



energy

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INTEGRATED RESOURCE PLAN FOR ELECTRICITY

2010

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INTEGRATED RESOURCE PLAN FOR ELECTRICITY DOCUMENT STRUCTURE

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1. INTRODUCTION

The Integrated Resource Plan (IRP) is a long-term electricity capacity plan, which defines the need for new generation and transmission capacity for the country.

This document outlines the concepts and development behind the integrated resource plan for the electricity industry in South Africa as well as the strategic objectives of the IRP including the policy and technical parameters that drive the planning process. Discussion is introduced on the methodology adopted to attain the appropriate plan along with information required to promote debate on the principles and results of the IRP.

2. PLANNING OBJECTIVES AND SCOPE OF WORK

The National Energy Act of 2008 (Act no 34 of 2008) obligates the Minister of Energy to develop and publish an Integrated Resource Plan for energy. As electricity forms a sub-component of the energy sector this electricity IRP needs to be integrated into the outlook for energy. The System Operations and Planning Division in Eskom has been mandated by the Department of Energy (DoE), under the New Generation Capacity regulations¹, to produce the integrated resource plan for electricity in consultation with the DOE and the National Energy Regulator of South Africa (NERSA).

The objective of the IRP is to develop a sustainable electricity investment strategy for generation capacity and transmission infrastructure for South Africa over the next twenty-five years. The investment strategy includes implications arising from demand-side management (DSM) and pricing, and including capacity provided by all generators (Eskom and independent power producers).

The IRP is intended to:

- Improve the long term reliability of electricity supply through meeting adequacy criteria over and above keeping pace with economic growth and development;
- Ascertain South Africa's capacity investment needs for the medium term business planning environment;
- Consider environmental and other externality impacts and the effect of renewable energy technologies;
- Provide the framework for Ministerial determination of new generation capacity (inclusive of the required feasibility studies) as envisaged in the New Generation Capacity regulations.

¹ Electricity Regulations on New Generation Capacity, 5 August 2009, Department of Energy



2.1 Governance

The process for approval of the IRP and the oversight over the assumptions and modelling must be laid out.

2.2 Scope

The scope must define the boundaries for the plan – this is not an integrated energy plan (catering for all energy sources and uses), but deals specifically with the integration of resources for electricity production and consumption. This would form a subset of the overall Integrated Energy Plan (IEP) produced by the DOE.

2.3 Planning Parameters

- Adequacy criteria
- Discount rate
- Technical assumptions
- Appendix A covers assumptions and parameters for expected energy consumption
- Appendix B covers assumptions and parameters for demand-side interventions (including energy efficiency initiatives).
- Appendix C covers assumptions and parameters for supply side options (including renewable energy technologies).

2.4 Modelling

Each of the scenarios produced (including the reference case) have been modelled with the objective of minimising the direct costs of the expansion plan (including capital, fuel and operating costs). While certain constraints have been imposed, including emissions constraints in specific scenarios, these are always constraints on the cost optimisation objective.

For modelling efficiency purposes the calendar year is converted into a load duration curve with time slices representing periods of similar demand. This mechanism is used for the expansion plan optimisation. For the robustness check in the sensitivity analysis, a full production optimisation is executed on the chronological calendar year ensuring that the pumping cycle, amongst other considerations, is accurately reflected.

Planned outage co-ordination is modelled by allowing the system to optimise planned outages according to capacity availability. In addition unplanned outages are modelled by adjusting the load duration curve to an effective load duration, which incorporates the probability of plant failure.



3. CURRENT SYSTEM

Description of the current electricity supply industry, including Eskom and non-Eskom generators and different consumers (and consumption patterns).

4. REFERENCE CASE

The least direct cost plan (or reference plan) is determined based on the cost assumptions for potential supply-side projects, assumptions for demand-side interventions as well as the underlying expected demand. All known, feasible projects are included in the reference plan.

These include:

- Eskom and non-Eskom committed generation projects;
- IPP programmes;
- Decommissioning programmes;
- Mandated demand-side interventions.

5. SCENARIOS

A number of scenarios have been contrived in order to incorporate specified uncertainties or unknowns, including possible policy objectives that are as yet unclear, and possible technology changes. The expectation is that the different scenario results will be assessed to determine a risk-adjusted IRP (as distinct from the least-cost reference IRP) to accommodate the policy considerations and uncertainties.

Key issues to cover under the scenarios are:

- Greenhouse gas emission targets
The actual target needs to be defined, and the approaches used to meet these: either through:
 - a) Enforcing the Emission Cap
The emission target established in the LTMS is set at 550 million tonnes of CO₂ per year. Of this target it is expected that the electricity industry will be responsible for 50%, thus a target of 275Mt/a is assumed as a constraint for some of the plans.
 - b) Introducing a Carbon Tax
The carbon tax assumed in the LTMS is included in the carbon tax scenario. The tax starts at R100/t in 2009 escalating over time to R750/t after 2040. This is modelled as part of the costs of the generators, modelled as a shadow price for emissions.



- Independent power producers
Scenarios can be developed on the inclusion of specific known IPP projects or potential projects.
- Technology changes
While it is nigh impossible to anticipate every eventuality (especially black swan events), some time should be spend on the potential impacts of known technologies that may bear fruit in the medium term, for example, the electric car.

6. RESULTS

For the purposes of comparison a few indicators from the scenario plans are highlighted here. Further discussion of each plan is included in the application of the criteria in order to assess the plan providing the best fit to the country's objectives.

7. MULTI-CRITERIA DECISION MAKING

A methodology will need to be developed to deal with identifying key criteria from the stakeholders against which to weigh the results. The methodology will lay out the weighting for the criteria and the scoring of the plans against these.

8. RISKS AND UNCERTAINTIES

8.1 Sensitivity Studies

Even with the policy and growth uncertainties to some extent catered for in the scenarios listed above, there are a number of other uncertainties that need to be considered. The models have been tested against changes in the underlying assumptions regarding, in particular:

- Changes in the energy forecast;
- Plant failure leading to sustained higher than targeted plant outage;
- Uncertain and prolonged lead times and cost for building new plant;
- Deviations from the assumed generation costs in each technology.

8.2 Key risks in the IRP

While the risk factor criterion provides a mechanism to evaluate the potential plans for the inherent risks of each plan, it is worth highlighting the risks to provide focus for possible mitigation.



9. RECOMMENDED EXPANSION PLAN

The result of the multi-criteria decision-making process – accommodating the sensitivity analysis – is indicated and recommended for approval.

10. DECISION MAKING TREES

The key risks and assumptions are highlighted to indicate under what conditions alternative strategies may be required. These alternative strategies with time-lines indicate the key decision-points where projects have to be approved or alternatives considered when assumptions do not materialise.

11. CONCLUSION

Summary of the key determinants of the proposed IRP.

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APPENDIX A GOVERNMENT POLICY

This section will list the relevant government policies that impact on the IRP, in particular:

- The nuclear policy
- The renewable policy
- The regional development policy

APPENDIX B ENERGY AND DEMAND FORECAST

- B1: Assumptions
- B2: Models
- B3: Results

APPENDIX C DEMAND SIDE INTERVENTIONS

- C1: Mandatory programmes
- C2: Options

APPENDIX D SUPPLY SIDE OPTIONS

- D1: Technology choices
- D2: Technical and financial assumptions
- D3: Costing of externalities

APPENDIX E DETAILED RESULTS

The optimal plans for each of the IRP scenarios are shown. The capacity required from each project in order to meet the annual peak is shown in each case.

APPENDIX F MEASURING AND SCORING THE CRITERIA

The methodology for the multi-criteria decision making framework will be detailed further. Sensitivities around the value functions and weightings are resolved to indicate to what extent these would need to change before an alternative plan would be preferred.

APPENDIX G LINKAGES TO INFRASTRUCTURE DEVELOPMENT

High-level linkages to other infrastructure development required to implement the selected plan i.e. water, transmission, roads etc.