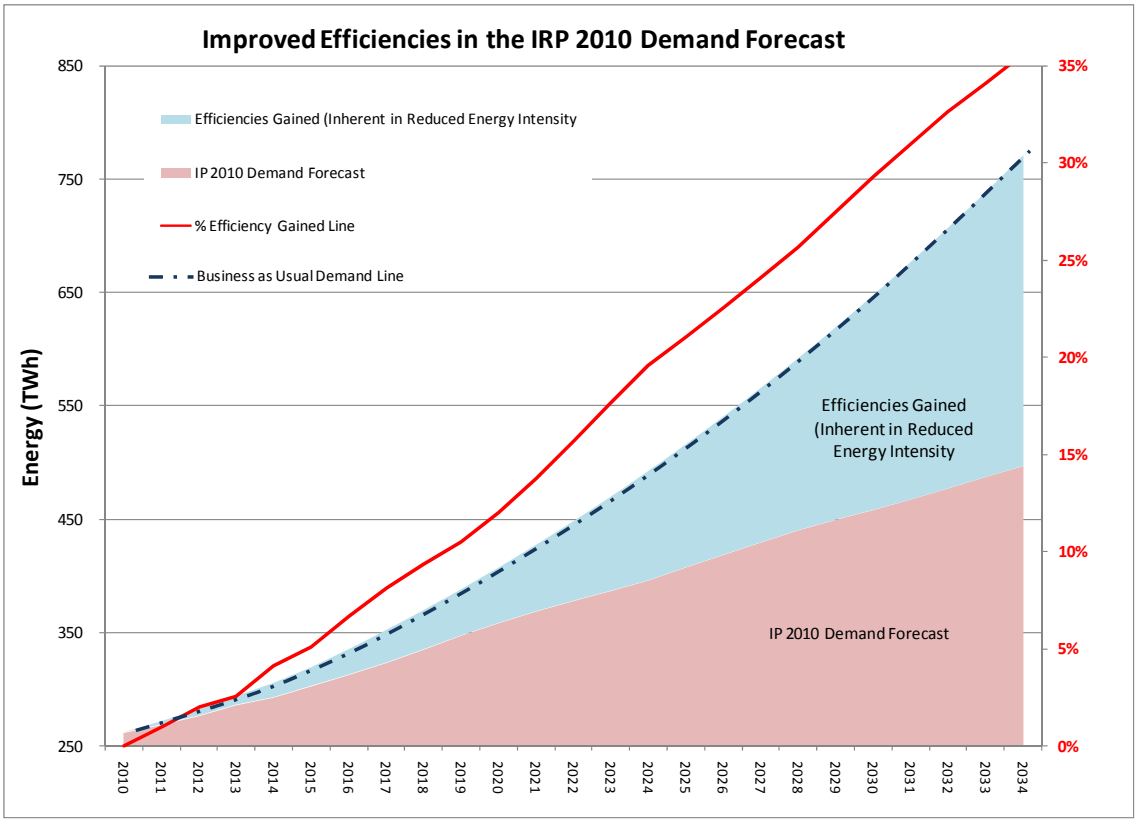
The balanced scenarios include the Eskom committed build programme plus the MTPP and REFIT commitments. A significant amount of wind is built, as this is the cheapest renewable energy option. Care is taken to ensure a steady and consistent build up in wind capacity in order to stimulate localisation of manufacturing and job creation. A consistent, although more modest, commitment is given to the more expensive concentrated solar option (CSP) in order to develop local experience with this technology as well as costs. The renewable energy options continue after 2020, but are not specified according to technology type at this stage. These choices will be made when there is more local knowledge and experience of both wind and solar energy. Nuclear energy comes in as a baseload option from 2023 – but because this is 13 years away, this decision does not yet have to be made. The scenario also provides for substantial diversity, with gas and regional hydro and coal options also

included. Allowance is also made for some short to medium term co-generation and self-build options to bolster security of supply concerns.

4.9. Energy Efficiency

It is important to highlight that the plan inherently contains significant energy efficiency savings which is accounted for in the demand forecasts.

The graph below illustrates that ~35% energy efficiency improvement is built into this IRP based on the reducing energy intensities which are used to determine the future energy demand.



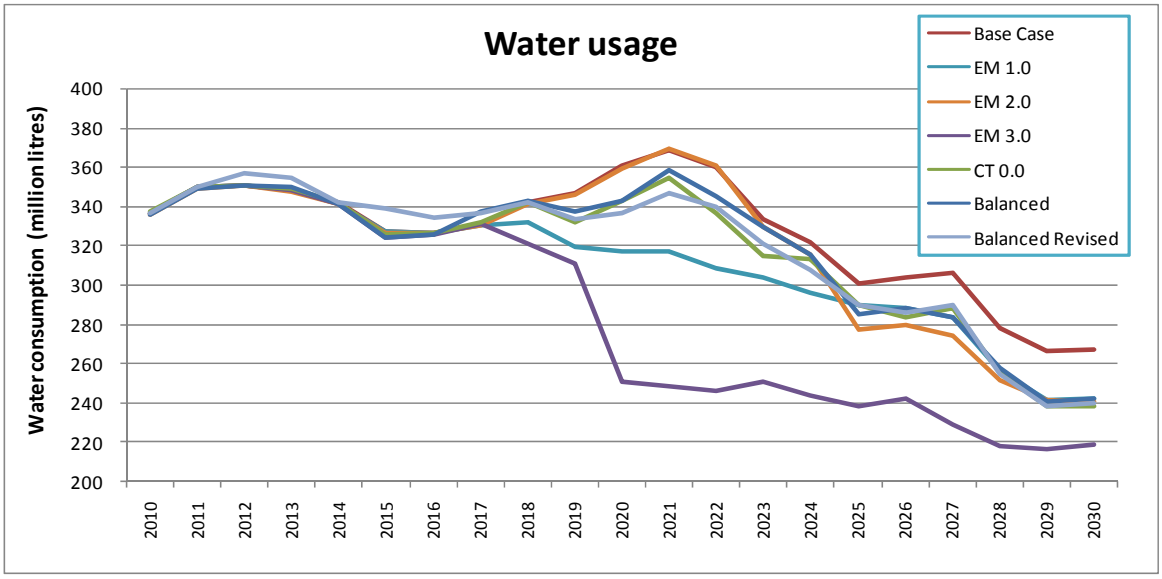
We can reasonably assume that for the next ~15 years most of the reduction in energy intensity is derived from improved energy efficiency, driven by increased electricity prices. After ~15 years any further reduction in energy intensity will then be driven by a changing economy model.

5. EVALUATING SCENARIOS

A set of criteria were proposed and discussed at a series of inter departmental workshops against which to assess a number of key parameters identified. These include:

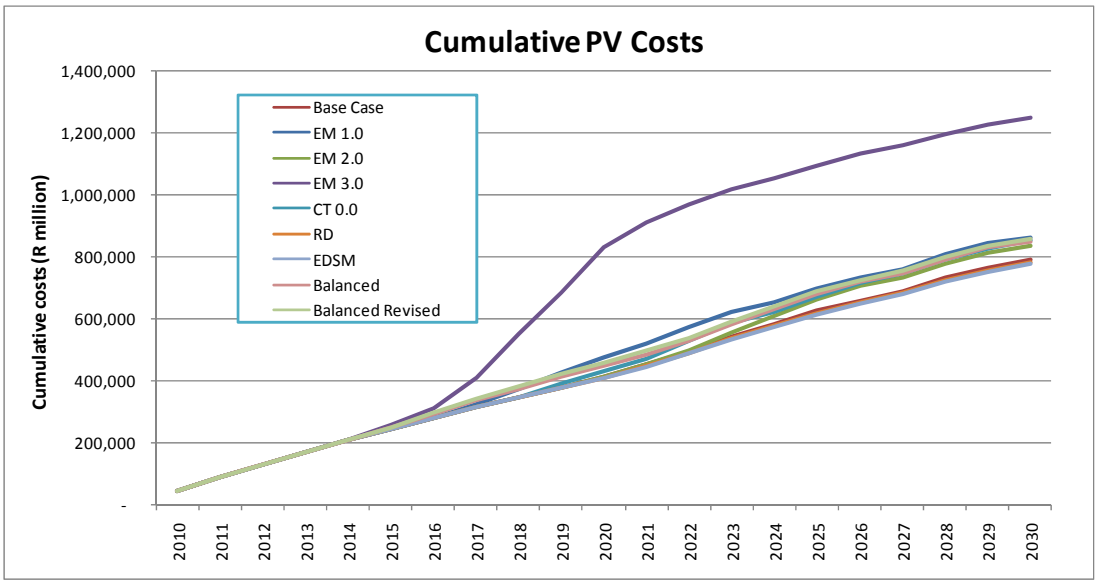
a) Water

The usage of water is quantified for each technology, according to the independent EPRI report and information from existing Eskom plant. The cost of water for existing plant and approved future plant is known and quantified. For plant that is recommended to be built in the proposed IRP 2010 only the usage of water is quantified given the fact that the location of the plant is not known at this stage in the development of the IRP.



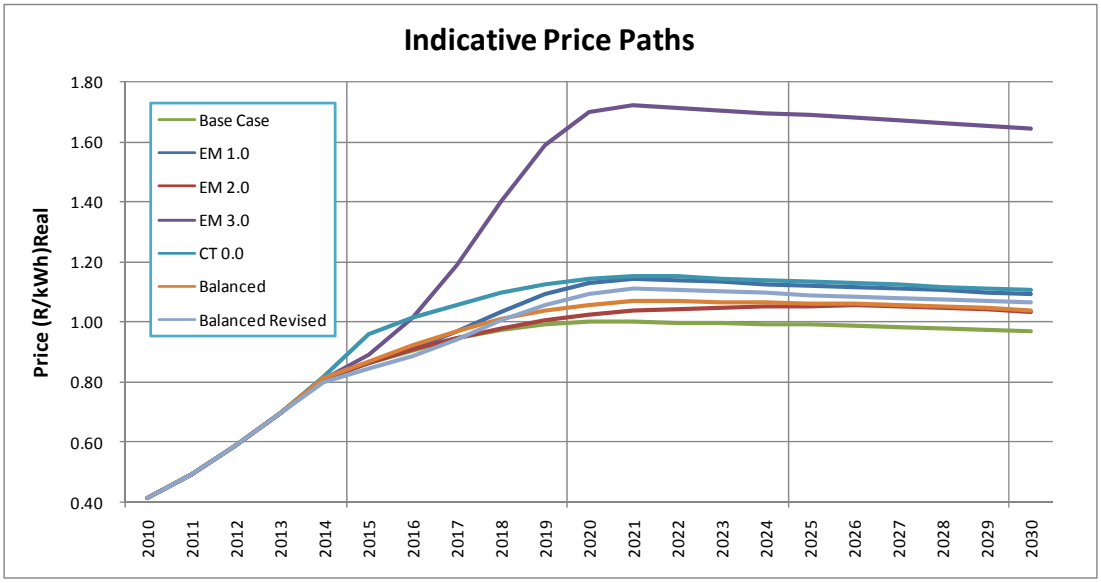
b) Cost

Each scenario will involve the construction of new generation capacity over the study period. For the current and approved projects the costs from the existing owner (Eskom, municipality or private supplier) will be used. For potential new projects the approved data set of option costs will be used. The criteria applied for this dimension should cover the direct costs associated with new generation capacity built under each scenario (including capital, operating and fuel costs) as well as existing plant (but excluding capital costs for committed plant) and will be summed to determine the total cost of the plan. This will be discounted to determine the present value of the plan and used as a comparator between the different scenarios.



Note: Present value (PV) costs are calculated in 2010 Rands (discounted at 8%) based on capital, O&M and fuel costs for all options (except capital costs for committed plant)

An alternative approach is to look at the future electricity price curves required to meet the generation costs incurred by the scenario portfolio. This model, similar to that applied in the Eskom MYPD decision by NERSA, provides an indicator of future costs to consumers for the electricity industry from each scenario portfolio.



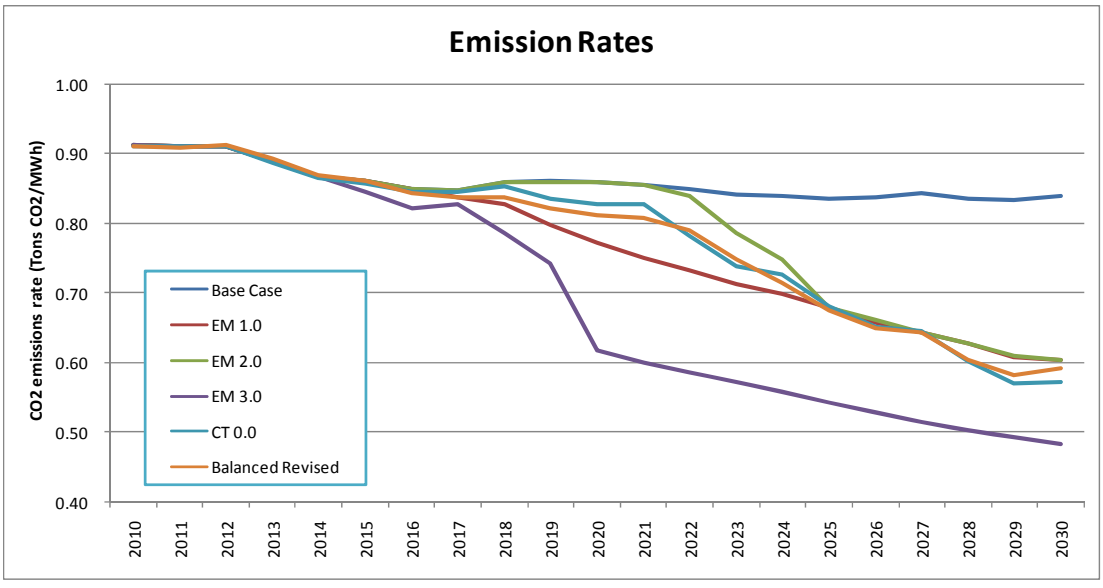
Note: The pricing curves apply the current Regulator pricing rules, and are calculated from a high level financial model using Eskom financial information from published annual statements for the past and the MYPD2 submission to the Regulator for the medium term future. Costs are escalated using the MYPD2 economic parameters. The prices are calculated using the approved rate of return methodology as adapted for the MYPD2 process, and the regulatory asset base was adjusted to reflect the approved asset values in the data base. Regulatory returns were set at the approved 8.17% and assets were depreciated over 25 years, indexing the values annually with the expected inflation rate.

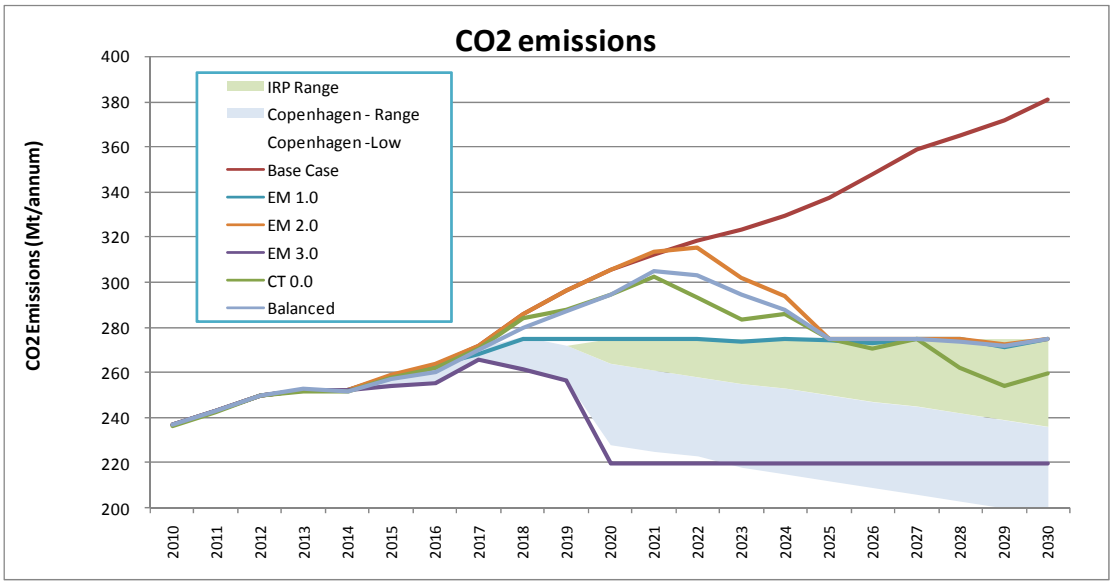
The base case was assumed to produce a price curve equivalent to the MYPD2 price curve. All other price curves for additional plans, scenarios and sensitivities were calculated by adding or subtracting the difference in capital spending, fuel cost and operating expenses to the base case schedules, resulting in a different price curve for each case according to the approved pricing rules, assuming all costs and expenses would be viewed as "efficiently incurred" expenses. The capital costs in the pricing model include allowance for owners' costs (assumed at 25% of the EPRI overnight capital costs). The Regulator's pricing rules do not allow interest during construction to be capitalised, instead work under construction earns a return.

For all new generation facilities the EPRI numbers from the IRP website were used. The full pricing model is based on public information to reflect the country plan results, intended to be published for public consumption.

c) Climate change mitigation

The Department of Environmental Affairs "Long Term Mitigation Strategy" (LTMS) provides guidance on the extent to which greenhouse gas (GHG) emissions should be restricted over time. For the purposes of the IRP the GHG emissions from existing and planned generation capacity can be quantified in the model and compared between scenarios. While certain scenarios may carry a specific limit to emissions, this criterion will compare the actual emissions between all scenarios.





d) Portfolio risk or uncertainty

An approach has been developed to identify and model risks associated with each of the scenario portfolios. There are different dimensions or sources of risk between the scenario portfolios, including (but not limited to):

- The validity of the cost assumptions for each technology;
- The validity of the lead time assumptions for each technology;
- The maturity of each technology;
- The security of fuel supplies for each technology; and
- Operational risks associated with each technology (including secondary life cycle effects), such as waste management, pollution and contamination.

Ideally these risks would carry cost elements which would enable incorporation into the IRP optimisation (through monetisation of the risk elements). However given the time constraints and dearth of data to support this process, this is not feasible at present. The second best approach would be to identify a probability distribution associated with the risks and use the standard deviation as a measure of risk and apply these across the identified dimensions. While this can be done for some of the risk dimensions, there is again a lack of information and time to produce such measures for every dimension. The third approach is to apply subjective expert judgement to each technology for every dimensions and derive a risk factor for each technology (and consequently, through capacity weightings, for each scenario portfolio). This methodology has been used for the IRP, with the resulting risk factor compared between the different scenarios.

e) Localisation benefit

A rating has been given to each scenario portfolio to indicate the extent to which this portfolio supports localisation of specific technologies and supporting industries. It is expected that the earlier a technology construction programme is triggered and the more steadily such technology capacity is added, the higher the potential to localise the technology industry. Thus a wind industry is supported by a regular build profile, starting earlier, and consequently a portfolio that incorporates such a build profile would have a higher score in this criterion. The application is however subjective.

f) Regional development

Workshops with government departments have indicated that this is an important criterion for the portfolios and that those portfolios that support increased import from regional options should have a higher score. Thus the portfolio with the higher percentage of imports (to the total capacity) scores higher on the regional development criterion. Technically speaking the total capacity is replaced in this calculation by the demand that must be met, so as to not penalise portfolios that build significant wind (which requires more capacity for each unit of demand due to the capacity credits applied to wind).

For the first three criteria (emissions, cost of plan and water) and the regional development criterion the measurement is provided by the optimisation results. The average domestic emissions figure is determined based on the emission contribution of each of the proposed projects and its expected output in each year. Similarly the cost of the plan is determined based on the capital, operating and fuel costs of each project (discounted to 2010 Rands), but specifically excludes the capital costs associated with existing power stations and the committed Eskom build. The water criterion is measured by summating the water requirements for the scenario portfolio for the entire study period.

The uncertainty factor criterion is measured using uncertainty factors for each technology and then applied, based on the relative capacity of each technology in the portfolio. The localisation criterion is based on a subjective score applied to the portfolios based on their perceived potential for localisation.

6. RATING THE SCENARIOS

Each of the scenarios provides the same reliability, since the model optimises between the cost of new generation and unserved energy. Thus security of supply is not treated as a criterion.

The criteria and associated metrics provide a framework in which the balanced scenario can be assessed for "goodness of fit". The principle is to achieve the best fit considering the divergent stakeholders' objectives. The table below contains the criteria metric values for each of the scenarios

Criteria metric scores for each scenario

Scenario	CO_2 emissions (million tons) av. p/a	Price path peak (cents/kWh)	Av. water consumption (million litres)	Uncertainty factor	Localisation potential	Regional development (% capacity imports)
Base Case 0.0	303	100	327	6.87	2	6.87
Emission 1.0	266	111	310	6.12	4	6.87
Emission 2.0	276	102	319	6.12	4	6.87
Emission 3.0	236	146	283	5.21	4	3.85
Carbon Tax 0.0	269	120	316	5.34	4	5.1
Regional Development 0.0	301	101	326	6.99	2	10.4
Enhanced DSM	299	104	324	6.86	2	6.87
Balanced	272	106	318	6.05	6	4.68
Revised Balance	271	103	318	6.22	8	8.63

Note: The above scores are comparable only in columns were the metric is the same and not across rows. For this purpose a multi-criteria decision making (MCDF) framework was adopted, details of which are described in the next section.

7. SCORING THE SCENARIOS

Using a rigorous multi-criteria decision making (MCDF) framework it is possible to describe, numerate and score the preferences and values of the stakeholders with respect to each of the criteria. This provides a foundation to assist in choosing a single portfolio as the preferred option. In addition it is possible to identify next-best alternates that can undergo additional stress testing to incorporate concerns regarding robustness to sensitivities.

An important step in the MCDF process is to determine weightings for each of the criterion. This provides the mechanism to score the scenario portfolios across the different criteria. Applying the agreed weighting for each criterion and value function returned the results contained in the table below.

Plans	Av. Annual CO_2 emissions	Price path peak	Water	Uncertainty	Localisation potential	Regional development	TOTAL
Base Case 0.0	-	21.74	-	2.73	-	6.08	30.54
Emission 1.0	12.41	18.03	5.24	16.14	6.47	6.08	64.36
Emission 2.0	9.43	21.17	2.53	16.14	6.47	6.08	61.81
Emission 3.0	21.74	-	10.87	19.57	6.47	-	58.65
Carbon Tax 0.0	11.50	13.86	3.50	19.26	6.47	2.77	57.36
Region Development 0.0	0.67	21.36	0.37	-	-	10.87	33.27
Enhanced DSM	1.54	20.31	0.94	3.04	-	6.08	31.91
Balanced	10.46	19.88	2.74	16.71	11.02	1.85	62.65
Revised Balance	11.01	20.90	2.92	14.73	15.22	8.85	**73.63**
Swing Weighting (/100)	21.74	21.74	10.87	19.57	15.22	10.87	100.00

The MCDF scores clearly demonstrate the extent to which the revised Balanced Scenario represents a fair and acceptable balance across the key criteria.

The MCDF also serves as a basis for debate on policy choices.

8. RECOMMENDED BALANCED SCENARIO

The balanced scenarios (the original balanced scenario and the Revised Balanced Scenario) were developed from workshops with government departments considering the results of all scenarios and the MCDF analysis.

The initial balanced scenario was based on the Emission 2 scenario which combined the interests of affordability (or least-cost) with an emission target that complied with LTMS requirements. It was decided, however, that the wind build programme started too late and was not sufficient to ensure a local industry to support this. Thus the wind programme was forced to start in 2014 (following the initial outlays from the renewable feed-in mechanism) at a steady construction for each year. In addition the build programme for Eskom's new coal-fired power stations were delayed – by twelve months for Medupi and by 24 months for Kusile. Costs for future coal were decreased from R300 a ton to R200 a ton, while LNG prices were increased to R80/GJ. Imported coal costs were changed from the generic costs of pulverised fuel without FGD to the cost inclusive of FGD.

Following discussions with government stakeholders it was decided that firstly, the emissions from imported coal should be excluded from domestic emissions accounting, and secondly, that a solar build programme was required alongside wind at a lower level initially, considering the fact that this technology is relatively new and still evolving. The current solar programme (as part of the renewable feed-in mechanism) was moved one year later to lay the foundation for this new programme which would continue at 100 MW for each year. After 2020 the renewable programme continues as a proxy for either wind, solar or other renewable technologies which are viable at that point. Also additional regional options were included as per the Regional Development scenario, and some CCGT capacity was forced to allow for a domestic contingency for import and renewable options.

The MCDF process confirmed that this Revised Balanced Scenario represents an appropriate balance between the different stakeholder expectations considering a number of key constraints and risks, for example:

- Affordability/Funding availability
- Reducing carbon emissions
- New technology uncertainties such costs, operability, lead time to build etc
- Water usage
- Localisation and job creation
- Southern African regional development and integration
- Security of supply

Another consideration included in the Revised Balanced Scenario is the support for the development of a local industry for renewable technologies, in particular wind and solar. By bringing the construction programme for these technologies forward and maintaining a stable roll-out programme, an opportunity is provided for localisation, not only in the construction of the equipment, but in the development of skills to support the renewable programme. By not specifically categorising the renewable technologies after 2020, a window is provided for government to direct alternative renewable technology development to meet government objectives.

The total wind capacity added by 2019 is 4500 MW, solar capacity by 2019 is 600 MW, and the total renewable capacity added from 2019 to 2030 is 7200 MW. By forcing the earlier adoption of renewable technologies the country is able to achieve a lower GHG emission peak (296 million tons in 2022, as opposed to 315 million tons in the Emission 2 scenario) at only a marginal increase in cost to the economy.

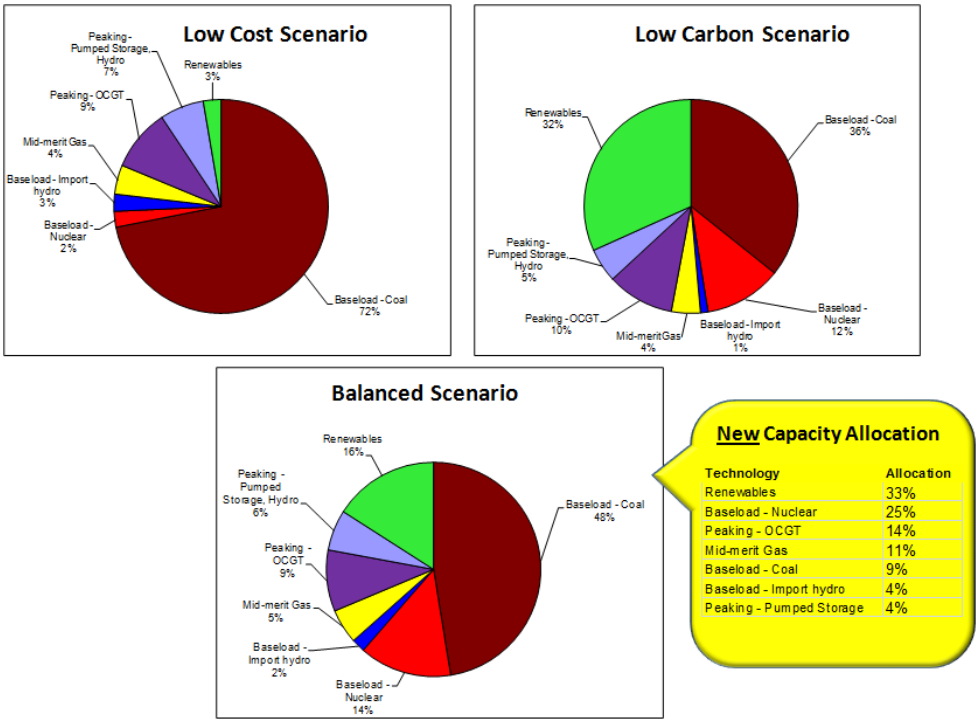
The Revised Balanced Scenario provides ample opportunity for private investment in electricity generation from the renewable programmes to the CCGT and regional options. The decision as to who builds this capacity must still be made as part of the feasibility assessment after the finalisation of the IRP 2010.

As part of the medium term business mitigation strategy a number of own generation or co-generation options have been identified before 2017. These options have been included in the Revised Balanced Scenario as additional capacity forced in as per the medium term schedule, in order to maintain some continuity between the plans. However these options have not been included in the calculations on water, prices or emissions.

The Balanced Revised Scenario follows the original decision that transmission infrastructure would not be included in the cost determination for different projects. However it is clear that the regional options are significantly impacted by the transmission infrastructure required to transport the power to South Africa. While there are debates regarding the actual costs of this infrastructure and what proportion would be met by domestic consumers, it is evident that options further from South Africa's borders are penalised relative to closer options. In this regard, the import hydro options identified in the Balanced Revised Scenario could end up more expensive than the coal options which are not built in this scenario. Thus it is possible that impart coal can be favoured over the other regional projects purely on the transmission infrastructure costs, and should not be penalised by carbon emissions as these do not count toward the domestic target. This would require a modification to the scenario (with regional hydro being delayed accordingly.

The graphs on the following pages serve to illustrate the extent to which the Revised Balanced Scenario represents an appropriate balance as compared to the two extreme scenarios of “Low Cost and Low Carbon”.

A Diversified Generation Mix by 2030 – Balancing Risk, Cost and Carbon

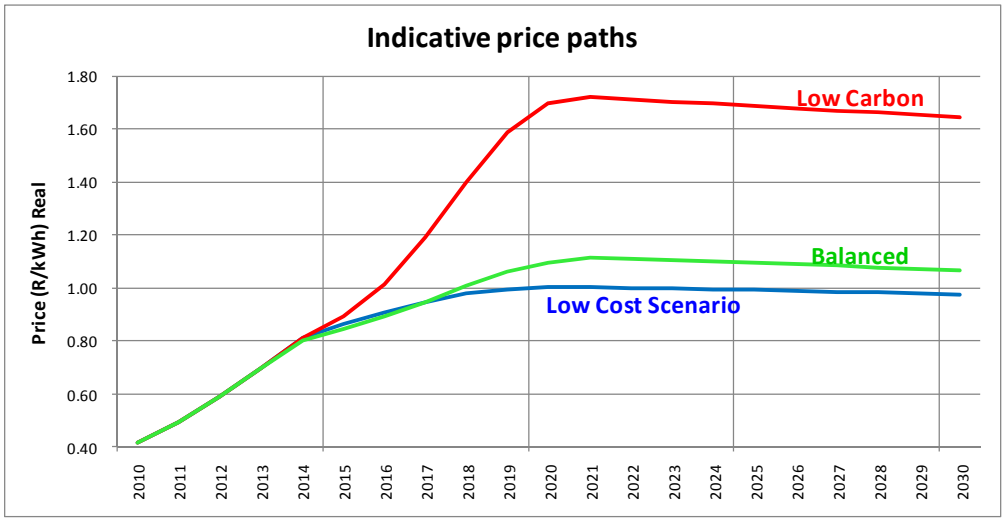


The generation mix for the Balanced Scenario shows a progressive shift away from coal towards renewables.

The possibility of the emergence in future of clean coal technologies cannot be ignored.

NB: IRP 2010 only sees the retirement of ~25% of the existing Eskom generating fleet and whilst this plan clearly shows a shift towards renewables the full extent of this shift can only be demonstrated with a 50 year plan.

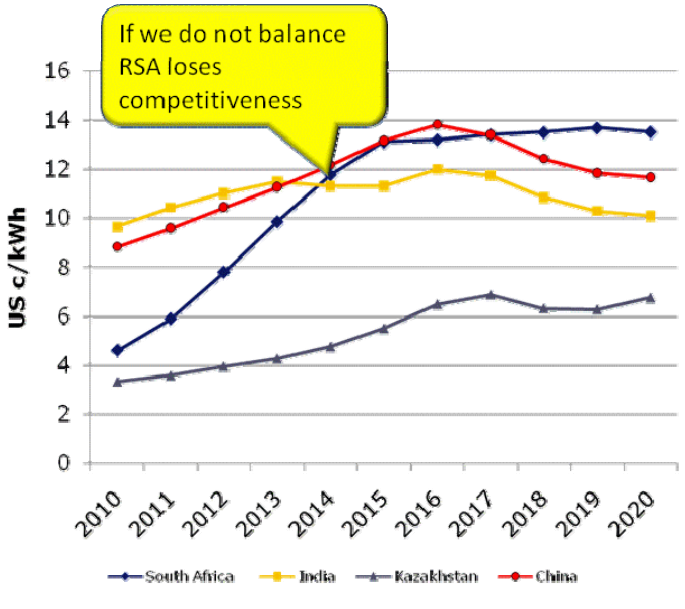
Affordability/Price (Indicative Price Paths)



The balanced scenario was able to achieve a price path very similar to the low cost scenario.

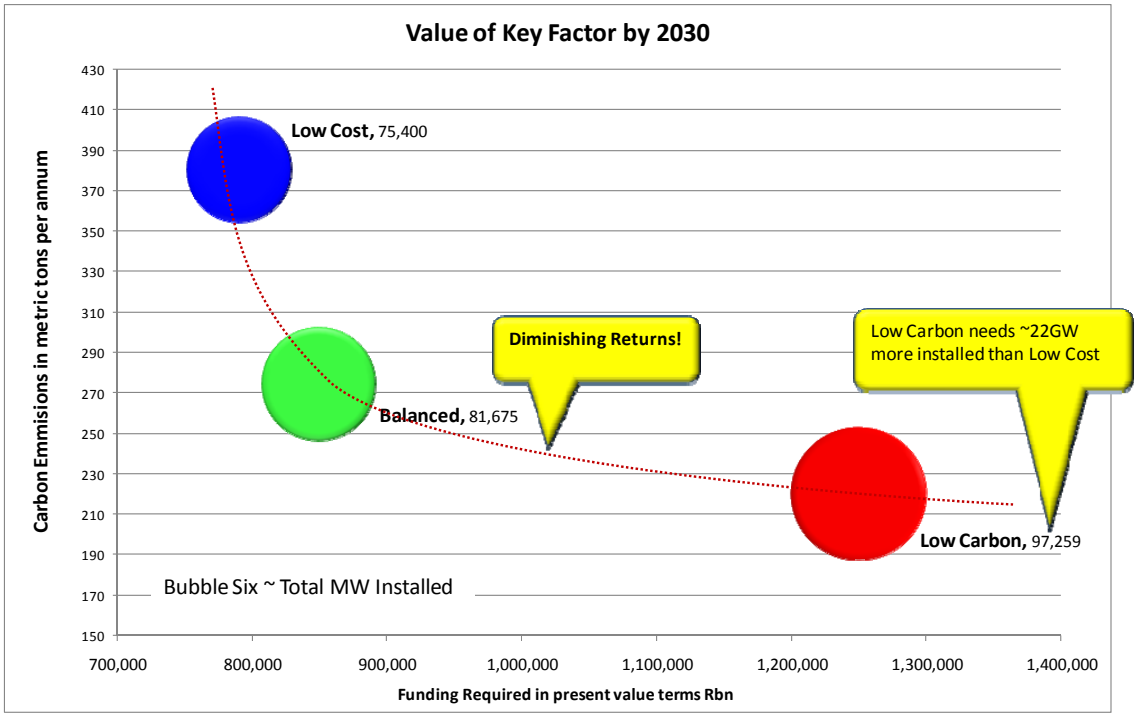
Notwithstanding, it is important to note that even at a 100c/kWh real price by 2020 will put South Africa in the top quartile (See next graph) of countries who are our competitors in the beneficiation of minerals.

RSA beneficiating competitiveness (Industrial electricity pricing comparison 2010-2020)



There is a real risk that if mineral beneficiation in South Africa stagnates or contracts due to high prices, this will lead to stranded new generating capacity which in turn will cause prices to rise even higher for remaining consumers to make up the loss of revenue.

Balancing Affordability, Price and Carbon (Diminishing returns on carbon reduction)

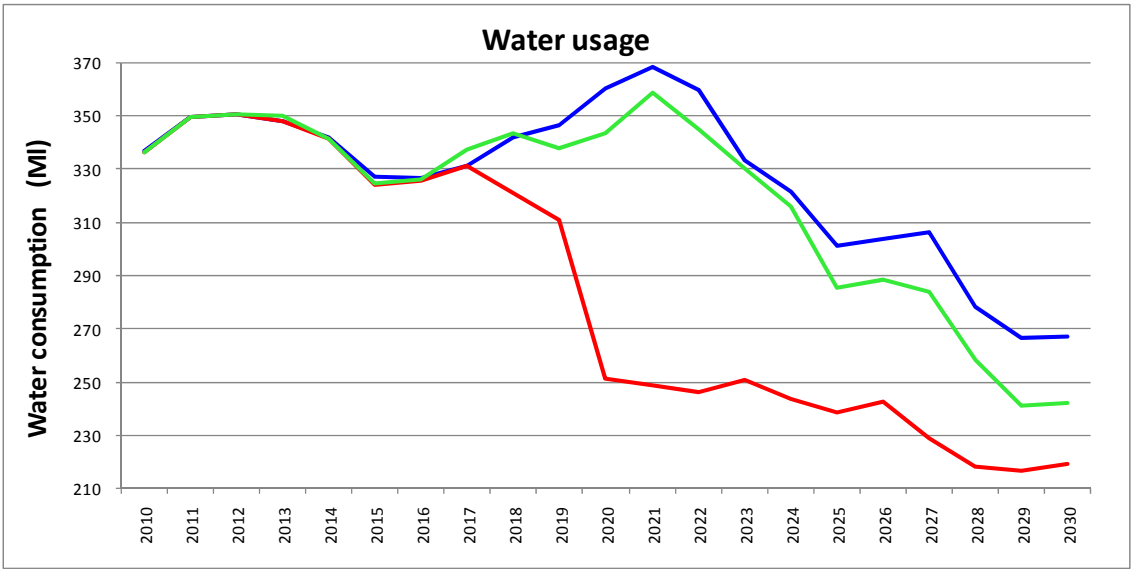


The graph above clearly shows the inherent diminishing returns on carbon reduction.

Nonetheless, it is possible that the high cost of carbon reduction today could come down in the future.

The Revised Balanced Scenario provides for an expansion plan that balances the requirements for reduced greenhouse gas emissions with future electricity prices, requirements for localisation and regional development, amongst other criteria. This provides a basis to reach the upper bound of the range of emission targets for the electricity sector, but does not provide for the full scope of the Copenhagen targets. The Copenhagen commitment included the proviso that these commitments must be met with international financing. The Revised Balanced Scenario provides a good foundation to meet the minimum or starting position for a low carbon future, but international financing support will be required to enable South Africa to develop more renewable options and thus meet the commitments.

Water (Total water consumption trends)



The water consumption by the electricity industry is reduced over the period by each programme, including the low cost scenario.

As mentioned earlier it must be borne in mind that IRP 2010 only sees the retirement of ~25% of the existing Eskom generating fleet and whilst this plan clearly shows a shift towards lower water consumption the full extent of this shift can only be demonstrated with a 50 year plan.

9. CONCLUSIONS

Government targets for emission reduction create the situation where the lower cost scenarios are not favoured as these continue the "business as usual" trend of carbon emissions. In order to meet these targets, a scenario that reduces absolute, as well as relative, carbon emissions was modelled. However it is important that these reductions in carbon emissions should be offset against the additional cost to the electricity consumer that would result from more expensive capacity. The Revised Balanced Scenario provides for a significant reduction in carbon emissions while allowing only a marginal increase in the price to the electricity consumer. Importantly the Revised Balanced Scenario provides for localisation of renewable technologies by establishing the grounds for a stable programme of capacity increase from renewable technology in the medium term.

This increase in renewable capacity does not come at the expense of security of supply as additional capacity is constructed to cater for lower capacity credits from renewable energy. Regional development does pose a minor risk to security of supply, especially where options are clustered around one source of fuel/power (e.g. the increased reliance on the Zambezi River) and too concentrated in one neighbouring country.

Due to the nature of the electricity industry, it is important that least-regret decisions are taken to secure supply for the next 10 years while technology evolution and growth trajectories are monitored and plans are modified as options appear. The following decisions need to be made this year:

- A commitment to current build programme by Eskom (12 GW).
- The conclusion of the first phase of the renewable energy feed-in tariff programme (up to 1025 MW).
- The support of co-generation and own generation options in the next 7 years to support security of supply and shift to lower intensity economy (up to 1500 MW).
- The conclusion of the Department of Energy Open Cycle Gas Turbine project (1000 MW).
- The renewable energy programme consisting of on-shore wind of up to 4.3 GW by 2019 and solar power of up to 600 MW by 2019. Choices after 2019 will be based on technology maturity and pricing. This will be supported by smaller projects in other renewable technologies such as landfill and mini-hydro projects.
- A commitment to regional development by developing the Mpanda Nkua project in Mozambique and being the counterparty to the power purchase agreement.
- Feasibility studies to develop a gas infrastructure in South Africa to support power generation and other uses.
- While nuclear power has been included from 2023, the decision to go for this option must be finalised as quickly as possible.

- Procurement process to support the commitment to a nuclear fleet programme by 2022.

The Revised Balanced scenario provides for some additional capacity until 2022 to cater for delays in implementation or cancellation of some of the programmes. However large scale deviations from the plan, in particular the nuclear fleet programme, pose a significant risk to security of supply. After finalising the IRP a mitigation strategy will be developed to consider alternatives. The IRP is regularly revised and changes can be incorporated if identified in time.

10. RECOMMENDATION

The scenario evaluation process confirmed that the "Revised Balanced Scenario" represents a fair and acceptable balance considering the divergence in stakeholder expectations and key constraints and risks, including:

- Affordability/Funding availability
- Reducing carbon emissions
- New technology uncertainties such costs, operability, lead time to build etc
- Water usage
- Job creation
- Security of supply

The IMC is requested to approve the commencement of the last round of public consultation, based on the "Revised Balanced Scenario" as set out in this report.

Scenario Data Tables

APPENDIX AA

Summary of Scenarios modelled for IRP 2010

Scenario	Constraints	Kusile
Base Case 0.0	Limited regional development options No externalities (incl carbon tax) or climate change targets	Committed
Base Case 0.1	As above	Excluded
Base Case 0.2	As above	Committed, but 24 month delay; and 12 month delay for Medupi
Emission Limit 1.0 (EM1)	Annual limit imposed on CO_2 emissions from electricity industry of 275MT CO_2-eq	Committed
Emission Limit 1.1	As above	Excluded
Emission Limit 2.0 (EM2)	Annual limit imposed on CO_2 emissions from electricity industry of 275MT CO_2-eq, imposed only from 2025	Committed
Emission Limit 2.1	As above	Excluded
Emission Limit 3.0 (EM3)	Annual limit imposed on CO_2 emissions from electricity industry 220MT CO_2-eq, imposed from 2020	Committed
Emission Limit 3.1	As above	Excluded
Carbon Tax 0.0 (CT)	Imposing carbon tax as per LTMS values (escalated to 2010 ZAR)	Committed
Carbon Tax 0.1	As above	Excluded
Regional Development 0.0 (RD)	Inclusion of additional regional projects as options	Committed
Regional Development 0.1	As above	Excluded
Enhanced DSM 0.0 (EDSM)	Additional DSM committed to extent of 6TWh energy equivalent in 2015	Committed
Enhanced DSM 0.1	As above	Excluded
Balanced Scenario	Emission constraints as with EM 2.0, Coal costs at R200/ton; LNG cost at R80/GJ, Import Coal with FGD, forced in Wind earlier with a ramp-up (200MW in 2014; 400MW in 2015; 800MW in 2016 and thereafter, until 2025 when the annual limit of 1600MW applies)	Committed, but 24 month delay; and 12 month delay for Medupi
Revised Balanced Scenario	As with Revised Balanced Scenario, with the additional requirement of a solar programme of 100MW in each year from 2016 to 2019 (and a delay in the REFIT solar capacity to 100MW in each of 2014 and 2015). CCGT forced in from 2019 to 2021 to provide backup options. Additional import hydro as per the Regional Development scenario	Committed, but 24 month delay; and 12 month delay for Medupi

Scenario Data Tables

Base Case 0.0 (Kusile in)

	Committed	Coal FBC	Import Coal	Gas CCGT	OCGT	Import Hydro	Coal PF + FGD	Total new build	Total system capacity	Peak demand (net sent-out) forecast	Demand Side Management	Reserve Margin	Reliable capacity Reserve Margin	Unserved energy	Annual energy (net sent-out) forecast	PV Total cost (cumulative)	Water	Total CO2 emissions	Capital expenditure (at date of commercial operation)
	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	%	%	GWh	GWh	Rm	ML	MT	Rbn
2010	640	0	0	0	0	0	0	640	44535	38885	252	15.28	15.18	-	259,685	44,138	336,420	237	-
2011	1009	0	0	0	0	0	0	1009	45544	39956	494	15.41	14.74	-	266,681	87,467	349,613	243	-
2012	1425	0	0	0	0	0	0	1425	46969	40995	809	16.88	15.25	-	274,403	128,921	350,510	250	-
2013	2601	0	0	0	0	0	0	2601	49570	42416	1310	20.59	17.84	-	283,914	168,689	347,830	252	-
2014	2543	0	0	0	0	0	0	2543	52113	43436	1966	25.66	23.52	-	290,540	206,850	341,505	252	-
2015	1988	0	0	0	0	0	0	1988	54101	44865	2594	27.98	23.48	-	300,425	244,060	327,011	259	-
2016	1355	0	0	0	0	0	0	1355	55456	45786	3007	29.63	24.52	-	310,243	280,709	326,392	264	-
2017	1446	0	0	0	0	0	0	1446	56902	47870	3420	28.01	22.54	-	320,751	314,878	330,861	272	-
2018	723	0	0	0	0	0	0	723	57625	49516	3420	25.01	19.82	-	332,381	346,282	341,701	286	-
2019	0	0	0	0	460	0	0	460	58085	51233	3420	21.48	16.57	-	344,726	378,543	346,415	297	1.95
2020	0	0	0	0	805	653	0	1458	59543	52719	3420	20.78	16.03	-	355,694	413,756	360,214	306	12.64
2021	-75	0	0	474	805	1023	0	2227	61770	54326	3420	21.34	16.72	-	365,826	451,476	368,262	313	22.47
2022	-1870	750	600	948	805	283	0	1516	63286	55734	3420	20.97	16.49	-	375,033	493,152	359,495	319	37.39
2023	-2280	750	600	711	0	0	1500	1281	64567	57097	3420	20.29	15.93	-	383,914	542,245	333,078	323	61.91
2024	-909	250	0	474	0	0	1500	1315	65882	58340	3420	19.96	15.70	-	392,880	581,161	321,490	330	39.47
2025	-1520	0	0	0	345	0	3000	1825	67707	60150	3420	19.35	15.24	-	404,358	625,387	300,861	337	65.21
2026	0	0	0	0	0	0	1500	1500	69207	61770	3420	18.61	14.63	-	415,281	657,853	303,450	348	31.87
2027	0	0	0	0	0	0	1500	1500	70707	63404	3420	17.88	14.02	-	426,196	688,775	306,068	359	31.87
2028	-2850	0	0	237	460	0	3750	1597	72304	64867	3420	17.67	13.91	-	436,761	730,641	277,801	365	83.15
2029	-1128	0	0	237	0	0	2250	1359	73663	66460	3420	16.85	13.20	-	445,888	762,702	266,200	372	49.32
2030	0	0	0	237	0	0	1500	1737	75400	67809	3420	17.10	13.52	-	454,357	789,481	266,721	381	33.39

Scenario Data Tables

Base Case 0.1 (Kusile out)

	Committed	Coal FBC	Import Coal	Gas CCGT	OCGT	Import Hydro	Coal PF + FGD	Total new build	Total system capacity	Peak demand (net sent-out) forecast	Demand Side Management	Reserve Margin	Reliable capacity Reserve Margin	Unserved energy	Annual energy (net sent-out) forecast	PV Total cost (cumulative)	Water	Total CO2 emissions	Capital expenditure (at date of commercial operation)
	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	%	%	GWh	GWh	Rm	ML	MT	Rbn
2010	640	0	0	0	0	0	0	640	44535	38885	252	15.28	15.18	-	259,685	44,138	336,420	237	-
2011	1009	0	0	0	0	0	0	1009	45544	39956	494	15.41	14.74	-	266,681	87,467	349,613	243	-
2012	1425	0	0	0	0	0	0	1425	46969	40995	809	16.88	15.25	-	274,403	128,921	350,510	250	-
2013	2601	0	0	0	0	0	0	2601	49570	42416	1310	20.59	17.84	-	283,914	168,689	347,830	252	-
2014	2543	0	0	0	0	0	0	2543	52113	43436	1966	25.66	21.81	-	290,540	206,590	341,713	253	-
2015	542	0	0	0	0	0	0	542	52655	44865	2594	24.56	20.13	-	300,425	243,721	340,606	261	-
2016	632	0	0	0	0	0	0	632	53287	45786	3007	24.56	19.58	-	310,243	280,351	343,534	267	-
2017	0	250	0	948	0	0	0	1198	54485	47870	3420	22.57	17.27	-	320,751	320,924	355,130	277	10.63
2018	0	750	0	948	0	0	0	1698	56183	49516	3420	21.88	16.78	-	332,381	363,705	365,153	289	19.76
2019	0	0	0	0	805	1023	0	1828	58011	51233	3420	21.33	16.42	-	344,726	405,213	370,827	296	19.44
2020	0	0	0	0	805	936	0	1741	59752	52719	3420	21.20	16.44	-	355,694	442,556	386,714	305	15.07
2021	-75	750	600	0	690	0	0	1965	61717	54326	3420	21.24	16.62	-	365,826	483,658	389,664	316	27.81
2022	-1870	0	600	0	690	0	2250	1670	63387	55734	3420	21.17	16.67	-	375,033	535,814	365,346	321	61.92
2023	-2280	0	0	237	345	0	3000	1302	64689	57097	3420	20.52	16.15	-	383,914	587,710	338,592	325	66.72
2024	-909	0	0	0	0	0	2250	1341	66030	58340	3420	20.23	15.97	-	392,880	630,110	328,208	334	47.81
2025	-1520	0	0	0	115	0	3000	1595	67625	60150	3420	19.20	15.10	-	404,358	674,865	305,605	341	64.23
2026	0	0	0	0	115	0	1500	1615	69240	61770	3420	18.66	14.68	-	415,281	708,137	307,920	351	32.36
2027	0	0	0	237	0	0	1500	1737	70977	63404	3420	18.33	14.46	-	426,196	740,045	311,777	363	33.39
2028	-2850	0	0	948	0	0	3000	1098	72075	64867	3420	17.30	13.54	-	436,761	779,607	283,643	366	69.81
2029	-1128	0	0	474	0	0	2250	1596	73671	66460	3420	16.86	13.21	-	445,888	812,796	271,939	373	50.84
2030	0	0	0	0	0	0	1500	1500	75171	67809	3420	16.75	13.17	-	454,357	839,972	273,753	382	31.87

Scenario Data Tables

Base Case 0.2 (Delay in Medupi and Kusile)

	Committed	Coal FBC	Import Coal	Gas CCGT	OCGT	Import Hydro	Coal PF + FGD	Total new build	Total system capacity	Peak demand (net sent-out) forecast	Demand Side Management	Reserve Margin	Reliable capacity Reserve Margin	Unserved energy	Annual energy (net sent-out) forecast	PV Total cost (cumulative)	Water	Total CO2 emissions	Capital expenditure (at date of commercial operation)
	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	%	%	GWh	GWh	Rm	ML	MT	Rbn
2010	640	0	0	0	0	0	0	640	44535	38885	252	15.28	15.18	-	259,685	44,138	336,420	237	-
2011	1009	0	0	0	0	0	0	1009	45544	39956	494	15.41	14.74	-	266,681	87,467	349,613	243	-
2012	703	0	0	0	0	0	0	703	46247	40995	809	15.08	13.47	0.22	274,403	129,310	356,709	251	-
2013	2601	0	0	0	0	0	0	2601	48848	42416	1310	18.83	16.10	-	283,914	170,119	358,017	255	-
2014	1821	0	0	0	0	0	0	1821	50669	43436	1966	22.18	18.39	-	290,540	209,189	350,803	256	-
2015	1264	250	0	0	0	0	0	1514	52183	44865	2594	23.45	19.04	-	300,425	250,830	350,937	264	4.57
2016	632	0	0	0	0	0	0	632	52815	45786	3007	23.46	18.51	-	310,243	288,356	343,572	268	-
2017	2168	0	0	237	0	0	0	2405	55220	47870	3420	24.23	18.87	-	320,751	324,478	343,379	276	1.52
2018	723	0	0	237	0	0	0	960	56180	49516	3420	21.88	18.30	-	332,381	357,709	350,153	288	1.52
2019	1446	0	0	0	805	0	0	2251	58431	51233	3420	22.21	17.27	-	344,726	391,034	350,444	296	3.41
2020	723	0	0	0	575	0	0	1298	59729	52719	3420	21.16	16.40	-	355,694	422,011	357,831	307	2.44
2021	-75	0	0	0	805	1023	0	1753	61482	54326	3420	20.77	16.17	-	365,826	458,680	369,668	315	19.44
2022	-1870	750	600	948	805	936	0	2169	63651	55734	3420	21.67	17.16	-	375,033	503,475	354,802	318	46.02
2023	-2280	750	600	474	0	0	1500	1044	64695	57097	3420	20.53	16.16	-	383,914	551,623	332,037	324	59.79
2024	-909	0	0	474	0	0	1500	1065	65760	58340	3420	19.74	15.49	-	392,880	589,015	321,490	330	34.90
2025	-1520	0	0	237	0	0	3000	1717	67477	60150	3420	18.94	14.85	-	404,358	633,234	300,863	338	65.26
2026	0	0	0	0	0	0	1500	1500	68977	61770	3420	18.21	14.24	-	415,281	665,675	303,452	348	31.87
2027	0	0	0	0	0	0	1500	1500	70477	63404	3420	17.49	13.65	-	426,196	696,585	306,070	359	31.87
2028	-2850	0	0	0	805	0	3750	1705	72182	64867	3420	17.47	13.71	-	436,761	738,423	278,156	365	83.09
2029	-1128	0	0	237	0	0	2250	1359	73541	66460	3420	16.66	13.01	-	445,888	770,472	266,469	372	49.32
2030	0	0	0	0	0	0	1500	1500	75041	67809	3420	16.54	12.97	-	454,357	796,931	267,192	381	31.87

Scenario Data Tables

Emissions 1.0

	Committed	Coal FBC	Import Coal	Gas CCGT	OCGT	Import Hydro	Wind	Nuclear Fleet	Coal PF + FGD	Total new build	Total system capacity	Peak demand (net sent-out) forecast	Demand Side Management	Reserve Margin	Reliable capacity Reserve Margin	Unserved energy	Annual energy (net sent-out) forecast	PV Total cost (cumulative)	Water	Total CO2 emissions	Capital expenditure (at date of commercial operation)
	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	%	%	GWh	GWh	Rm	ML	MT	Rbn
2010	640	0	0	0	0	0	0	0	0	640	44535	38885	252	15.28	15.18	-	259,685	44,138	336,420	237	-
2011	1009	0	0	0	0	0	0	0	0	1009	45544	39956	494	15.41	14.74	-	266,681	87,467	349,613	243	-
2012	1425	0	0	0	0	0	0	0	0	1425	46969	40995	809	16.88	15.25	-	274,403	128,921	350,510	250	-
2013	2601	0	0	0	0	0	0	0	0	2601	49570	42416	1310	20.59	17.84	-	283,914	168,689	347,830	252	-
2014	2543	0	0	0	0	0	0	0	0	2543	52113	43436	1966	25.66	23.52	-	290,540	206,850	341,505	252	-
2015	1988	0	0	0	0	0	0	0	0	1988	54101	44865	2594	27.98	23.48	-	300,425	244,060	327,011	259	-
2016	1355	0	0	0	0	0	0	0	0	1355	55456	45786	3007	29.63	24.52	-	310,243	280,709	326,392	264	-
2017	1446	0	0	0	0	0	1200	0	0	2646	58102	47870	3420	30.71	23.40	-	320,751	325,028	330,424	268	17.95
2018	723	0	0	948	0	0	1600	0	0	3271	61373	49516	3420	33.14	23.76	-	332,381	372,475	331,897	275	30.00
2019	0	0	0	948	0	740	1600	0	0	3288	64661	51233	3420	35.24	23.94	-	344,726	425,196	319,036	275	43.60
2020	0	0	0	948	0	370	1600	0	0	2918	67579	52719	3420	37.08	23.95	-	355,694	472,514	317,333	275	36.80
2021	-75	0	0	948	0	0	1600	0	0	2473	70052	54326	3420	37.61	22.82	-	365,826	516,670	317,085	275	30.00
2022	-1870	0	0	0	0	0	1400	1600	0	1130	71182	55734	3420	36.07	19.96	-	375,033	573,594	308,548	275	78.17
2023	-2280	0	0	0	805	0	0	1600	0	125	71307	57097	3420	32.85	17.22	-	383,914	620,892	303,971	274	60.63
2024	-909	0	0	0	805	283	1200	0	0	1379	72686	58340	3420	32.35	15.65	-	392,880	653,285	295,954	275	23.80
2025	-1520	0	0	0	805	283	0	1600	0	1168	73854	60150	3420	30.19	14.06	-	404,358	695,121	289,791	275	63.07
2026	0	0	0	0	230	0	0	1600	0	1830	75684	61770	3420	29.71	14.03	-	415,281	733,015	287,851	273	58.20
2027	0	250	0	474	690	0	800	0	0	2214	77898	63404	3420	29.86	13.73	-	426,196	760,364	283,339	275	22.49
2028	-2850	750	1200	0	0	0	0	1600	750	1450	79348	64867	3420	29.13	13.39	-	436,761	806,411	256,206	275	109.23
2029	-1128	750	0	0	115	0	0	1600	0	1337	80685	66460	3420	27.99	12.66	0	445,888	841,096	241,365	271	71.41
2030	0	0	0	0	690	283	0	0	0	973	81658	67809	3420	26.82	11.83	-	454,357	860,504	241,785	275	5.36

Scenario Data Tables

Emissions 1.1 (Kusile out)

	Committed	Coal FBC	Import Coal	Gas CCGT	OCGT	Import Hydro	Wind	Nuclear Fleet	Coal PF + FGD	Total new build	Total system capacity	Peak demand (net sent-out) forecast	Demand Side Management	Reserve Margin	Reliable capacity Reserve Margin	Unserved energy	Annual energy (net sent-out) forecast	PV Total cost (cumulative)	Water	Total CO2 emissions	Capital expenditure (at date of commercial operation)
	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	%	%	GWh	GWh	Rm	ML	MT	Rbn
2010	640	0	0	0	0	0	0	0	0	640	44535	38885	252	15.28	15.18	-	259,685	44,138	336,420	237	-
2011	1009	0	0	0	0	0	0	0	0	1009	45544	39956	494	15.41	14.74	-	266,681	87,467	349,613	243	-
2012	1425	0	0	0	0	0	0	0	0	1425	46969	40995	809	16.88	15.25	-	274,403	128,921	350,510	250	-
2013	2601	0	0	0	0	0	0	0	0	2601	49570	42416	1310	20.59	17.84	-	283,914	168,689	347,830	252	-
2014	2543	0	0	0	0	0	0	0	0	2543	52113	43436	1966	25.66	21.81	-	290,540	206,590	341,713	253	-
2015	542	0	0	0	0	0	0	0	0	542	52655	44865	2594	24.56	20.13	-	300,425	243,721	340,606	261	-
2016	632	0	0	0	0	0	1400	0	0	2032	54687	45786	3007	27.84	20.63	-	310,243	292,939	339,264	263	20.95
2017	0	0	0	711	0	0	1600	0	0	2311	56998	47870	3420	28.23	18.36	-	320,751	343,102	345,535	269	28.49
2018	0	0	0	948	0	0	1600	0	0	2548	59546	49516	3420	29.18	17.37	-	332,381	390,784	354,302	275	30.00
2019	0	0	0	711	0	1110	1600	0	0	3421	62967	51233	3420	31.69	18.05	-	344,726	445,725	351,839	275	48.88
2020	0	0	0	948	575	0	1600	0	0	3123	66090	52719	3420	34.06	18.63	-	355,694	491,096	350,182	275	32.44
2021	-75	0	0	948	805	566	1600	0	0	3844	69934	54326	3420	37.38	20.29	-	365,826	538,150	341,588	275	38.28
2022	-1870	0	0	0	115	0	800	1600	0	645	70579	55734	3420	34.92	17.34	-	375,033	592,621	337,736	275	69.68
2023	-2280	750	0	0	575	0	0	1600	0	645	71224	57097	3420	32.69	15.61	-	383,914	645,226	329,010	274	73.36
2024	-909	750	0	0	805	0	600	0	0	1246	72470	58340	3420	31.95	14.55	-	392,880	679,784	313,825	275	26.09
2025	-1520	250	600	0	0	0	0	1600	750	1680	74150	60150	3420	30.71	13.88	-	404,358	730,669	290,717	273	88.91
2026	0	0	0	0	0	0	0	1600	0	1600	75750	61770	3420	29.82	13.47	0	415,281	769,248	290,696	272	57.22
2027	0	0	0	0	805	283	1000	0	0	2088	77838	63404	3420	29.76	12.76	-	426,196	797,055	288,699	275	20.81
2028	-2850	0	0	0	0	0	0	1600	3000	1750	79588	64867	3420	29.52	12.92	-	436,761	846,910	261,483	273	120.96
2029	-1128	0	0	0	0	0	0	1600	750	1222	80810	66460	3420	28.19	12.02	1	445,888	882,925	247,239	269	73.16
2030	0	0	0	0	805	0	0	0	0	805	81615	67809	3420	26.75	10.95	-	454,357	903,250	247,384	273	3.41

Scenario Data Tables

Emissions 2.0

	Committed	Coal FBC	Import Coal	Gas CCGT	OCGT	Import Hydro	Wind	Nuclear Fleet	Coal PF + FGD	Total new build	Total system capacity	Peak demand (net sent-out) forecast	Demand Side Management	Reserve Margin	Reliable capacity Reserve Margin	Unserved energy	Annual energy (net sent-out) forecast	PV Total cost (cumulative)	Water	Total CO2 emissions	Capital expenditure (at date of commercial operation)
	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	%	%	GWh	GWh	Rm	ML	MT	Rbn
2010	640	0	0	0	0	0	0	0	0	640	44535	38885	252	15.28	15.18	-	259,685	44,138	336,420	237	-
2011	1009	0	0	0	0	0	0	0	0	1009	45544	39956	494	15.41	14.74	-	266,681	87,467	349,613	243	-
2012	1425	0	0	0	0	0	0	0	0	1425	46969	40995	809	16.88	15.25	-	274,403	128,921	350,510	250	-
2013	2601	0	0	0	0	0	0	0	0	2601	49570	42416	1310	20.59	17.84	-	283,914	168,689	347,830	252	-
2014	2543	0	0	0	0	0	0	0	0	2543	52113	43436	1966	25.66	23.52	-	290,540	206,850	341,505	252	-
2015	1988	0	0	0	0	0	0	0	0	1988	54101	44865	2594	27.98	23.48	-	300,425	244,060	327,011	259	-
2016	1355	0	0	0	0	0	0	0	0	1355	55456	45786	3007	29.63	24.52	-	310,243	280,709	326,392	264	-
2017	1446	0	0	0	0	0	0	0	0	1446	56902	47870	3420	28.01	22.54	-	320,751	314,878	330,861	272	-
2018	723	0	0	0	0	0	0	0	0	723	57625	49516	3420	25.01	19.82	-	332,381	346,282	341,701	286	-
2019	0	0	0	0	575	0	0	0	0	575	58200	51233	3420	21.72	16.80	-	344,726	378,773	346,414	296	2.44
2020	0	0	0	0	805	653	0	0	0	1458	59658	52719	3420	21.01	16.26	-	355,694	413,983	359,481	305	12.64
2021	-75	0	0	237	805	1023	0	0	0	1990	61648	54326	3420	21.10	16.49	-	365,826	451,041	369,552	313	20.96
2022	-1870	750	0	948	805	283	1600	0	0	2516	64164	55734	3420	22.65	16.12	-	375,033	497,317	360,838	315	49.55
2023	-2280	250	0	948	0	0	1600	1600	0	2118	66282	57097	3420	23.48	15.15	-	383,914	556,835	330,101	302	91.79
2024	-909	0	0	948	0	0	1600	1600	0	3239	69521	58340	3420	26.59	16.45	-	392,880	610,191	315,790	294	87.22
2025	-1520	0	0	711	0	0	1600	1600	0	2391	71912	60150	3420	26.76	15.10	-	404,358	660,475	277,549	275	85.71
2026	0	0	0	0	0	0	1600	1600	0	3200	75112	61770	3420	28.73	15.54	-	415,281	705,297	279,917	275	81.16
2027	0	0	0	474	115	0	1600	0	0	2189	77301	63404	3420	28.87	14.28	-	426,196	734,485	274,581	275	27.46
2028	-2850	750	1200	0	230	0	400	1600	0	1330	78631	64867	3420	27.96	13.31	-	436,761	778,629	252,124	275	100.25
2029	-1128	0	0	0	0	0	0	1600	750	1222	79853	66460	3420	26.67	12.41	-	445,888	813,912	241,916	272	73.16
2030	0	0	0	0	805	0	800	0	0	1605	81458	67809	3420	26.51	11.73	-	454,357	835,491	241,091	275	15.38

Scenario Data Tables

Emissions 2.1 (Kusile out)

	Committed	Coal FBC	Import Coal	Gas CCGT	OCGT	Import Hydro	Wind	Nuclear Fleet	Coal PF + FGD	Total new build	Total system capacity	Peak demand (net sent-out) forecast	Demand Side Management	Reserve Margin	Reliable capacity Reserve Margin	Unserved energy	Annual energy (net sent-out) forecast	PV Total cost (cumulative)	Water	Total CO2 emissions	Capital expenditure (at date of commercial operation)
	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	%	%	GWh	GWh	Rm	ML	MT	Rbn
2010	640	0	0	0	0	0	0	0	0	640	44535	38885	252	15.28	15.18	-	259,685	44,138	336,420	237	-
2011	1009	0	0	0	0	0	0	0	0	1009	45544	39956	494	15.41	14.74	-	266,681	87,467	349,613	243	-
2012	1425	0	0	0	0	0	0	0	0	1425	46969	40995	809	16.88	15.25	-	274,403	128,921	350,510	250	-
2013	2601	0	0	0	0	0	0	0	0	2601	49570	42416	1310	20.59	17.84	-	283,914	168,689	347,830	252	-
2014	2543	0	0	0	0	0	0	0	0	2543	52113	43436	1966	25.66	21.81	-	290,540	206,590	341,713	253	-
2015	542	0	0	0	0	0	0	0	0	542	52655	44865	2594	24.56	20.13	-	300,425	243,721	340,606	261	-
2016	632	0	0	0	0	0	0	0	0	632	53287	45786	3007	24.56	19.58	-	310,243	280,351	343,534	267	-
2017	0	0	0	948	0	0	0	0	0	948	54235	47870	3420	22.01	17.27	-	320,751	320,931	355,279	278	10.63
2018	0	750	0	711	0	0	0	0	0	1461	55696	49516	3420	20.83	15.76	-	332,381	360,554	369,827	290	13.68
2019	0	0	0	0	805	1023	0	0	0	1828	57524	51233	3420	20.31	15.43	-	344,726	402,372	375,349	297	19.44
2020	0	0	0	0	805	936	0	0	0	1741	59265	52719	3420	20.22	15.97	-	355,694	442,002	385,196	305	19.64
2021	-75	750	0	0	690	0	1600	0	0	2965	62230	54326	3420	22.24	16.03	-	365,826	488,353	389,522	312	40.57
2022	-1870	0	1200	0	690	0	1600	1600	0	3220	65450	55734	3420	25.11	16.99	-	375,033	556,601	353,235	301	106.46
2023	-2280	250	0	948	0	0	1600	1600	750	2868	68318	57097	3420	27.28	16.90	-	383,914	619,801	323,923	289	103.16
2024	-909	0	0	948	0	0	1600	0	0	1639	69957	58340	3420	27.38	15.33	-	392,880	655,496	316,621	289	30.00
2025	-1520	0	0	711	460	0	1600	1600	0	2851	72808	60150	3420	28.34	14.80	-	404,358	706,826	284,836	275	87.66
2026	0	0	0	0	0	0	1600	1600	0	3200	76008	61770	3420	30.26	15.24	-	415,281	752,117	289,719	275	81.16
2027	0	0	0	0	460	0	1600	0	0	2060	78068	63404	3420	30.15	13.79	-	426,196	781,269	285,229	275	25.89
2028	-2850	0	0	0	0	0	0	1600	3000	1750	79818	64867	3420	29.90	13.92	-	436,761	831,030	258,205	275	120.96
2029	-1128	0	0	0	0	0	0	1600	1500	1972	81790	66460	3420	29.74	14.17	-	445,888	870,251	244,361	273	89.09
2030	0	0	0	0	805	0	400	0	0	1205	82995	67809	3420	28.90	13.25	-	454,357	891,015	243,877	275	9.40

Scenario Data Tables

Emissions 3.0

	Committed	Coal FBC	Import Coal	Gas CCGT	OCGT	Import Hydro	Wind	Nuclear Fleet	CSP	Total new build	Total system capacity	Peak demand (net sent-out) forecast	Demand Side Management	Reserve Margin capacity	Reserve Margin	Unserved energy	Annual energy (net sent-out) forecast	PV Total cost (cumulative)	Water	Total CO2 emissions	Capital expenditure (at date of commercial operation)
	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	%	%	GWh	GWh	Rm	ML	MT	Rbn
2010	640	0	0	0	0	0	0	0	0	640	44535	38885	252	15.28	15.18	-	259,685	44,138	336,420	237	-
2011	1009	0	0	0	0	0	0	0	0	1009	45544	39956	494	15.41	14.74	-	266,681	87,467	349,613	243	-
2012	1425	0	0	0	0	0	0	0	0	1425	46969	40995	809	16.88	15.25	-	274,403	128,921	350,510	250	-
2013	2601	0	0	0	0	0	0	0	0	2601	49570	42416	1310	20.59	17.84	-	283,914	168,689	347,830	252	-
2014	2543	0	0	0	0	0	0	0	0	2543	52113	43436	1966	25.66	23.52	-	290,540	206,844	341,494	252	-
2015	1988	0	0	0	0	0	1600	0	0	3588	55701	44865	2594	31.77	24.70	-	300,425	259,821	324,217	254	23.94
2016	1355	0	0	0	0	0	1600	0	0	2955	58656	45786	3007	37.11	26.92	-	310,243	311,093	325,526	255	23.94
2017	1446	0	0	948	0	0	1600	0	1500	5494	64150	47870	3420	44.32	29.69	-	320,751	410,634	331,122	265	114.28
2018	723	0	0	948	0	0	1600	0	3125	6396	70546	49516	3420	53.04	33.12	-	332,381	551,328	320,855	261	205.57
2019	0	0	0	948	805	0	1600	0	3125	6478	77024	51233	3420	61.09	36.28	-	344,726	686,055	310,920	256	208.99
2020	0	0	0	948	805	1110	1600	0	3125	7588	84612	52719	3420	71.63	42.06	-	355,694	832,231	251,137	220	229.38
2021	-75	0	0	474	805	0	1600	0	375	3179	87791	54326	3420	72.46	41.36	-	365,826	910,046	248,837	220	51.45
2022	-1870	0	0	0	0	0	1600	1600	0	1330	89121	55734	3420	70.36	38.14	-	375,033	971,083	245,914	220	81.16
2023	-2280	0	0	0	0	0	200	1600	0	-480	88641	57097	3420	65.14	33.61	-	383,914	1,019,413	250,447	220	60.21
2024	-909	0	0	0	0	0	1600	0	0	691	89332	58340	3420	62.66	29.98	-	392,880	1,053,142	243,538	220	23.94
2025	-1520	0	0	0	0	0	0	1600	0	80	89412	60150	3420	57.61	26.07	-	404,358	1,093,535	238,351	220	57.22
2026	0	0	0	0	805	0	400	1600	0	2805	92217	61770	3420	58.04	26.90	-	415,281	1,134,046	242,436	220	66.62
2027	0	0	0	0	805	0	1400	0	0	2205	94422	63404	3420	57.41	25.59	-	426,196	1,162,091	228,833	220	24.36
2028	-2850	0	0	0	805	0	0	1600	0	-445	93977	64867	3420	52.94	21.95	-	436,761	1,195,990	218,252	220	60.63
2029	-1128	0	0	0	805	0	400	1600	0	1677	95654	66460	3420	51.74	21.13	2	445,888	1,229,179	216,538	220	66.62
2030	0	0	0	0	805	0	800	0	0	1605	97259	67809	3420	51.05	20.27	-	454,357	1,250,053	218,970	220	15.38

Scenario Data Tables

Emissions 3.1

	Committed	Coal FBC	Gas CCGT	OCGT	Import Hydro	Wind	Nuclear Fleet	CSP	Total new build	Total system capacity	Peak demand (net sent-out) forecast	Demand Side Management	Reserve Margin	Reliable capacity Reserve Margin	Unserved energy	Annual energy (net sent-out) forecast	PV Total cost (cumulative)	Water	Total CO2 emissions	Capital expenditure (at date of commercial operation)
	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	%	%	GWh	GWh	Rm	ML	MT	Rbn
2010	640	0	0	0	0	0	0	0	640	44535	38885	252	15.28	15.18	-	259,685	44,138	336,420	237	-
2011	1009	0	0	0	0	0	0	0	1009	45544	39956	494	15.41	14.74	-	266,681	87,467	349,613	243	-
2012	1425	0	0	0	0	0	0	0	1425	46969	40995	809	16.88	15.25	-	274,403	128,921	350,510	250	-
2013	2601	0	0	0	0	0	0	0	2601	49570	42416	1310	20.59	17.84	-	283,914	168,689	347,830	252	-
2014	2543	0	0	0	0	0	0	0	2543	52113	43436	1966	25.66	21.81	-	290,540	206,590	341,713	253	-
2015	542	0	0	0	0	1600	0	0	2142	54255	44865	2594	28.35	21.35	-	300,425	259,322	332,430	256	23.94
2016	632	0	0	0	0	1600	0	0	2232	56487	45786	3007	32.04	21.99	-	310,243	310,191	329,870	258	23.94
2017	0	0	948	0	0	1600	0	1375	3923	60410	47870	3420	35.90	21.67	-	320,751	404,866	331,716	257	107.25
2018	0	0	948	0	0	1600	0	3125	5673	66083	49516	3420	43.36	23.86	-	332,381	544,327	335,070	254	205.57
2019	0	0	948	805	1023	1600	0	3125	7501	73584	51233	3420	53.90	29.42	-	344,726	685,375	327,097	247	225.02
2020	0	0	948	805	936	1600	0	3125	7414	80998	52719	3420	64.30	35.05	-	355,694	829,396	263,280	220	220.65
2021	-75	0	474	805	0	1600	0	0	2804	83802	54326	3420	64.62	34.21	-	365,826	902,000	252,181	220	30.38
2022	-1870	0	0	805	0	1600	1600	0	2135	85937	55734	3420	64.27	32.68	-	375,033	964,850	274,297	220	84.57
2023	-2280	0	0	0	0	1600	1600	0	920	86857	57097	3420	61.82	29.12	-	383,914	1,020,148	273,368	220	81.16
2024	-909	0	0	0	0	1600	0	0	691	87548	58340	3420	59.41	25.59	-	392,880	1,053,778	264,328	220	23.94
2025	-1520	0	0	230	0	1200	1600	0	1510	89058	60150	3420	56.99	22.90	0	404,358	1,099,538	261,508	220	76.15
2026	0	0	0	805	0	400	1600	0	2805	91863	61770	3420	57.43	23.81	1	415,281	1,139,645	260,747	220	66.62
2027	0	0	0	805	0	1600	0	0	2405	94268	63404	3420	57.16	22.69	-	426,196	1,167,907	258,510	220	27.35
2028	-2850	0	0	805	0	0	1600	0	-445	93823	64867	3420	52.69	19.12	-	436,761	1,202,008	256,587	220	60.63
2029	-1128	250	0	805	0	0	1600	0	1277	95100	66460	3420	50.86	18.55	6	445,888	1,235,289	243,827	216	65.20
2030	0	250	0	805	0	800	0	0	2105	97205	67809	3420	50.97	18.12	6	454,357	1,257,457	245,613	220	19.95

Scenario Data Tables

Carbon Tax 0.0

	Committed	Coal FBC	Import Coal	Gas CCGT	OCGT	Import Hydro	Wind	Nuclear Fleet	Coal PF + FGD	Total new build	Total system capacity	Peak demand (net sent-out) forecast	Demand Side Management	Reserve Margin	Reliable capacity Reserve Margin	Unserved energy	Annual energy (net sent-out) forecast	PV Total cost (cumulative)	Water	Total CO2 emissions	Capital expenditure (at date of commercial operation)
	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	%	%	GWh	GWh	Rm	ML	MT	Rbn
2010	640	0	0	0	0	0	0	0	0	640	44535	38885	252	15.28	15.18	-	259,685	44,144	336,986	237	-
2011	1009	0	0	0	0	0	0	0	0	1009	45544	39956	494	15.41	14.74	-	266,681	87,480	349,508	243	-
2012	1425	0	0	0	0	0	0	0	0	1425	46969	40995	809	16.88	15.25	-	274,403	128,943	350,347	250	-
2013	2601	0	0	0	0	0	0	0	0	2601	49570	42416	1310	20.59	17.84	-	283,914	168,796	348,884	252	-
2014	2543	0	0	0	0	0	0	0	0	2543	52113	43436	1966	25.66	23.52	-	290,540	206,991	342,094	252	-
2015	1988	0	0	0	0	0	0	0	0	1988	54101	44865	2594	27.98	23.48	-	300,425	244,286	325,753	258	-
2016	1355	0	0	0	0	0	0	0	0	1355	55456	45786	3007	29.63	24.52	-	310,243	281,090	325,941	262	-
2017	1446	0	0	0	0	0	0	0	0	1446	56902	47870	3420	28.01	22.54	-	320,751	315,275	331,571	271	-
2018	723	0	0	0	0	0	0	0	0	723	57625	49516	3420	25.01	19.82	-	332,381	346,875	342,090	284	-
2019	0	0	0	0	690	1110	0	0	0	1800	59425	51233	3420	24.29	19.29	-	344,726	389,131	332,002	288	23.32
2020	0	0	0	0	575	283	1600	0	0	2458	61883	52719	3420	25.53	18.53	-	355,694	431,146	342,493	294	28.81
2021	-75	0	0	0	460	283	1600	0	0	2268	64151	54326	3420	26.02	17.17	-	365,826	470,793	354,372	302	28.32
2022	-1870	0	0	0	805	0	1600	1600	0	2135	66286	55734	3420	26.71	16.08	-	375,033	529,377	336,477	293	84.57
2023	-2280	0	0	711	575	0	1600	1600	0	2206	68492	57097	3420	27.60	15.27	-	383,914	586,151	314,969	284	88.15
2024	-909	0	0	948	230	283	1600	0	0	2152	70644	58340	3420	28.63	14.64	-	392,880	621,666	313,255	286	33.41
2025	-1520	0	0	948	0	0	1600	1600	0	2628	73272	60150	3420	29.16	13.75	-	404,358	671,141	289,593	275	87.22
2026	0	0	0	0	0	0	1600	1600	0	3200	76472	61770	3420	31.06	14.23	-	415,281	715,339	283,735	271	81.16
2027	0	0	0	948	0	0	1600	0	0	2548	79020	63404	3420	31.74	13.59	0	426,196	743,944	287,897	275	30.00
2028	-2850	750	0	711	690	0	1600	1600	0	2501	81521	64867	3420	32.67	13.22	-	436,761	788,574	255,199	262	102.33
2029	-1128	250	0	0	230	0	1600	1600	0	2552	84073	66460	3420	33.37	12.72	1	445,888	826,849	238,257	254	86.70
2030	0	750	0	0	0	0	1600	0	0	2350	86423	67809	3420	34.22	12.35	0	454,357	852,377	238,561	260	37.64

Scenario Data Tables

Carbon Tax 0.1

	Committed	Coal FBC	Import Coal	Gas CCGT	OCGT	Import Hydro	Wind	Nuclear Fleet	Coal PF + FGD	Total new build	Total system capacity	Peak demand (net sent-out) forecast	Demand Side Management	Reserve Margin	Reliable capacity Reserve Margin	Unserved energy	Annual energy (net sent-out) forecast	PV Total cost (cumulative)	Water	Total CO2 emissions	Expenditure (at date of commercial operation)
	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	%	%	GWh	GWh	Rm	ML	MT	Rbn
2010	640	0	0	0	0	0	0	0	0	640	44535	38885	252	15.28	15.18	-	259,685	44,144	336,986	237	-
2011	1009	0	0	0	0	0	0	0	0	1009	45544	39956	494	15.41	14.74	-	266,681	87,480	349,508	243	-
2012	1425	0	0	0	0	0	0	0	0	1425	46969	40995	809	16.88	15.25	-	274,403	128,943	350,347	250	-
2013	2601	0	0	0	0	0	0	0	0	2601	49570	42416	1310	20.59	17.84	-	283,914	168,796	348,884	252	-
2014	2543	0	0	0	0	0	0	0	0	2543	52113	43436	1966	25.66	21.81	-	290,540	206,770	343,493	253	-
2015	542	0	0	0	0	0	0	0	0	542	52655	44865	2594	24.56	20.13	-	300,425	243,973	335,139	260	-
2016	632	0	0	0	0	0	0	0	0	632	53287	45786	3007	24.56	19.58	-	310,243	280,622	340,966	267	-
2017	0	0	0	948	0	0	1600	0	0	2548	55835	47870	3420	25.61	17.87	-	320,751	331,915	350,621	272	30.00
2018	0	0	0	948	0	0	1600	0	0	2548	58383	49516	3420	26.66	16.90	-	332,381	379,607	363,118	280	30.00
2019	0	0	0	0	805	1110	1600	0	0	3515	61898	51233	3420	29.46	17.78	-	344,726	434,053	356,459	279	47.75
2020	0	0	0	0	805	283	1600	0	0	2688	64586	52719	3420	31.01	17.52	-	355,694	477,052	363,889	286	29.78
2021	-75	0	0	237	805	0	1600	0	0	2567	67153	54326	3420	31.91	16.76	-	365,826	517,869	375,852	292	28.87
2022	-1870	0	0	474	575	283	1600	1600	0	2662	69815	55734	3420	33.45	16.67	0	375,033	579,388	351,030	281	89.06
2023	-2280	250	0	948	0	0	1600	1600	0	2118	71933	57097	3420	34.01	15.68	-	383,914	638,794	323,326	268	91.79
2024	-909	750	0	711	0	283	1600	0	0	2435	74368	58340	3420	35.41	15.54	-	392,880	678,957	314,781	271	44.62
2025	-1520	500	0	0	115	0	1600	1600	0	2295	76663	60150	3420	35.14	14.05	-	404,358	730,261	289,238	262	90.78
2026	0	0	0	0	0	0	1600	1600	0	3200	79863	61770	3420	36.87	14.52	1	415,281	774,999	287,094	259	81.16
2027	0	250	0	0	575	0	1600	0	0	2425	82288	63404	3420	37.18	13.68	1	426,196	804,312	288,875	264	30.94
2028	-2850	0	1200	0	690	0	1600	1600	0	2240	84528	64867	3420	37.56	12.89	-	436,761	850,277	255,193	252	106.46
2029	-1128	0	0	0	345	0	1600	1600	0	2417	86945	66460	3420	37.92	12.19	4	445,888	888,075	239,690	244	82.62
2030	0	0	0	0	115	0	1600	0	750	2465	89410	67809	3420	38.86	12.00	3	454,357	914,638	240,992	249	40.36

Scenario Data Tables

Regional development 0.0

	Committed	Coal FBC	Import Coal	Import Gas	Gas CCGT	OCGT	Import Hydro	Coal PF + FGD	Total new build	Total system capacity	Peak demand (net sent-out) forecast	Demand Side Management	Reserve Margin	Reliable capacity Reserve Margin	Unserved energy	Annual energy (net sent-out) forecast	PV Total cost (cumulative)	Water	Total CO2 emissions	Capital expenditure (at date of commercial operation)
	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	%	%	GWh	GWh	Rm	ML	MT	Rbn
2010	640	0	0	0	0	0	0	0	640	44535	38885	252	15.28	15.18	-	259,685	44,138	336,420	237	-
2011	1009	0	0	0	0	0	0	0	1009	45544	39956	494	15.41	14.74	-	266,681	87,467	349,613	243	-
2012	1425	0	0	0	0	0	0	0	1425	46969	40995	809	16.88	15.25	-	274,403	128,921	350,510	250	-
2013	2601	0	0	0	0	0	0	0	2601	49570	42416	1310	20.59	17.84	-	283,914	168,689	347,830	252	-
2014	2543	0	0	0	0	0	0	0	2543	52113	43436	1966	25.66	23.52	-	290,540	206,850	341,505	252	-
2015	1988	0	0	0	0	0	0	0	1988	54101	44865	2594	27.98	23.48	-	300,425	244,060	327,011	259	-
2016	1355	0	0	0	0	0	0	0	1355	55456	45786	3007	29.63	24.52	-	310,243	280,709	326,392	264	-
2017	1446	0	0	0	0	0	0	0	1446	56902	47870	3420	28.01	22.54	-	320,751	314,878	330,861	272	-
2018	723	0	0	0	0	0	0	0	723	57625	49516	3420	25.01	19.82	-	332,381	346,282	341,701	286	-
2019	0	0	0	0	0	575	0	0	575	58200	51233	3420	21.72	16.80	-	344,726	378,773	346,414	296	2.44
2020	0	0	0	0	0	805	480	0	1285	59485	52719	3420	20.66	15.92	-	355,694	411,154	360,645	306	6.08
2021	-75	0	0	0	237	805	1183	0	2150	61635	54326	3420	21.08	16.46	-	365,826	449,227	369,814	313	23.38
2022	-1870	750	0	0	948	805	1686	0	2319	63954	55734	3420	22.25	17.73	-	375,033	491,263	358,187	314	39.64
2023	-2280	750	2200	0	474	690	0	0	1834	65788	57097	3420	22.56	18.14	-	383,914	539,596	330,000	319	61.67
2024	-909	250	0	0	237	0	0	1500	1078	66866	58340	3420	21.75	17.45	-	392,880	577,374	318,869	325	37.95
2025	-1520	0	0	0	0	0	0	3000	1480	68346	60150	3420	20.48	16.34	-	404,358	620,605	298,252	333	63.74
2026	0	0	0	0	0	230	0	1500	1730	70076	61770	3420	20.09	16.08	-	415,281	652,813	300,788	344	32.85
2027	0	0	0	0	0	0	0	1500	1500	71576	63404	3420	19.33	15.43	-	426,196	683,229	303,455	355	31.87
2028	-2850	0	0	0	237	805	0	3750	1942	73518	64867	3420	19.64	15.84	-	436,761	724,996	274,127	360	84.61
2029	-1128	0	0	0	237	115	0	2250	1474	74992	66460	3420	18.96	15.26	-	445,888	756,729	263,087	367	49.81
2030	0	0	0	0	237	0	0	1500	1737	76729	67809	3420	19.17	15.54	-	454,357	783,120	262,911	376	33.39

Scenario Data Tables

Regional development 0.1

	Committed	Coal FBC	Import Coal	Import Gas	Gas CCGT	OCGT	Import Hydro	Coal PF + FGD	Total new build	Total system capacity	Peak demand (net sent-out) forecast	Demand Side Management	Reserve Margin	Reliable capacity Reserve Margin	Unserved energy	Annual energy (net sent-out) forecast	PV Total cost (cumulative)	Water	Total CO2 emissions	Capital expenditure (at date of commercial operation)
	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	%	%	GWh	GWh	Rm	ML	MT	Rbn
2010	640	0	0	0	0	0	0	0	640	44535	38885	252	15.28	15.18	-	259,685	44,138	336,420	237	-
2011	1009	0	0	0	0	0	0	0	1009	45544	39956	494	15.41	14.74	-	266,681	87,467	349,613	243	-
2012	1425	0	0	0	0	0	0	0	1425	46969	40995	809	16.88	15.25	-	274,403	128,921	350,510	250	-
2013	2601	0	0	0	0	0	0	0	2601	49570	42416	1310	20.59	17.84	-	283,914	168,689	347,830	252	-
2014	2543	0	0	0	0	0	0	0	2543	52113	43436	1966	25.66	21.81	-	290,540	206,590	341,713	253	-
2015	542	0	0	0	0	0	0	0	542	52655	44865	2594	24.56	20.13	-	300,425	243,721	340,606	261	-
2016	632	0	0	0	0	0	0	0	632	53287	45786	3007	24.56	19.58	-	310,243	280,351	343,534	267	-
2017	0	0	0	0	948	0	120	0	1068	54355	47870	3420	22.28	16.98	-	320,751	319,003	357,352	277	7.20
2018	0	500	0	0	948	0	520	0	1968	56323	49516	3420	22.19	17.07	-	332,381	361,266	367,487	287	19.16
2019	0	0	0	0	0	805	1023	0	1828	58151	51233	3420	21.62	16.70	-	344,726	402,611	373,978	294	19.44
2020	0	250	0	0	0	805	936	0	1991	60142	52719	3420	21.99	17.21	-	355,694	441,711	386,503	303	19.64
2021	-75	750	600	0	0	460	0	0	1735	61877	54326	3420	21.55	16.93	-	365,826	482,176	389,596	314	26.84
2022	-1870	250	1600	0	0	805	750	750	2285	64162	55734	3420	22.65	18.12	-	375,033	532,798	359,561	316	59.54
2023	-2280	0	0	0	0	345	0	3000	1065	65227	57097	3420	21.52	17.13	-	383,914	583,498	335,981	321	65.21
2024	-909	0	0	0	0	115	0	2250	1456	66683	58340	3420	21.42	17.13	-	392,880	625,464	324,424	329	48.30
2025	-1520	0	0	0	0	575	0	3000	2055	68738	60150	3420	21.17	17.01	-	404,358	670,256	300,978	336	66.18
2026	0	0	0	0	0	0	0	1500	1500	70238	61770	3420	20.37	16.35	-	415,281	702,908	303,540	346	31.87
2027	0	0	0	0	0	0	0	1500	1500	71738	63404	3420	19.60	15.70	-	426,196	733,942	307,513	358	31.87
2028	-2850	0	0	0	474	460	0	3000	1084	72822	64867	3420	18.51	14.73	-	436,761	772,814	281,026	362	68.73
2029	-1128	0	0	0	474	0	0	2250	1596	74418	66460	3420	18.05	14.37	-	445,888	805,588	269,328	368	50.84
2030	0	0	0	0	0	0	0	1500	1500	75918	67809	3420	17.91	14.31	-	454,357	832,388	270,782	378	31.87

Scenario Data Tables

Enhanced Demand Side Management 0.0

	Committed	Coal FBC	Import Coal	Gas CCGT	OCGT	Import Hydro	Coal PF + FGD	Total new build	Total system capacity	Peak demand (net sent-out) forecast	Demand Side Management	Reserve Margin	Reliable capacity Reserve Margin	Unserved energy	Annual energy (net sent-out) forecast	PV Total cost (cumulative)	Water	Total CO2 emissions	Capital expenditure (at date of commercial operation)
	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	%	%	GWh	GWh	Rm	ML	MT	Rbn
2010	640	0	0	0	0	0	0	640	44535	38885	252	15.28	15.18	-	259,685	44,138	336,420	237	-
2011	1009	0	0	0	0	0	0	1009	45544	39956	494	15.41	14.74	-	266,681	87,467	349,613	243	-
2012	1425	0	0	0	0	0	0	1425	46969	40995	1059	17.61	15.67	-	274,403	128,819	349,386	249	-
2013	2601	0	0	0	0	0	0	2601	49570	42416	1822	22.11	18.70	-	283,914	168,406	345,486	250	-
2014	2543	0	0	0	0	0	0	2543	52113	43436	2987	28.84	25.30	-	290,540	206,341	341,210	248	-
2015	1988	0	0	0	0	0	0	1988	54101	44865	4128	32.80	26.10	-	300,425	243,228	324,075	252	-
2016	1355	0	0	0	0	0	0	1355	55456	45786	4539	34.45	27.11	-	310,243	279,591	325,855	257	-
2017	1446	0	0	0	0	0	0	1446	56902	47870	4954	32.59	24.98	-	320,751	313,505	330,096	266	-
2018	723	0	0	0	0	0	0	723	57625	49516	4954	29.32	22.12	-	332,381	344,579	333,656	281	-
2019	0	0	0	0	805	0	0	805	58430	51233	4954	26.26	19.45	-	344,726	377,106	334,966	290	3.41
2020	0	0	0	0	805	0	0	805	59235	52719	4954	24.01	17.50	-	355,694	407,974	354,603	302	3.41
2021	-75	0	0	0	805	1023	0	1753	60988	54326	4954	23.53	17.24	-	365,826	444,098	364,178	310	19.44
2022	-1870	750	600	948	690	936	0	2054	63042	55734	4954	24.15	18.00	-	375,033	488,207	349,074	313	45.54
2023	-2280	750	600	948	805	0	750	1573	64615	57097	4954	23.92	17.94	-	383,914	532,663	331,778	318	50.30
2024	-909	250	0	237	0	0	1500	1078	65693	58340	4954	23.05	17.24	-	392,880	570,655	320,189	324	37.95
2025	-1520	0	0	0	0	0	3000	1480	67173	60150	4954	21.70	16.12	-	404,358	614,075	299,568	332	63.74
2026	0	0	0	0	0	0	1500	1500	68673	61770	4954	20.87	15.47	-	415,281	646,186	302,155	343	31.87
2027	0	0	0	0	0	0	2250	2250	70923	63404	4954	21.34	16.07	-	426,196	680,702	301,755	355	47.81
2028	-2850	0	0	474	460	0	3000	1084	72007	64867	4954	20.19	15.08	-	436,761	718,736	276,661	360	68.73
2029	-1128	0	0	0	115	0	2250	1237	73244	66460	4954	19.08	14.14	-	445,888	750,275	265,172	366	48.30
2030	0	0	0	0	230	0	1500	1730	74974	67809	4954	19.28	14.43	-	454,357	776,661	266,254	376	32.85

Scenario Data Tables

Enhanced Demand Side Management 0.1

	Committed	Coal FBC	Import Coal	Gas CCGT	OCGT	Import Hydro	Coal PF + FGD	Total new build	Total system capacity	Peak demand (net sent-out) forecast	Demand Side Management	Reserve Margin	Reliable capacity Reserve Margin	Unserved energy	Annual energy (net sent-out) forecast	PV Total cost (cumulative)	Water	Total CO2 emissions	Capital expenditure (at date of commercial operation)
	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	%	%	GWh	GWh	Rm	ML	MT	Rbn
2010	640	0	0	0	0	0	0	640	44535	38885	252	15.28	15.18	-	259,685	44,138	336,420	237	-
2011	1009	0	0	0	0	0	0	1009	45544	39956	494	15.41	14.74	-	266,681	87,467	349,613	243	-
2012	1425	0	0	0	0	0	0	1425	46969	40995	1059	17.61	15.67	-	274,403	128,819	349,386	249	-
2013	2601	0	0	0	0	0	0	2601	49570	42416	1822	22.11	18.70	-	283,914	168,406	345,486	250	-
2014	2543	0	0	0	0	0	0	2543	52113	43436	2987	28.84	23.56	-	290,540	206,085	341,450	249	-
2015	542	0	0	0	0	0	0	542	52655	44865	4128	29.25	22.68	-	300,425	242,713	330,727	255	-
2016	632	0	0	0	0	0	0	632	53287	45786	4539	29.19	22.08	-	310,243	278,837	337,613	262	-
2017	0	250	0	948	0	0	0	1198	54485	47870	4954	26.96	19.61	-	320,751	318,896	346,008	271	10.63
2018	0	750	0	948	0	0	0	1698	56183	49516	4954	26.08	19.03	-	332,381	361,175	356,147	283	19.76
2019	0	0	0	0	805	1023	0	1828	58011	51233	4954	25.35	18.58	-	344,726	402,121	358,012	289	19.44
2020	0	0	0	0	805	936	0	1741	59752	52719	4954	25.10	18.54	-	355,694	438,786	374,476	298	15.07
2021	-75	750	0	237	805	0	0	1717	61469	54326	4954	24.50	18.17	-	365,826	475,524	387,158	310	18.63
2022	-1870	0	1200	0	805	0	1500	1635	63104	55734	4954	24.27	18.12	-	375,033	525,556	362,887	315	57.66
2023	-2280	0	0	0	575	0	3000	1295	64399	57097	4954	23.51	17.54	-	383,914	576,773	337,295	320	66.18
2024	-909	0	0	0	0	0	2250	1341	65740	58340	4954	23.14	17.32	-	392,880	618,709	326,908	329	47.81
2025	-1520	0	0	0	345	0	3000	1825	67565	60150	4954	22.41	16.80	-	404,358	663,323	304,063	336	65.21
2026	0	0	0	0	115	0	1500	1615	69180	61770	4954	21.76	16.33	-	415,281	696,200	306,090	346	32.36
2027	0	0	0	0	0	0	1500	1500	70680	63404	4954	20.92	15.67	-	426,196	727,351	310,626	358	31.87
2028	-2850	0	0	948	115	0	3000	1213	71893	64867	4954	19.99	14.89	-	436,761	766,688	282,341	361	70.30
2029	-1128	0	0	474	0	0	2250	1596	73489	66460	4954	19.48	14.53	-	445,888	799,562	270,641	367	50.84
2030	0	0	0	0	0	0	1500	1500	74989	67809	4954	19.31	14.46	-	454,357	826,429	272,628	377	31.87

Scenario Data Tables

Balanced Scenario

	Committed	Coal FBC	Import Coal	Gas CCGT	OCGT	Import Hydro	Wind	Nuclear Fleet	Coal PF + FGD	Total new build	Total system capacity	Peak demand (net sent-out) forecast	Demand Side Management	Reserve Margin	Reliable capacity Reserve Margin	Unserved energy	Annual energy (net sent-out) forecast	PV Total cost (cumulative)	Water	Total CO2 emissions	Capital expenditure (at date of commercial operation)
	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	%	%	GWh	GWh	Rm	ML	MT	Rbn
2010	640	0	0	0	0	0	0	0	0	640	44535	38885	252	15.28	15.18	-	259,685	44,138	336,420	237	-
2011	1009	0	0	0	0	0	0	0	0	1009	45544	39956	494	15.41	14.74	-	266,681	87,467	349,613	243	-
2012	703	0	0	0	0	0	0	0	0	703	46247	40995	809	15.08	15.25	-	274,403	128,921	350,510	250	-
2013	2601	0	0	0	0	0	0	0	0	2601	48848	42416	1310	18.83	16.10	-	283,914	168,999	350,208	253	-
2014	1821	0	0	0	0	0	200	0	0	2021	50869	43436	1966	22.66	23.68	-	290,540	209,286	341,515	251	2.99
2015	1264	0	0	0	0	0	400	0	0	1664	52533	44865	2594	24.28	23.93	-	300,425	250,426	324,482	257	5.98
2016	632	0	0	0	0	0	800	0	0	1432	53965	45786	3007	26.15	25.57	-	310,243	294,325	326,187	261	11.97
2017	2168	0	0	0	0	0	800	0	0	2968	56933	47870	3420	28.08	19.39	-	320,751	336,017	337,415	270	11.97
2018	723	0	0	0	0	0	800	0	0	1523	58456	49516	3420	26.81	18.86	-	332,381	374,208	343,296	280	11.97
2019	1446	0	0	0	0	0	800	0	0	2246	60702	51233	3420	26.96	16.71	-	344,726	411,135	337,736	287	11.97
2020	723	0	0	0	575	0	800	0	0	2098	62800	52719	3420	27.39	16.37	-	355,694	446,855	343,273	295	14.41
2021	-75	0	0	237	805	0	800	0	0	1767	64567	54326	3420	26.83	15.15	-	365,826	482,121	358,681	305	16.90
2022	-1870	250	0	948	805	1110	800	0	0	2043	66610	55734	3420	27.33	14.94	-	375,033	526,618	345,092	303	46.41
2023	-2280	0	0	711	805	566	800	1600	0	2202	68812	57097	3420	28.20	15.12	-	383,914	581,802	329,844	295	82.01
2024	-909	0	0	474	230	0	600	1600	0	1995	70807	58340	3420	28.93	15.41	-	392,880	629,275	315,583	288	70.20
2025	-1520	0	0	711	0	0	1600	1600	0	2391	73198	60150	3420	29.03	14.08	-	404,358	678,476	285,251	275	85.71
2026	0	0	0	0	0	0	400	1600	0	2000	75198	61770	3420	28.87	13.89	-	415,281	717,888	288,015	275	63.21
2027	0	0	0	948	230	0	1400	0	0	2578	77776	63404	3420	29.66	13.53	-	426,196	746,887	283,541	275	27.99
2028	-2850	750	0	0	0	0	0	1600	1500	1000	78776	64867	3420	28.20	12.48	-	436,761	791,663	258,267	274	102.79
2029	-1128	750	0	0	115	0	0	1600	750	2087	80863	66460	3420	28.27	12.94	-	445,888	829,800	240,756	272	87.34
2030	0	0	0	237	575	0	0	0	0	812	81675	67809	3420	26.85	11.86	-	454,357	848,906	241,943	275	3.95

Scenario Data Tables

Balanced Revised Scenario

	Committed build											New build options														
	RTS Capacity	Medupi	Kusile	Ingula	DOE OCGT IPP	Cogeneration, own build	Wind	CSP	Landfill, hydro	Sere	Decommissioning	Coal FBC	Cogeneration, own build	Import Coal	Gas CCGT	OCGT	Import Hydro	Wind	Solar PV, CSP	Renewables (Wind, Solar CSP, Solar PV, Landfill, Biomass, etc.)	Nuclear Fleet	Coal PF + FGD	Total new build	Total system capacity	Peak demand (net sent-out) forecast	Demand Side Management	Reserve Margin
	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	MW	%
2010	380	0	0	0	0	260	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	640	44535	38885	252	15.28
2011	679	0	0	0	0	130	200	0	0	0	0	0	103	0	0	0	0	0	0	0	0	0	1112	45647	39956	494	15.67
2012	303	0	0	0	0	0	200	0	100	100	0	0	0	0	0	0	0	0	0	0	0	0	703	46350	40995	809	15.34
2013	101	722	0	333	1020	0	300	0	25	0	0	0	124	0	0	0	0	0	0	0	0	0	2625	48975	42416	1310	19.14
2014	0	722	0	999	0	0	0	100	0	0	0	0	426	0	0	0	0	200	0	0	0	0	2447	51422	43436	1966	24.00
2015	0	1444	0	0	0	0	0	100	0	0	-180	0	600	0	0	0	0	400	0	0	0	0	2364	53786	44865	2594	27.24
2016	0	722	0	0	0	0	0	0	0	0	-90	0	0	0	0	0	0	800	100	0	0	0	1532	55318	45786	3007	29.31
2017	0	722	1446	0	0	0	0	0	0	0	0	0	0	0	0	0	0	800	100	0	0	0	3068	58386	47870	3420	31.35
2018	0	0	723	0	0	0	0	0	0	0	0	0	0	0	0	0	0	800	100	0	0	0	1623	60009	49516	3420	30.18
2019	0	0	1446	0	0	0	0	0	0	0	0	0	0	0	474	0	0	800	100	0	0	0	2820	62829	51233	3420	31.41
2020	0	0	723	0	0	0	0	0	0	0	0	0	0	0	711	0	360	0	0	800	0	0	2594	65423	52719	3420	32.71
2021	0	0	0	0	0	0	0	0	0	0	-75	0	0	0	711	0	750	0	0	800	0	0	2186	67609	54326	3420	32.81
2022	0	0	0	0	0	0	0	0	0	0	-1870	0	0	0	0	805	1110	0	0	800	0	0	845	68454	55734	3420	30.85
2023	0	0	0	0	0	0	0	0	0	0	-2280	0	0	0	0	805	1129	0	0	800	1600	0	2054	70508	57097	3420	31.36
2024	0	0	0	0	0	0	0	0	0	0	-909	0	0	0	0	575	0	0	0	800	1600	0	2066	72574	58340	3420	32.14
2025	0	0	0	0	0	0	0	0	0	0	-1520	0	0	0	0	805	0	0	0	1400	1600	0	2285	74859	60150	3420	31.96
2026	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	600	1600	0	2200	77059	61770	3420	32.06
2027	0	0	0	0	0	0	0	0	0	0	0	250	0	500	0	805	0	0	0	1200	0	0	2755	79814	63404	3420	33.06
2028	0	0	0	0	0	0	0	0	0	0	-2850	750	0	500	0	805	0	0	0	0	1600	750	1555	81369	64867	3420	32.42
2029	0	0	0	0	0	0	0	0	0	0	-1128	750	0	0	0	805	0	0	0	0	1600	0	2027	83396	66460	3420	32.29
2030	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	345	0	0	0	0	0	1500	1845	85241	67809	3420	32.39