OVERVIEW OF INTEGRATED ENERGY PLANNING APPROACH

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Chief Director: Energy Planning
CONTENTS

• SCOPE, PURPOSE AND OBJECTIVES
• HIGH-LEVEL PLANNING APPROACH
• IEP CONTEXT (KEY POLICY ISSUES)
• BASE CASE AND TEST CASES
• WAY FORWARD
SCOPE OF IEP

- Is not an electricity capacity expansion plan
- Considers all primary energy sources
  - Those used for electricity generation
  - Those used directly within other sectors of the economy, such as:
    - Households
    - Industry
    - Transport
SCOPE OF IEP

Integrated energy planning seeks to consider all the key elements of the energy value-chain at a national level.

- **PRIMARY ENERGY/RESOURCES**
  - **RENEWABLES**
    - Solar
    - Wind
    - Biomass
    - Hydro
  - **FOSSIL FUELS**
    - Coal
    - Crude Oil
    - Natural Gas
  - **NUCLEAR FUELS**
    - Uranium
    - Resources extraction and sourcing

- **CONVERSION TECHNOLOGIES**
  - **POWER GENERATION**
    - Conventional Coal Plant
    - Nuclear
    - CCGT
    - OCGT
    - Solar
    - Wind
  - **FUEL PROCESSING**
    - Oil refineries
    - GTL
    - CTL
  - **REGASIFICATION**

- **SECONDARY ENERGY CARRIERS**
  - Electricity
  - Heat
  - Refined Petroleum Products

- **END-USE TECHNOLOGIES**
  - **INDUSTRY**
    - Steam boilers
    - Furnace
    - Machinery
  - **COMMERCIAL SECTOR**
    - Electronic Communication
    - Cooling
    - **COMMERCIAL SECTOR**
    - **RESIDENTIAL SECTOR**
    - **AGRICULTURAL SECTOR**
    - **TRANSPORT SECTOR**
    - **TRANSPORT SECTOR**
    - Person kms

- **DEMAND FOR ENERGY SERVICES**
  - **INDUSTRIAL SECTOR**
  - **COMMERCIAL SECTOR**
  - **AGRICULTURE**
  - **TRANSPORT**
  - **INDUSTRY**
    - Process Steam
    - Motive Power
  - **COMMERCIAL SECTOR**
    - Electronic Communication
    - Cooling
  - **RESIDENTIAL SECTOR**
    - Space Heat
    - Refrigeration
    - Cooking
    - Hot water
  - **AGRICULTURAL SECTOR**
    - Water supply
  - **TRANSPORT SECTOR**
    - Person kms

Integrated energy planning seeks to consider all the key elements of the energy value-chain at a national level.
The IEP is a multi-faceted policy which has multiple objectives:

- Describes the recommended **ENERGY PATHWAY/ENERGY SECTOR ROADMAP** for South Africa
- Guides the development of energy policies and where relevant set the framework for regulations in the energy sector
- Guides the selection of appropriate technology to meet energy demand (i.e. what types and size of new power plants and refineries should be built and what prices should be charged for fuels)
- It therefore also guides the investment and development of energy infrastructure in South Africa
- Proposes alternative energy strategies which are informed by testing the potential impacts of exogenous factors
KEY QUESTIONS

Between now and 2050...

• What is the desired economic growth and socio-economic needs of the country?

• **Energy Demand:** What will be the energy requirements to support this economic growth and socio-economic development?

• **Energy Efficiency and Demand Side Interventions:** Is there a way in which we can reduce these energy requirements without stifling the desired economic growth and socio-economic development?

• **Energy Access:** What are the full energy requirements (not just on-grid electricity) for all people? What strategies need to be put in place to ensure that there is universal access?
Between now and 2050...

- **Security of Supply:** What supply options do we need to put in place to ensure that we don’t suffer a supply deficit?
- **What new technologies and feedstock combinations should we consider?**
- **Minimise costs:** How much do different technologies cost and what will the costs be in the future?
- **Diversity of Supply Sources:** Where should the feedstock come from and what will the costs of the feedstock be?
- **Diversity of Supply:** Primary Resources – How do we exploit our natural endowment while minimising overreliance on a single source
KEY QUESTIONS

Between now and 2050...

• **Environmental impact:** How do we ensure that we do not make choices which create additional pressure on the environment in the future
  – i.e. Minimise the water requirements of the chosen technologies
  – i.e. Minimise emissions associated with technologies and primary energy resources
KEY QUESTIONS

Between now and 2050...

• Localisation and technology transfer: In recommending these supply-side options/technologies, how do we ensure that local players can participate?
  – What is the employment-intensity of energy production for these technologies and what strategies should be considered to ensure an increase in the employment-intensity of the energy sector?
  – What level of regulation and market structure will optimise this?
8 KEY OBJECTIVES

- Cost of energy
- Access to energy
- Security of supply
- Minimise emissions
- Diversify supply sources
- Promote localization & technology transfer
- Water consumption
- Promote energy efficiency

IEP

Economic Development
Social Development
Environmental Sustainability

DRAFT INTEGRATED ENERGY PLANNING REPORT
CONTENTS

• PURPOSE AND OBJECTIVES
• HIGH-LEVEL PLANNING APPROACH
• IEP CONTEXT (KEY POLICY ISSUES)
• BASE CASE AND TEST CASES
• WAY FORWARD
HIGH-LEVEL ENERGY PLANNING PROCESS

• Energy Planning is iterative
• The scope of the IEP development process is encompassed in Steps I, II and III
• Steps IV, V, and VI are within the broader scope of the IEP process, but fall outside the sphere of its development
• Once the IEP recommendations have been made and promulgated, implementation, monitoring and review of those recommendations need to take place
• The outcomes from these steps must inform future iterations of the IEP.
I. DEFINE PROBLEM STATEMENT AND OBJECTIVES

- Define problem statement and key objectives
- Describe current state of energy sector
- Define key policy questions

II. DEFINE AND ANALYSE OPTIONS

- Identify policy alternatives
- Analyse and present policy alternatives

III. MAKE RECOMMENDATIONS

- Evaluate policy alternatives
- Make recommendations

Public Stakeholder Input
The chosen approach enables for:

1) Combination of **Quantitative** (data-driven) and **Qualitative** (expert judgement) analysis
2) A parallel consideration of each of the following elements:
   - Existing and future energy technologies and energy carriers
   - *Existing and proposed policies* with a significant impact on the energy sector
   - Other socio-economic factors which need to be considered
   - Objectives upon which different options should be evaluated

**Diagram Description**

- **Technologies, Energy Carriers, Energy Services**
- **Reference Energy System**
- **Existing High-Impact Policies**
- **New/Proposed High-Impact Policies**
- **Other policy and socio-economic factors**
- **Key Objectives (Criteria for Policy Analysis)**
- **Base Case**
- **Test Cases**
- **ENERGY MODELS**
  - Supply Optimisation
  - Demand Projections
- **MODEL OUTPUT (ENERGY RESOURCES AND TECHNOLOGY OPTIONS)**
- **Evaluate Model Output and Policy Proposals** (Multi-Criteria Decision Analysis)
- **Recommendations**
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The IEP takes into consideration existing policies

- Informs development of future energy sector roadmaps
- Provides feedback to development & review of external policies

IEP AND OTHER PLANS

Solar Energy Technology Road Map
Biofuels Strategy
Renewable Energy Roadmap
Gas Roadmap
Coal Roadmap
Liquid Fuels Roadmap
Electricity Roadmap
Transmission Development Plan
Distribution Infrastructure Plan
Integrated Resource Plan (IRP)

Diversity of Supply
Security of Supply
Carbon Tax Policy
National Climate Change Policy
Energy Efficiency Strategy
Universal Energy Access Strategy
Beneficiation Strategy
Transport Plan

THE INTERGRATED ENERGY PLAN (IEP) 2050

The IEP 2013 - Report
The IEP seeks to quantify and provide feedback on the extent to which policy objectives outside the sector may impact on the attainment of energy sector imperatives and vice versa.
# HIGH-IMPACT POLICIES

## OVERARCHING NATIONAL POLICIES
- **New Growth Path**
  - Sets aspirational targets for employment, economic growth and green economy
- **National Development Plan**
  - Defines alternatives that should be considered for ensuring security of liquid fuel supply is met
  - Alternative sources for electricity generation
- **National Treasury**
  - Economic Growth Projections

## POLICIES WITH UNIDIRECTIONAL IMPACT
- **Proposed Carbon Tax Policy**
  - Proposes a carbon tax for energy supply and energy end-use amongst other sectors

## POLICIES WITH BIDIRECTIONAL IMPACT
- **National Climate Change Response White Paper**
  - “Peak, Plateau, Decline” emission reduction targets have significant implications for the energy sector
- **Beneficiation Strategy**
  - Implementation of strategy will affect demand profile of industrial sector
- **Transport Plan**
  - Modal shifts from passenger vehicles to mass transit, from road to rail, amongst others have implications on future energy requirements transport from the sector
KEY POLICY ISSUES

HIGH-IMPACT POLICIES

National Climate Change Response White Paper
Proposed Carbon Tax Policy
Renewable Energy White Paper
National Development Plan

KEY POLICY ISSUES

Climate Change and Emission Reductions
The role of Renewable Energy Technologies in moving towards a low-carbon economy
Role of Alternative Supply Options such as Nuclear and Natural Gas
Liquid Fuels Supply Options under different crude oil price scenarios

TEST CASES

• ‘Peak-Plateau-Decline’ Emissions Limit Case
• Carbon Tax Case
• Renewable Energy Target Case
• Emissions Limit - No New Nuclear Case
• Emissions Limit - Natural Gas Case
• High Oil Price Case
• Low Oil Price Case
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## BASE CASE AND TEST CASES

### BASE CASE
- The Base Case encapsulates the state of energy demand and supply over the planning horizon, which is most closely informed by current energy market trends; the national macroeconomic outlook; assumed energy prices; existing energy infrastructure and the existing suite of policies and government programmes.
- Not a representation of the most likely future or most likely scenario, but is rather a simplistic representation of a future outcome that could materialise in light of current policies and macroeconomic trends.
- Represents a Business-As-Usual or Status Quo scenario where current trends continue into the future.

### TEST CASE
- Deviation from the status quo as a result of specific policy interventions.
- Defines a set of circumstances and resultant outcomes or impacts which is informed by the possible impacts of policies and policy interventions.
- Does not indicate what will happen but rather tests what could happen if a particular course of action is pursued.
- Specifically differentiated from a Scenario in that a Scenario is largely influenced by exogenous forces which the policy maker has no control over, while a Test Case seeks to test the possible implications of active policy interventions.
BASE CASE

IRP Committed and New Build Options

<table>
<thead>
<tr>
<th>NEW BUILD OPTIONS</th>
<th>COMMITTED</th>
<th>Non-IRP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coal Imports</td>
<td>Nuclear</td>
<td>Import Hydro</td>
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<tr>
<td>MW</td>
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<td>MW</td>
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<tr>
<td>TOTAL</td>
<td>6,250</td>
<td>9,600</td>
</tr>
</tbody>
</table>

1. Demand Projections
   - Average estimated economic growth projections based on National Treasury projections for the 2012 Budget

2. IRP Committed Builds
   - Pre-IRP Eskom builds include Medupi, Kusile, Ingula and Sere
   - Other commitments include landfill, hydro, CSP, wind and co-gen

3. New IRP Build Options
   - 2011 and 2012 determinations
   - Window 1 and Window 2 Renewable Energy Options

3. Liquid Fuel
   - No constraints

4. No additional emissions constraints

5. No carbon tax
**EMISSIONS LIMIT TEST CASES**

**“Peak Plateau Decline” Emissions Limit Trajectory**

<table>
<thead>
<tr>
<th>TEST CASE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
</table>
| ‘Peak-Plateau-Decline’ Emissions Limit Case | • Emissions limits for electricity generation and liquid fuel supply as derived from the *Peak-Plateau-Decline* trajectory  
• No carbon tax  
• No restriction on technology choices |
| Emissions Limit with - No New Nuclear Case | • Emissions limits as above  
• No carbon tax  
• New Nuclear explicitly excluded |
| Emissions Limit - Natural Gas Case | • As above  
• Natural gas options for power generation enforced |

Emissions Limit Test Cases primarily focus on exploring technology options that can effectively contribute toward mitigating against climate change.
## TEST CASES

<table>
<thead>
<tr>
<th>TEST CASE</th>
<th>DESCRIPTION</th>
<th>POLICY ISSUE</th>
</tr>
</thead>
</table>
| **Renewable Energy Target Case** | • No emissions constraints  
• No carbon tax  
• Target minimum 10% of all energy output to be from renewable energy by 2030  
• Target minimum 10% of all energy output to be from renewable energy must be maintained up to 2050 | • Analyses the efficacy of setting renewable energy targets in the absence of other policy instruments as a mechanism for reducing emissions within the energy sector  
• It also provides insight into the economic implications of renewable technologies as an alternative option in the energy mix |
| **Carbon Tax Case**        | • Impose a carbon tax of R120 per ton of CO₂-eq above the tax-free threshold for the first five years. The tax rate is increased by 10% per annum for a further five years*  
• Maximum of R120 per ton of CO₂-eq is assumed for remainder of planning period | • Analyses the cost implications of a possible carbon tax on the energy sector as defined in the impending Carbon Tax Policy  
• Seeks to provide insight as to the efficacy of a carbon tax on the reduction of emissions to be within the “Peak-Plateau-Decline” trajectory |

*The actual carbon tax is subject to review once the Carbon Tax Policy has been promulgated (Carbon tax calculated on absolute emissions and not on emissions intensity)
## TEST CASES

<table>
<thead>
<tr>
<th>TEST CASE</th>
<th>DESCRIPTION</th>
<th>POLICY ISSUE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Low Crude Oil Price Case</strong></td>
<td>• Low crude oil price sensitivity analysis on Base Case</td>
<td>• These sensitivity analyses seek to assess alternative options for ensuring security of fuel supply for different crude oil price scenarios.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Seek to provide a starting point for analysing viability of the various liquid fuel supply options presented in the National development Plan.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1) Build a new oil-to-liquid refinery;</td>
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<tr>
<td></td>
<td></td>
<td>2) Build a new coal-to-liquid refinery;</td>
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<tr>
<td></td>
<td></td>
<td>3) Upgrade existing refineries or allow significant expansions of one or more of the existing refineries or both;</td>
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<tr>
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<td>4) Import refined product; and/or</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5) Partner with Angola or Nigeria to build a new refinery.</td>
</tr>
<tr>
<td><strong>High Crude Oil Price Case</strong></td>
<td>• High crude oil price sensitivity analysis on Base Case</td>
<td></td>
</tr>
</tbody>
</table>
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PROGRESS TO DATE

ENERGY PLANNING COLLOQUIUM
- Policy and socio-economic issues
- Planning considerations
- Technology options
- Energy Modelling Approaches

INTER-GOVERNMENTAL FORUMS
- Policy and macroeconomic assumptions
- Key planning objectives
- High-impact policies
- Energy supply technology assumptions

PUBLISHED DRAFT IEP REPORT
- Presentation of:
  - Estimated future energy requirements in support of macroeconomic and socio-economic requirements
  - Energy supply options in light of:
    - High-impact national policy imperatives
    - Various technology assumptions
WAY FORWARD

Published Draft IEP Report

Energy Planning Colloquium

Stakeholder Input

IEP
STAKEHOLDER CONSULTATIONS ON DRAFT IEP REPORT

• Public input on policy and macroeconomic assumptions
• Additional policy and socio-economic issues
• Other planning considerations

INTER-GOVERNMENTAL FORUMS

• Review policy, macroeconomic and technology assumptions
• Consider socio-economic issues and other planning issues
• Consider alternative energy demand scenarios
• Evaluate energy supply options
• Make final recommendations

FINAL IEP REPORT (IEP)

• Presentation of:
  • Estimated future energy requirements
  • Recommended energy pathway/roadmap supported by:
    • Socio-economic implications
    • Macroeconomic implications
WAY FORWARD

Consultations with experts and Public Consultations

Stakeholder input

Revise Relevant Assumptions and Test Cases
Re-run Models

Macroeconomic Impact Analysis

Multi-criteria Evaluation of Output from Test Cases

Drafting of Final IEP Report

Incorporate output from Revised IRP and 20-Year Liquid Fuel Roadmap

Draft Output from Liquid Fuel Roadmap

Revised IRP 2010 Scenarios/Test Cases

Demand Projections for alternative scenarios

Month 1 - 3

Month 4 - 6

Month 7 - 9

Month 9 - 12
SOME AREAS OF FURTHER ANALYSIS

• Additional scenarios for demand projections
• Enhance carbon tax assumptions
• Explore impact of regional options (In particular electricity and natural gas imports)
• Analyse potential impact of technological advancements on future energy efficiency improvements
• Employment-Intensity and job creation potential of different options
• Macroeconomic impact analysis
PURPOSE OF STAKEHOLDER CONSULTATION PROCESS

DOE to ... 

• Provide overview of Draft IEP Report
• Communicate key policy issues considered
• Communicate key assumptions
• Communicate key model output
• Explain linkages of IEP with other plans and policies (i.e. Integrated Resource Plan, National Energy Efficiency Strategy, Renewable Energy Roadmap, Liquid Fuel Masterplan, Gas Roadmap, Universal Access Strategy)
• Communicate the way forward
PURPOSE OF STAKEHOLDER CONSULTATION PROCESS

DoE to obtain input and comment on...

• The key objectives of the IEP
• The minimum content of the IEP
• Quantitative baselines and assumptions
• Key gaps and areas of further analysis
• Input on different energy pathways/test cases
### STAKEHOLDER CONSULTATION WORKSHOPS

<table>
<thead>
<tr>
<th>PROVINCE (CITY)</th>
<th>DATE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gauteng (Johannesburg)</td>
<td>25 &amp; 26 September</td>
</tr>
<tr>
<td>Western Cape (Cape Town)</td>
<td>24 &amp; 25 October</td>
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<tr>
<td>Free State (Bloemfontein)</td>
<td>28 October</td>
</tr>
<tr>
<td>Kwa-Zulu Natal (Durban)</td>
<td>30 &amp; 31 October</td>
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<tr>
<td>Eastern Cape (East London)</td>
<td>12 November</td>
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<tr>
<td>Northern West (Mmabatho)</td>
<td>14 November</td>
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<tr>
<td>Northern Cape (Kimberly)</td>
<td>18 November</td>
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<tr>
<td>Mpumalanga (Nelspruit)</td>
<td>19 November</td>
</tr>
</tbody>
</table>
CLOSING DATE FOR WRITTEN COMMENTS

15 DECEMBER 2013
All queries and comments to be directed to:

Mr Tshepo Madingoane
Email: tshepo.madingoane@energy.gov.za
Telephone: 012 406 7554

More information is also available on the Department of Energy website

www.energy.gov.za
Click on “Integrated Energy Plan”
THANK YOU