Response to Draft 2012 **Integrated Energy Planning** Report (June 2013)

by R Worthington, for

Project 90x30 / Electricity Governance Initiative

Overview:

Context and process

Scope of work and range of options

Balance of policy priorities

Key assumptions and limitations (incl. discount rate)

Motivation for broader range of options

Way forward

Introduction

- There is a lot of good work here, but we need to be cautious about drawing conclusions from what we have so far…
- We commend the officials who have produced the document and the analysis reported upon so far, particularly in light of the constraints within which this has been undertaken, even as we critique the report in light of the provisions of the Energy Policy White Paper of 1998, the National Energy Act of 2008, the expectations that were raised at the IEP colloquium of May 2012 and further progress that is urgently needed.
- welcome the acknowledgement of the role of human input and judgement (e.g. p 39; section 1.2 – II) and recognition of the need for clear and inclusive criteria for assessment of policy options and pathways, as well as "the effectiveness of… governance structures to ensure on-going enhancement" (p.40; 1.2 – V)
- Deterministic decision-making is not adequate to act decisively in face of uncertainties, risks and lack of assured international cooperation; lack of data/research and analysis to support deterministic decisions translates into business-as-usual (BAU) lack of strategic direction, or options, or action;
- Constrained by endeavouring to remain consistent with IRP2010, which was itself limited and inadequate….. There is little exploration of new territory or scoping of potential strategic departure from BAU;
- Not adequately resourced and mandate too vague;

Context – some relevant developments

- First IEP started circa 2002; published 2004 noting shortcomings; IEP2, including commissioning of externalities study, put in abeyance in 2006 - efforts turned to producing supply-side strategies for electricity and liquid fuels - Medupi and Kusile approved; new pipeline;
- IEP2 process had a multi-stakeholder Review Committee (initially Steering Committee) and set of Working Groups, to provide guidance regarding the process, as well as input data and assumptions;
- Mandate for liberalisation of electricity supply industry not implemented – some space being carved out for IPPs; - ISMO?
- No coal or gas strategies (Sasol pipeline); tentative biofuel strategy is being revised / revisited; SA Coal Road Map sketches potential, avoids key questions;
- Copenhagen CC commitments; coal&water issues surface (Mafutha shelved);
- No renewable energy strategy coherence (RE White Paper non-committal); Feed-In Tariffs shelved; Road map work tentative;
- IRP2010 sets precedent for IEP, as well as Mitigation Potential Analysis (DEA)…
- Strong political support for a new nuclear industry, despite costs;
- Cleaving to coal as perceived economic advantage; on-going marginalisation of renewable resources; fixation on “baseload plant” rather than dynamic system;
- Carbon Tax Policy Paper somewhat apologetic; appeasing; incremental;

Context – big picture

- Food-Water-Energy nexus – growing inter-dependence;
- International Energy Agency notes at least 60% of fossil fuel reserves should not be used (without CCS) for 50:50 chance of staying below 2 degrees global warming; global carbon budget 2010-2050 below 1000 GtCO_2e;
- South African carbon budget (approx. 2010-2050):
  - LTMS Required By Science: ~ 16.4 Gt
  - Equitable per capita allocation: ~ 8 Gt
  - NCCRP: widening range (avoids key LTMS finding; defers action);
- Primacy of GDP and 'growth' starting to wane; growing understanding of the negative impacts for all of high inequality;
- Decline in energy return on energy invested in fossil fuels and increase in rate of water use required;
- National Development Plan calls for shift to a low carbon economy; concerted inter-departmental cooperation for robust IEP and review of prospects for nuclear and natural gas;
- Delay in implementing NCCRP provisions for sector and sub-sector carbon budgets and Flagship Programmes;

Scope of work and range of options

- Scope and range too narrow, even into mid 2030s;
- "… clear and inclusive criteria for assessment of policy options and pathways" requires an inclusive range of options and possible pathways
- Energy Mix – share of fossil fuels in total primary energy in 2050
  - Base Case: >95%; Lowest share: >82% in Emissions Limit (RE:~90%)
- Emissions outcomes – maximum reduction from business-as-usual (Base Case) is 24% to 2050 – difference of 5.3 Gt
  - Base Case: 22.1 Gt; Lowest level: 16.8 Gt (Emissions Limit Test Case)
- Job creation potential not assessed and no discussion of labour intensity and potential for localisation;
- Carbon Tax Test Case does not assess impact of applying carbon price at the base rate or "taking account of externalised cost"
- 'New industry' commitment ('fleet procurement' approach) only applied to one technology i.e. nuclear; there is no assessment of a similar approach to solar technologies or acting on1998 policy prescription for "an equitable level of national resources is invested in renewable technologies, given their potential…"

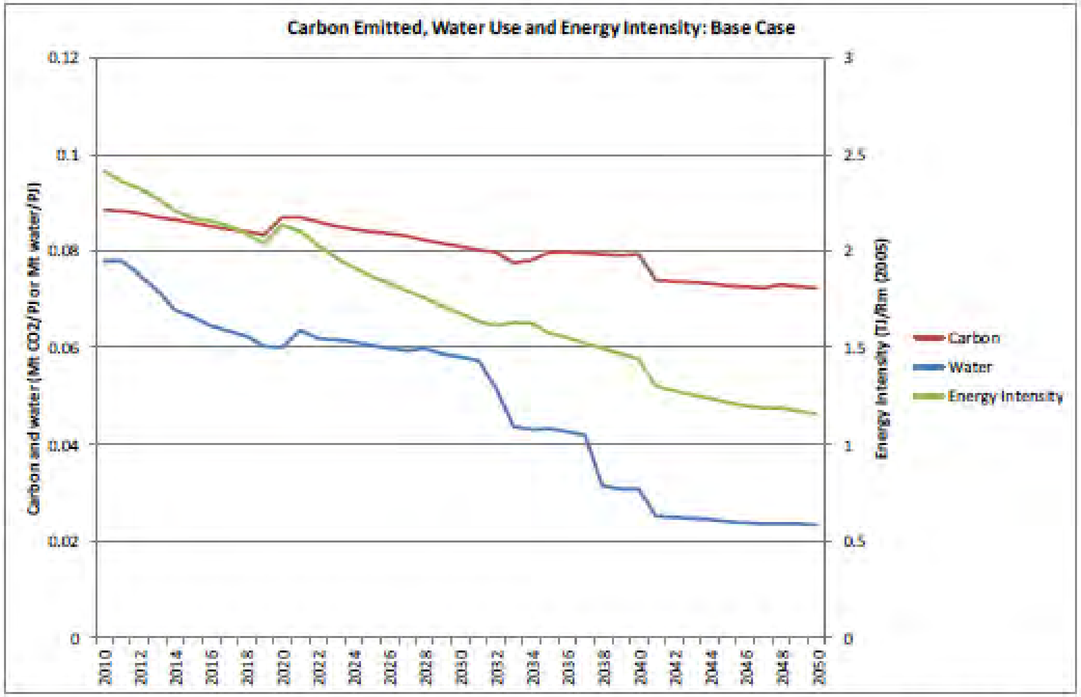


Figure 2.31: Emissions, water use and energy intensity in Base Case

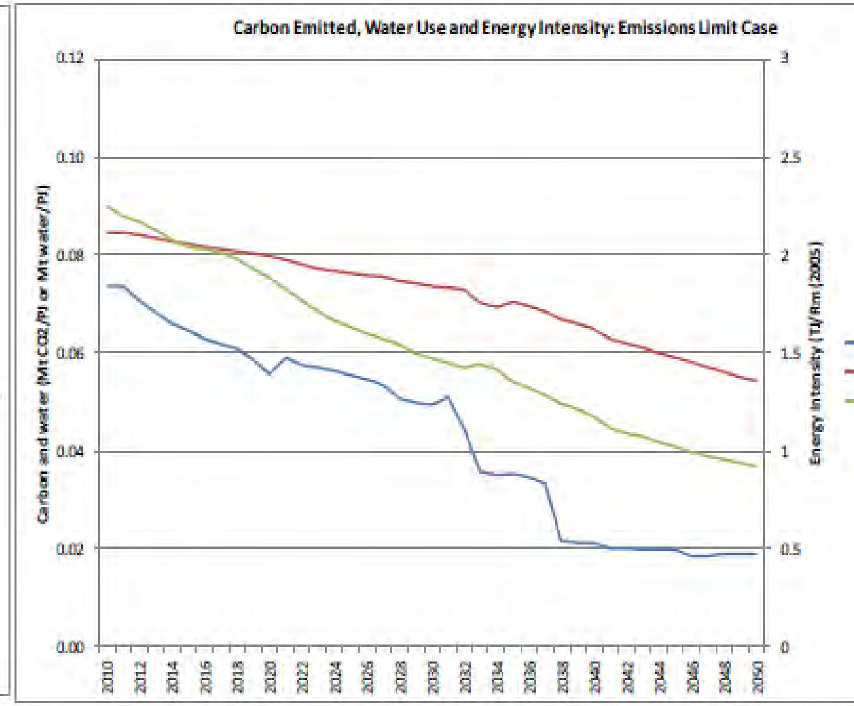


Figure 3.21: Emissions, water use and energy intensity in Emissions

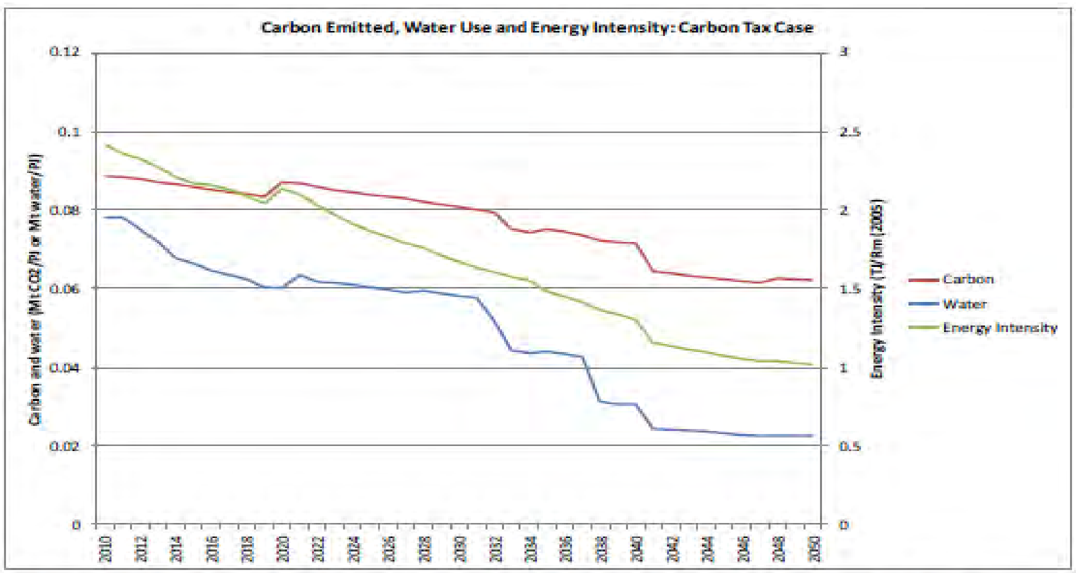


Figure 6.14: Emissions, water use and energy intensity in Carbon Tax Case

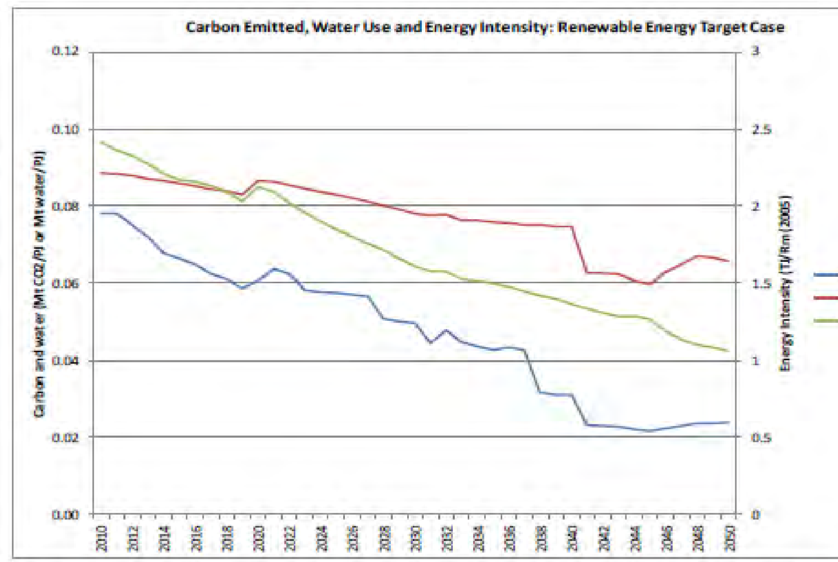


Figure 5.13: Emissions, water use and energy intensity in Renewable En
Case

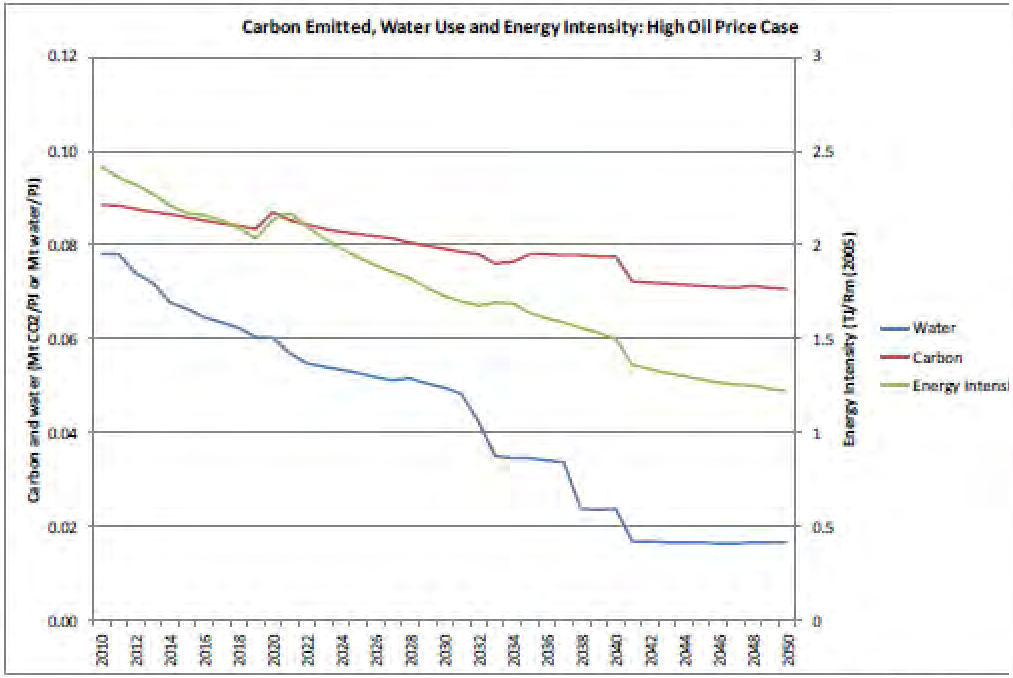


Figure 7.15: Emissions, water use and energy intensity in High Oil Price Case

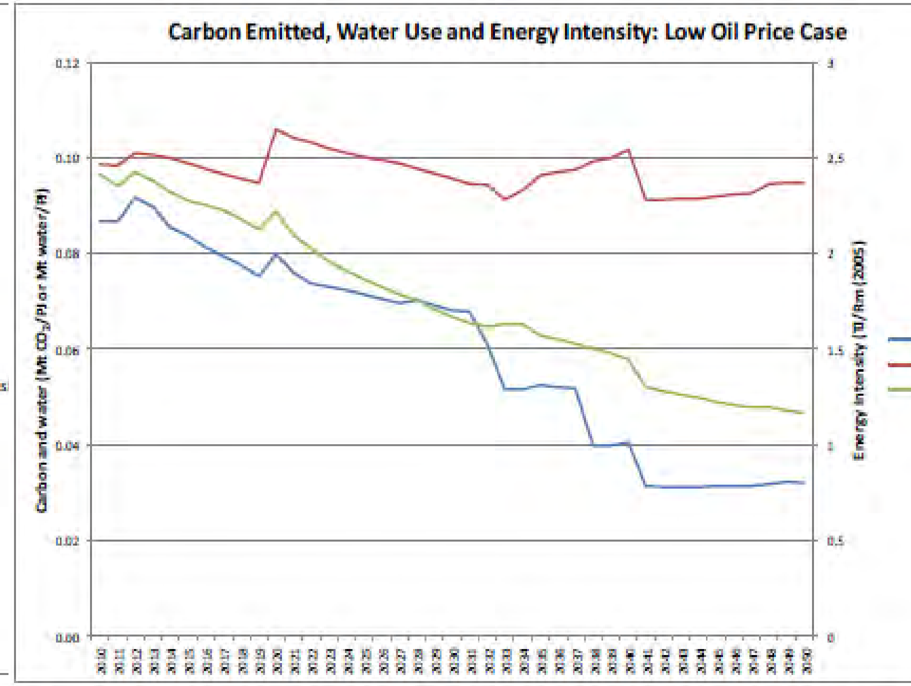


Figure 8.14: Emissions, water use and energy intensity in Low Oil Price

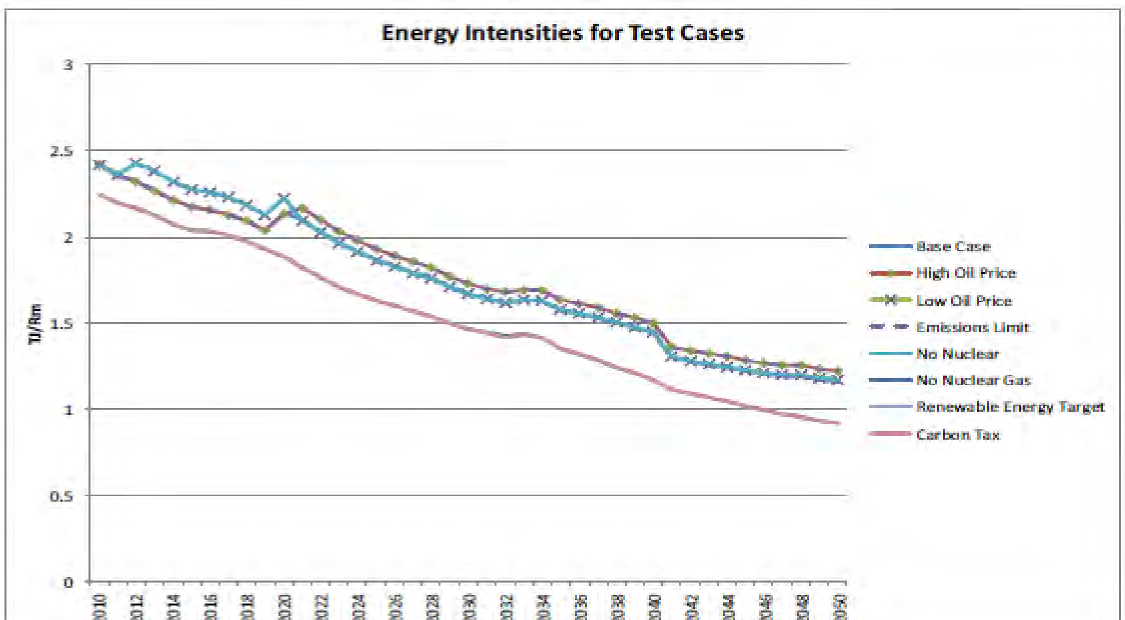


Figure 9.5: Energy intensity for all test cases

Balance of policy priorities

- Pre-eminence of "cost" optimisation against current data and assumptions - with focus/weight on bulk demand; how does model treat diesel-fired peak power vs CSP with storage?
- Development equated with GDP growth – in effect, incl:
- Job creation, labour intensity and local content not assessed or even discussed;
- Policy for Free Basic Alternative Energy (access) omitted from overview of relevant policies;
- Environmental and social impacts of traditional biomass use (~8% of primary energy) ignored;
- What consideration of shifting composition of demand and/or different growth rates of particular sectors (incl. EE&DSM industry) ?

Table 9.2: Emissions comparison and abatement costs

	Base Case	High Oil Price	Low Oil Price	Emissions Limit	No Nuclear	No Nuclear Gas	RE Target	Carbon Tax
Total Discounted Cost	**2484**	**2977**	**1779**	**2701**	**2705**	**2707**	**2570**	**2644**
Difference in cost from Base Case (Rb)	0	494	-705	218	222	223	87	160
Difference in cost from Base Case (%)	0.0%	19.9%	-28.4%	8.8%	8.9%	9.0%	3.5%	6.4%
Model Period Emissions 2010-2050 (Mt)	22101	22425	22393	16811	16808	16808	20419	19833
Difference in emissions from Base Case (Mt)	0	324	292	-5290	-5293	-5293	-1682	-2268
Average cost difference of CO2 from Base Case (R/t)	0	1525	-2411	-41	-42	-42	-52	-71

Is total cost difference being shown meaningful as abatement cost?

Change the oil price either way and you get more emissions – the cost difference is not strongly related to the emissions outcome in these 2 cases;

Emissions limit - with or without nuclear, or gas - provides highest abatement and at lowest cost; trend for these Test Cases against Base Case is for cost of abatement to decline as ‘ambition’/ level of abatement increases, therefore reasonable to

Expect that “abatement cost” would be lower, per unit of emissions avoided, with considerably higher quantum of emissions reduced

Ambiguity in treatment of coal?

There is ambiguity in the treatment of coal – not just a reasonable expectation, but rather a determination that there will be new coal-fired power plants, because coal is deemed essential to competitiveness of the national economy, without sufficiently testing this assumption. It is treated (a priori) as good for the economy and thus scope does not provide for or test phasing out coal over the four-decade time-scale (i.e. no new coal after Medupi and Kusile plus 2500MW coal in Determination of December 2012), while some results show otherwise;

Revealing of assumptions or mind-set, rather than a statement of fact, is the assertion that competitiveness of SA requires finding new technologies to reduce carbon intensity of coal (p.62):

- "Unless new technologies, aimed at reducing the carbon intensity of coal are discovered and put into use, the international competitiveness of South African exports could potentially be negatively affected."

"technologies to reduce the carbon intensity of coal" may be a veiled reference to carbon capture and storage (CCS), but this technology can be applied to various sources of emissions and may be a better mitigation proposition when applied to biomass, or gas (though in the case of gas, fugitive methane emissions are more important). The fact that government has decided to research and develop CCS does not require that this be tied to coal in energy planning – there is no rationale provided through the modelling for coal with CCS.

Key assumptions and limitations

- Chosen discount rate - contest the assertion that 11.3% is a "social" discount rate - the choice of discount rate is pivotal to the issue of cost competitiveness of generation options, particularly with the use of levelised costs (as appropriately chosen for IRP);
- EPRI costs for IRP201 - outdated & which value for nuclear (not incl. additional 40%?);
- Emissions limit derivation/rationale – max 'acceptable' emissions (mandated limit), not max achievable mitigation;
- Very little increase in fossil fuel costs over-all;

Information not clearly presented:

Includes:

- Resource potential estimations and limits (p.37): The model suggests four types of solar energy: PV thin film, PV crystalline, CSP tower with 12 hours storage and CSP trough with 9 hours of storage. While **practical limits were placed on solar PV**, the concentrating solar power technologies were not limited during the modelling and total CSP capacity reaches 35GW by 2050.
- Methodology for arriving at discounted costs
- Should acknowledge in more detail the data constraints and data collection challenges (Is this perhaps in report on demand modelling?)

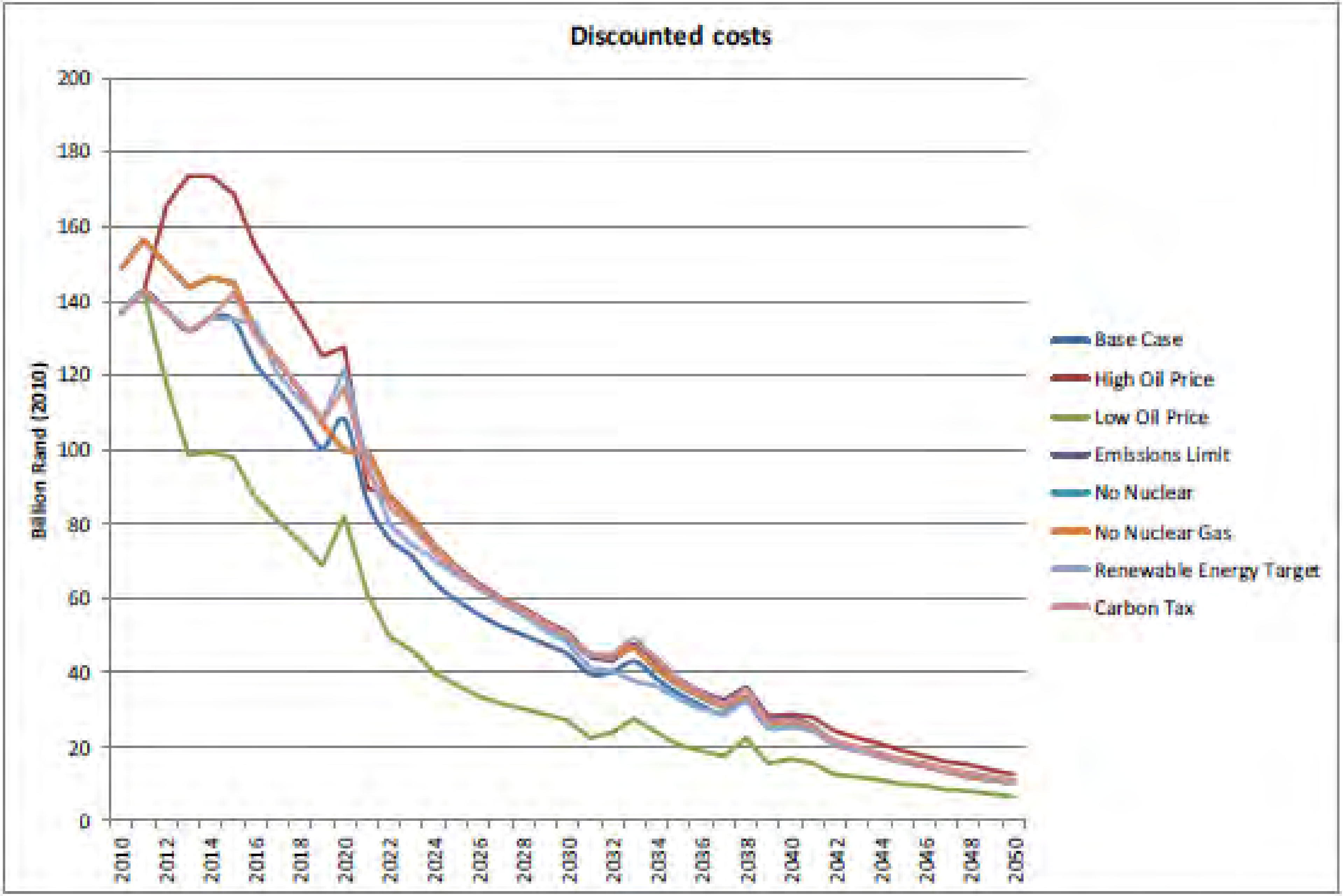


Figure 9.2: Discounted costs for the energy system for the test cases

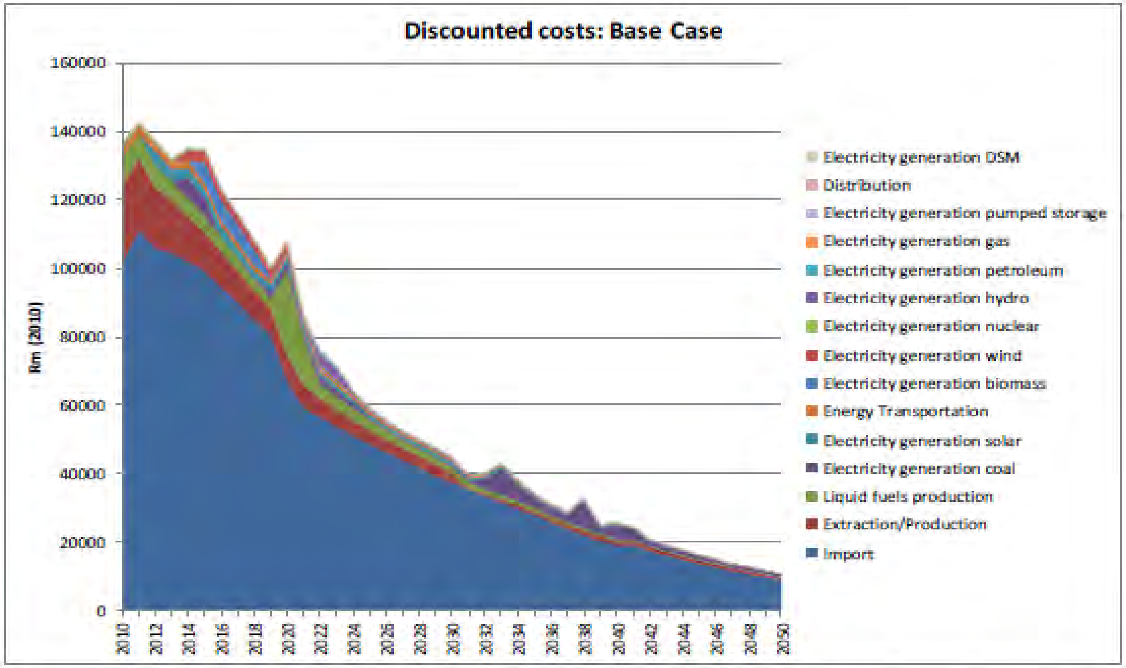


Figure 2.27: Total discounted costs for energy supply in Base Case (Rm '2010)

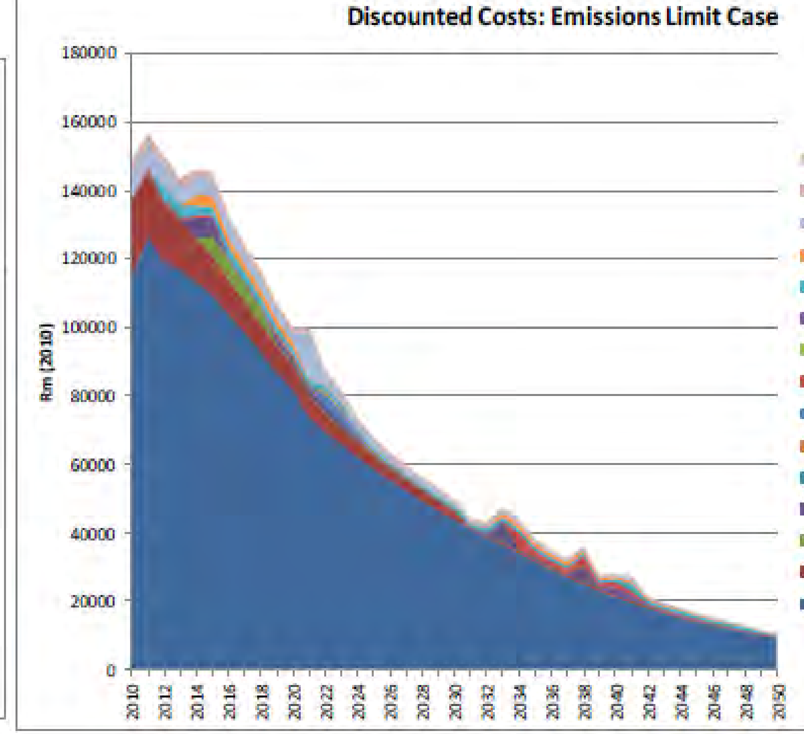


Figure 3.17: Total discounted costs in Emissions Lim

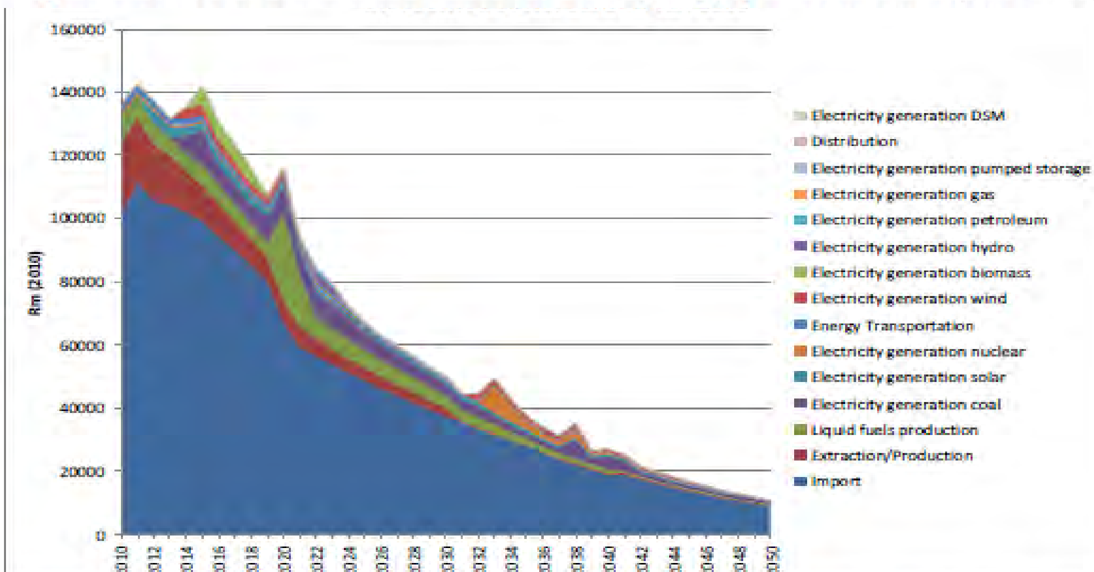


Figure 6.10: Total discounted costs for energy supply in Carbon Tax Case (Rm)

Total discounted costs not shown for no nuclear case; elect. generation costs of base case not shown

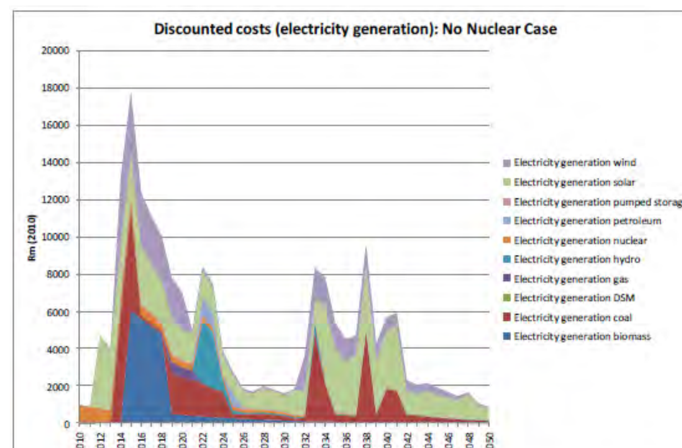


Figure 4.10: Total discounted costs for electricity generation in the Emissions Limit No Nuclear Case (Rm)

Motivation for broader range of options

- Need to broaden the range of results, to be fed into further analysis, with at least one more test case, in which mitigation effort and the potential role of renewable energy are not artificially constrained by non-technical factors
- It is good to see the recognition that a carbon-intensive energy sector is likely to be detrimental to the global competitiveness of the South African economy, at least in the medium and long term. However, this needs to be fully thought through, with consideration of a broader range of test cases, including at least one that explores strong decarbonisation of energy supply, driven not just by a modest limit on emissions, but also e.g. by RE reaching grid parity.

Cleantech – Underestimation to Ambition

Predictions around 2000 from IEA, US Dept Energy, EU Wind Energy Assoc, World Bank

'Non-hydro renewables would reach 3% of global energy by 2020'
That benchmark was reached in 2008

'There will be 30 gigawatts of wind power worldwide by 2010',
Wind power produced in 2010 was 7 times that - 200 gigawatts

'U.S. wind power capacity could reach 10 gigawatts by 2010'.
The country reached that amount in 2006 and quadrupled between 2006 and 2010.

'Europe could have 50 gigawatts of wind by 2010'
84 gigawatts of wind power were feeding into the European electric grid by 2012.

'China would have 2 gigawatts of wind power installed by 2010'.
China reached 45 gigawatts by the end of 2010.

'We will have an additional 1 gigawatt of PV solar capacity annual market by 2010'.
The annual market in 2010 was 17 times that at 17 gigawatts.

'China will reach 0.5 gigawatts of solar photovoltaic by 2020'.
China reached almost double that mark — 900 megawatts — by 2010.

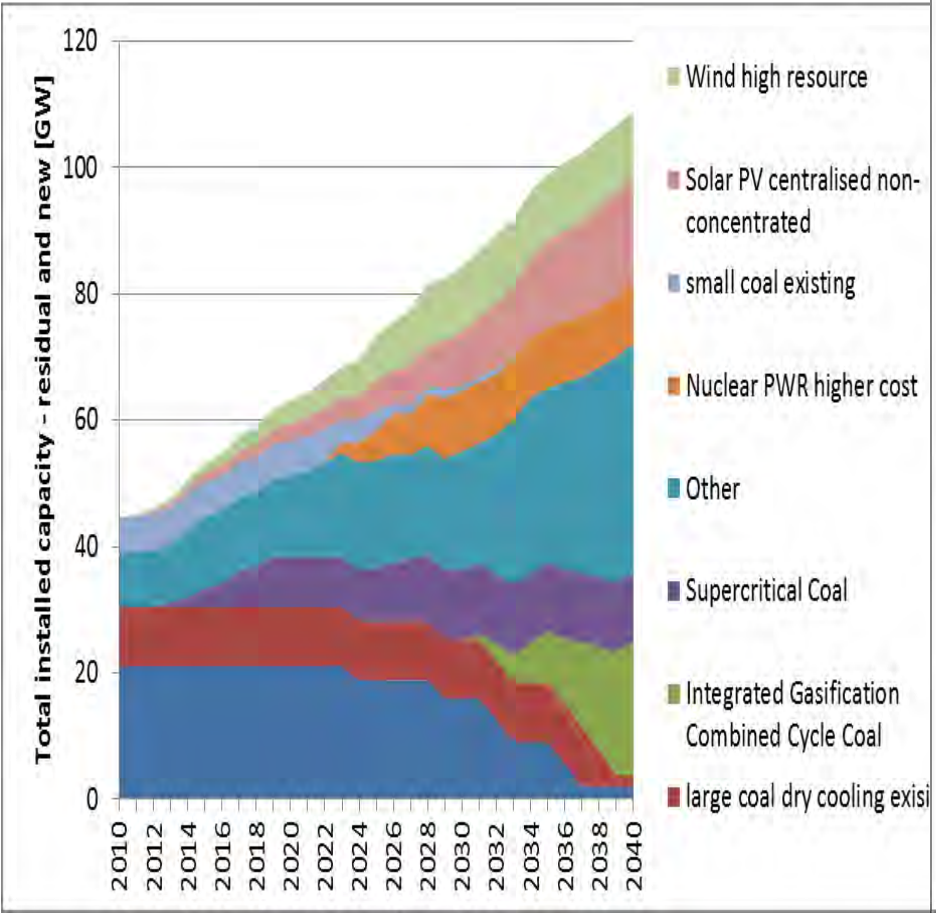
2 Supply scenarios against 'IRP2010 extended' demand:

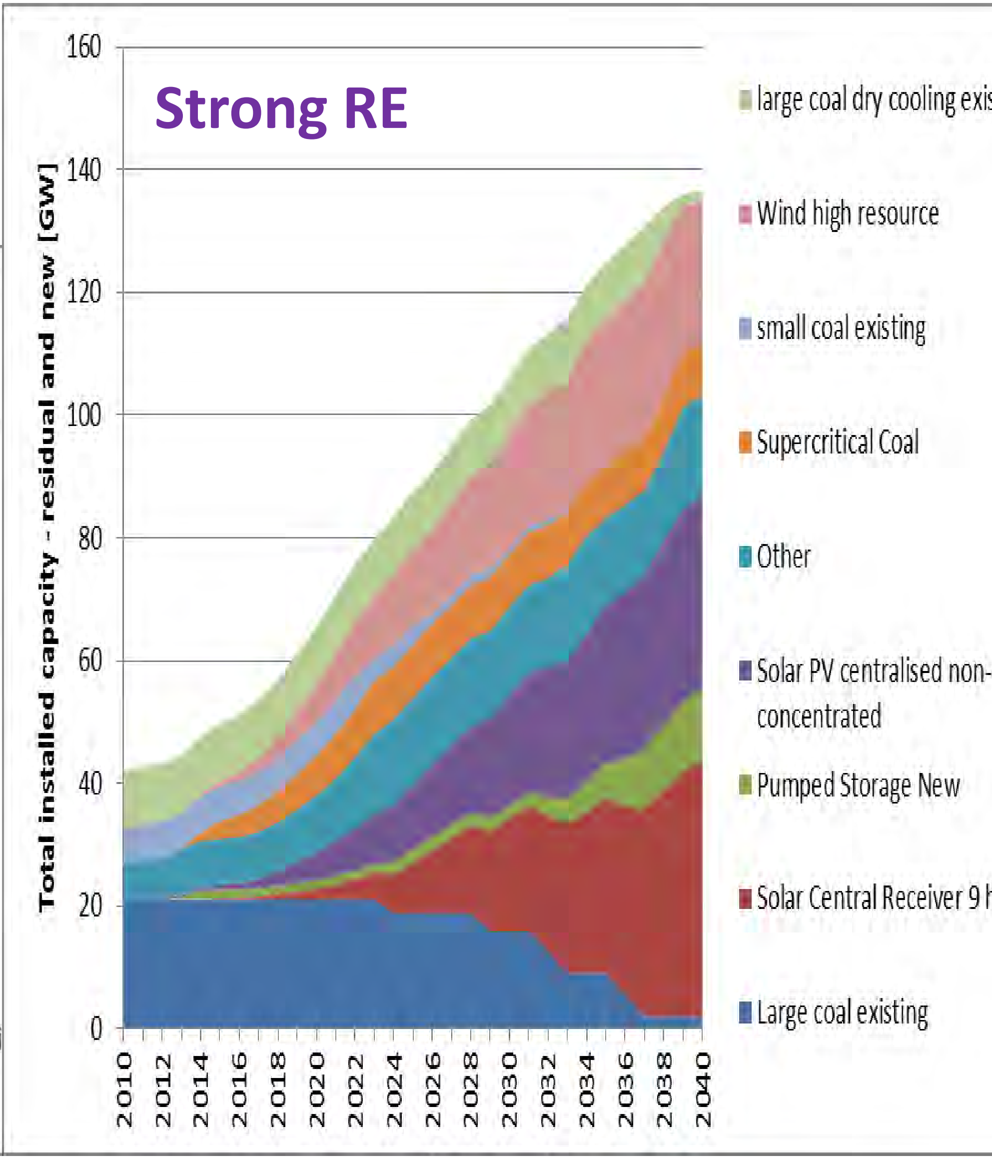
IRP-extended: big coal (34.7GW); 9.6 GW nuclear; 11.8 CCGT; 26.5 solar; 14 Wind

Strong RE growth: 42 GW CSP solar; 32 GW PV; 29 GW wind; 11.5 GW 'storage' ;

Installed Capacity

Reference Case: 'Govt plans'





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Capital Cost

Reference Case:
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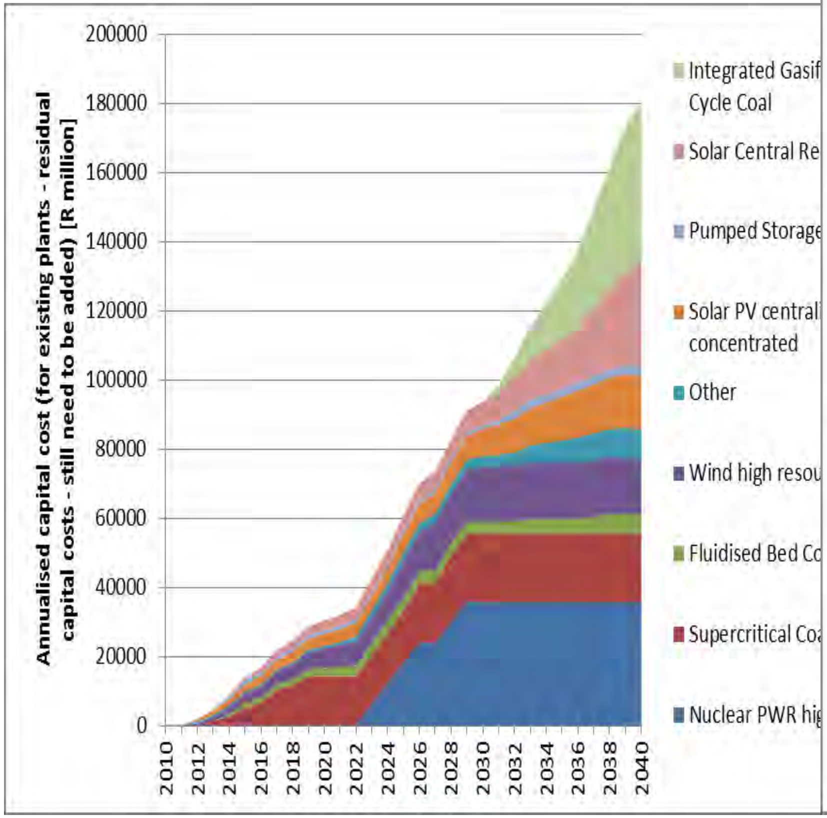
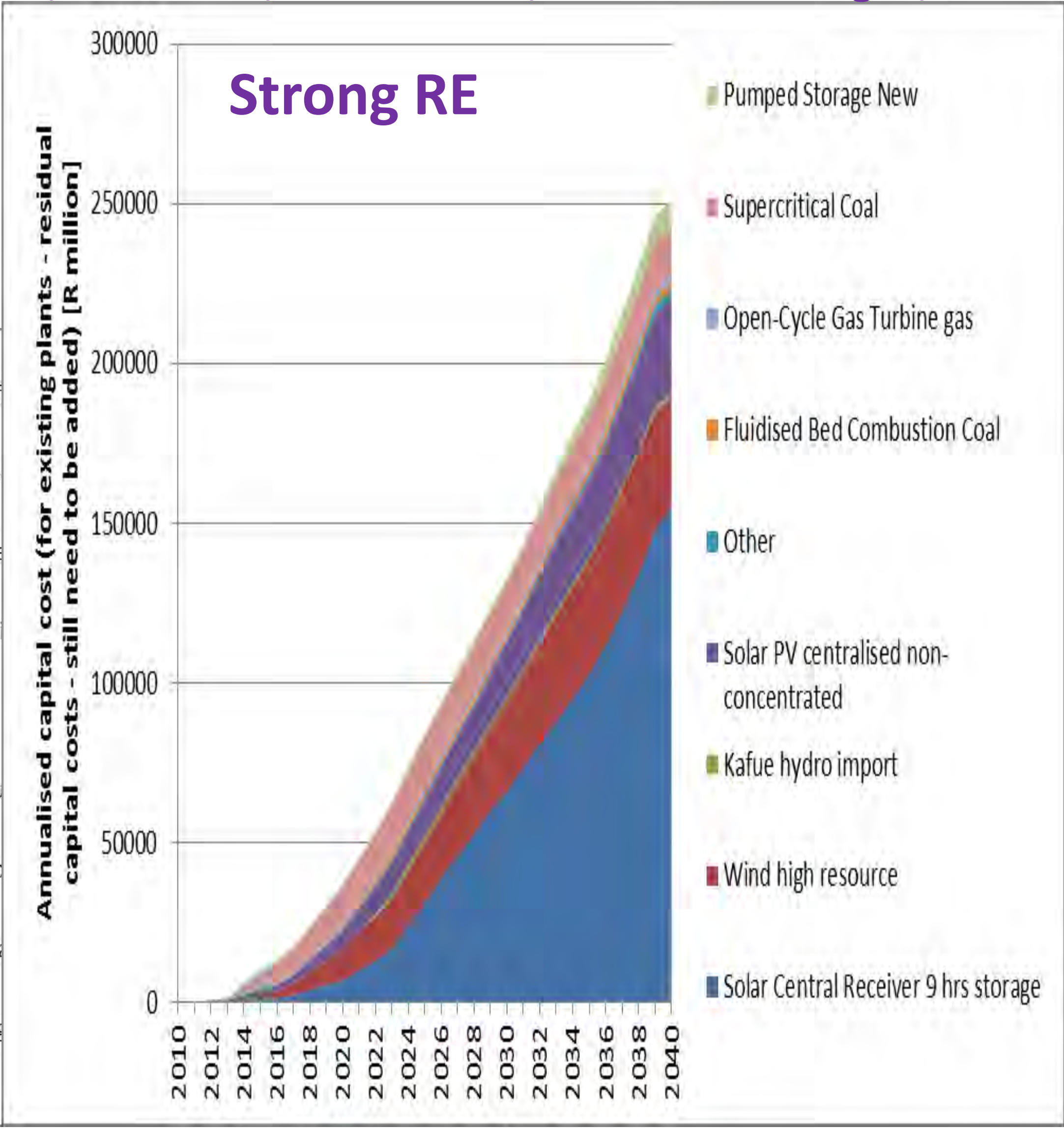
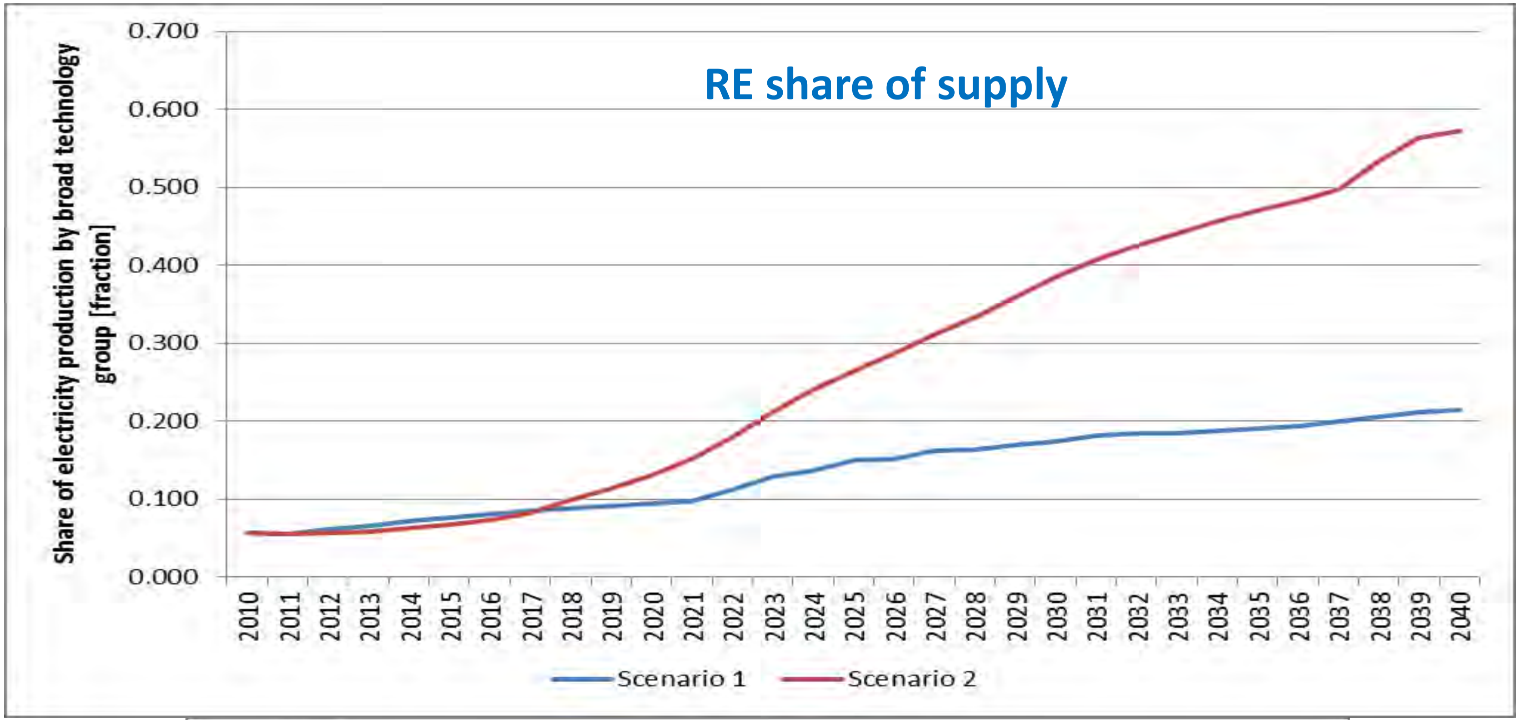


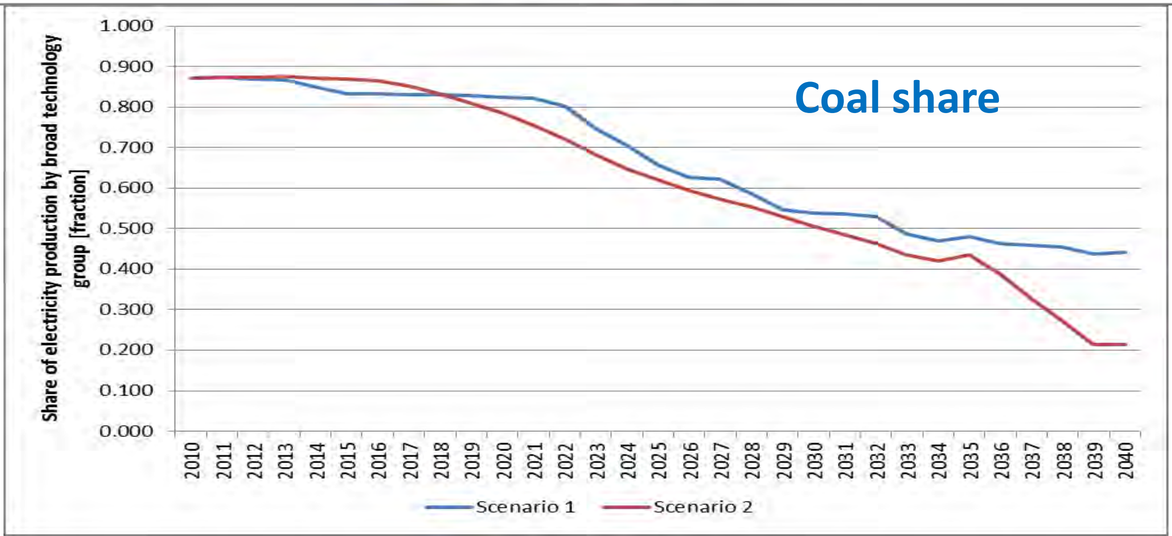
Strong RE



2 Supply scenarios against 'IRP2010 extended' demand:

Share of RE & Share of coal





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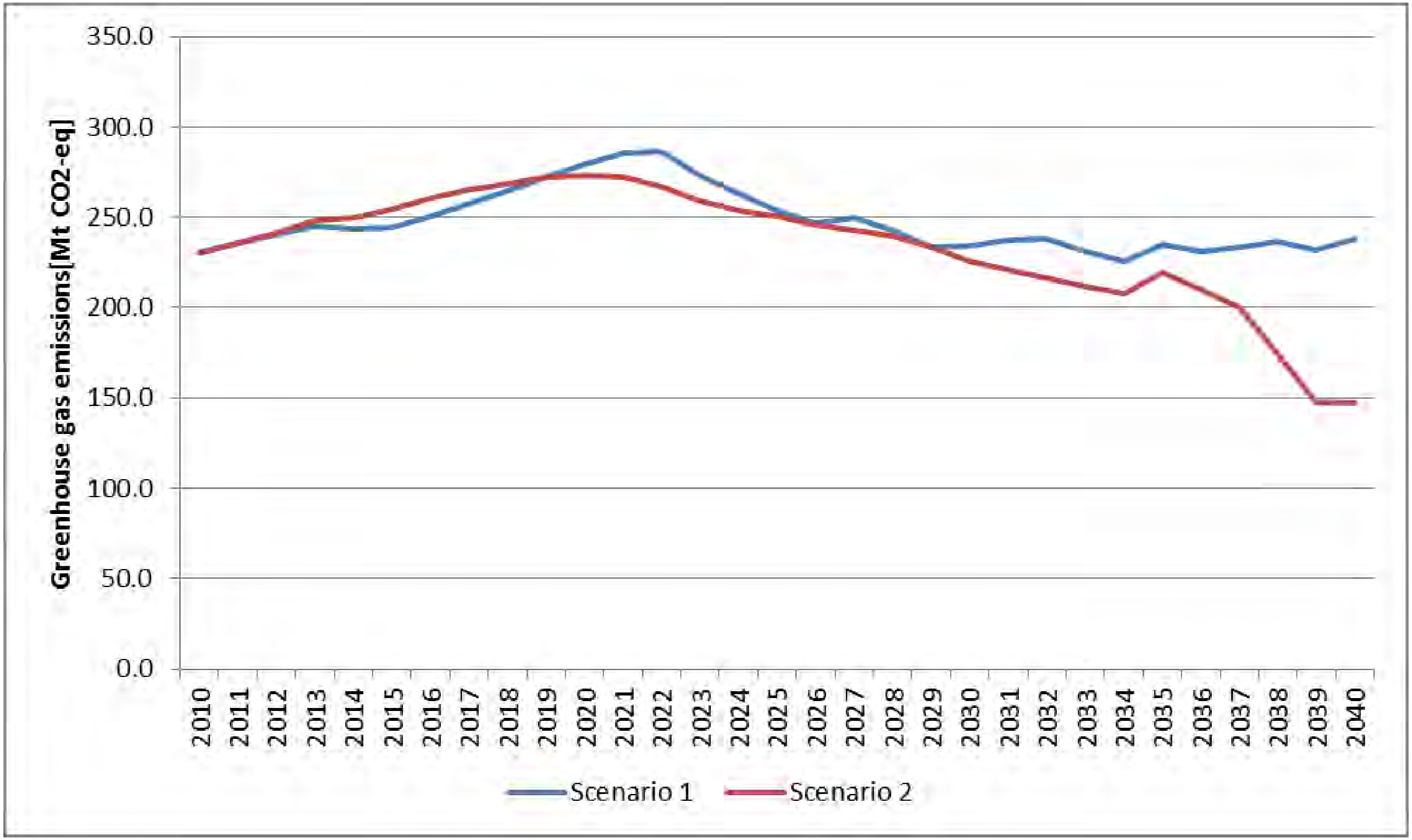
Greenhouse Gas Emissions



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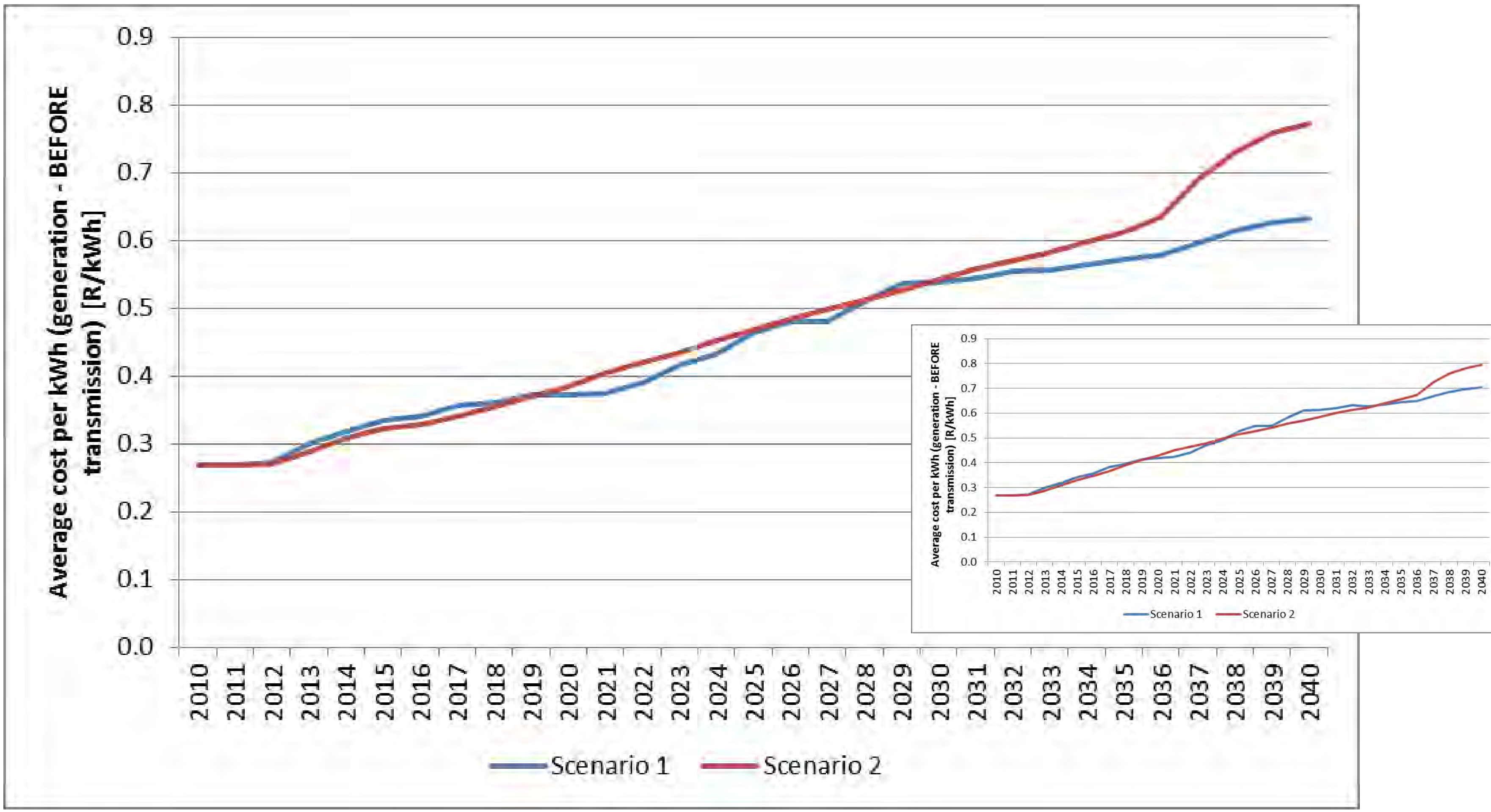
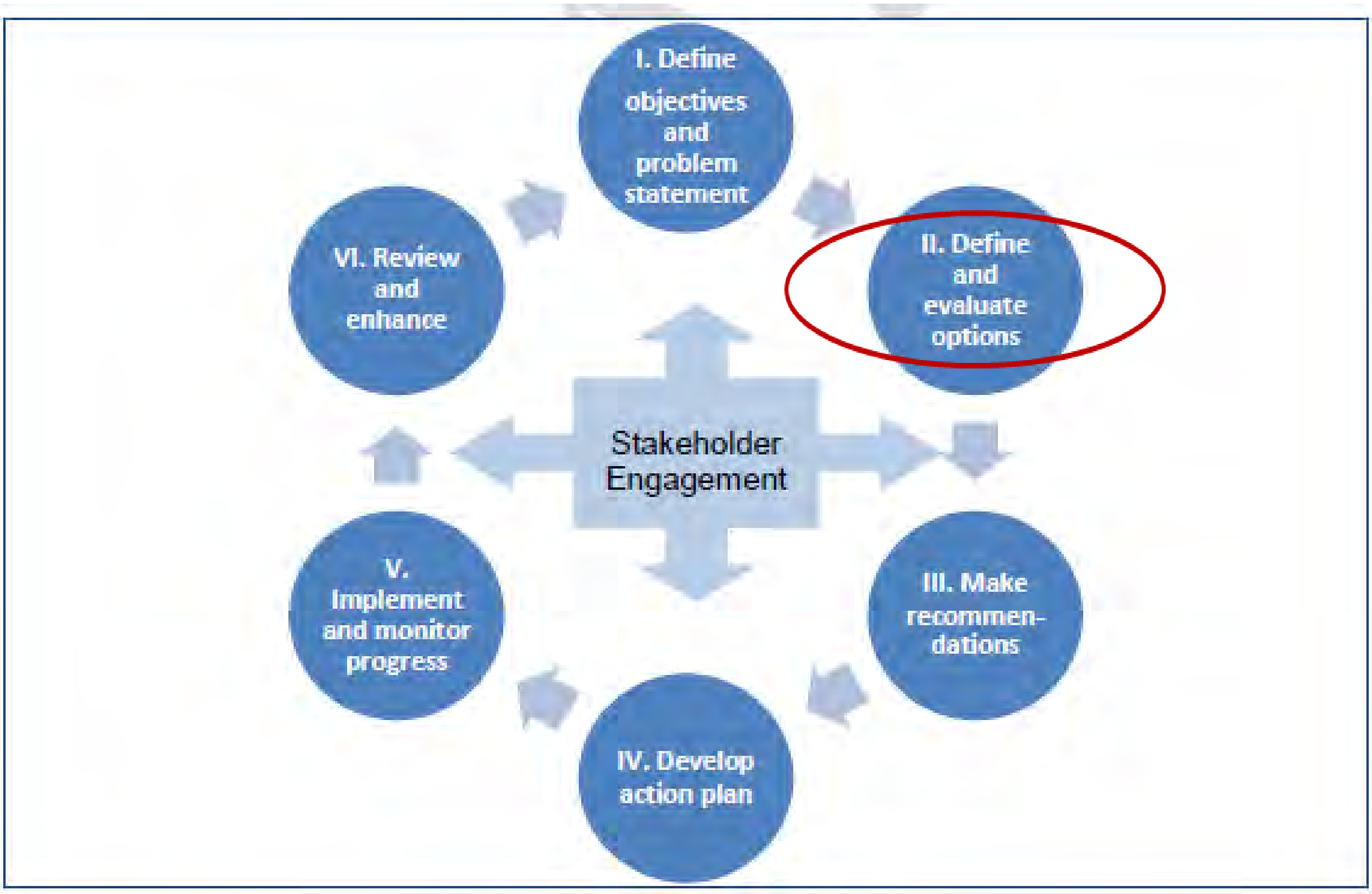
Average cost per kWh



High level planning approach



Risk-averse, resource-efficient & low carbon

The proposition of an appropriate Test Case, to allow for inclusive assessment of the development benefits of energy planning decisions and strategy, could be characterised primarily as **a risk-averse pathway**; for example one could apply an externalities cost or carbon tax, for modelling and analysis purposes, at a rate of R200 from 2015, increasing to R300 in 2020 and by at least 5% annually to 2030 and thereafter tracking inflation – this would be simplistic, but usefully indicative and easily undertaken. Alternatively it could be characterised primarily as seeking optimal localisation in manufacturing of the most labour-intensive energy supply technology options; however, reliable data and analysis is not readily available to support such an approach in the short term.

Definition and evaluation of such an option, in a Test Case, could also go some way to addressing a further short-coming in energy planning, in that there has been no attempt to explore the full potential for avoiding greenhouse gas emissions in energy supply. The emissions limit applied assumes a very generous allocation of 'carbon space', sp. future emissions entitlement to the electricity supply, and it is arguably inadequate to support optimal economic development while meeting our international commitments and obligations. A test case exploring the full potential of renewable energy would advance our understanding of mitigation potential and provide further insight into the prospects and policy options for a low carbon economy.

A proposition for such a Test Case should include

(initial notes):

- Either exclude nuclear, on the basis of the massive scale of the investment decision and package required, and the huge uncertainties regarding capital costs (not to mention the externalised costs of the full nuclear fuel chain); or allow for inclusion of nuclear at a precautionary capital costing of no less than $6000 per kW.
- Any RE penetration/deployment rate limitations should assume concerted development of grid infrastructure, with extensive storage capacity by 2030 (as well as utilisation for grid peaking support of the extensive back-up generation capacity recently procured by electricity consumers);

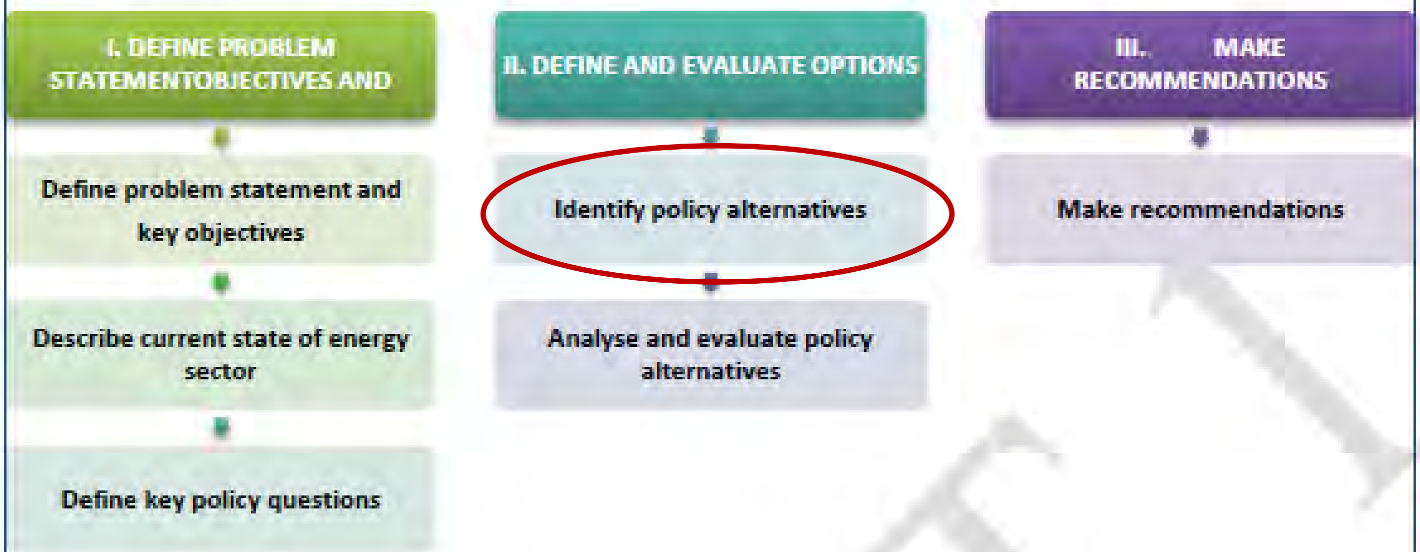
Technology-specific assumptions - e.g.: (numbers illustrative only at this time)

- CSP with 6 hours thermal storage available at scale from [2022?]
- CSP with 9 hours thermal storage available from [2025?]
- Wind <10% total power to 2025 [?]; 15% to 2035;
- PV <10% total electricity supply in early 2020s; no more than 50% maximum [?]
- Need to review assumptions or ceiling re Hydro imports
- Gas as per emissions limit test case [? – need to know what these are]
- Electric vehicle use scales up earlier and more rail is electrified;
- Share of electricity in delivery (energy carrier) mix: <60% by 2050; and < 40% by 2035 [?]
- Learning curves as per IRP but not ramped down as much post 2030 as in Mitigation Potential Analysis (is IEP consistent with MPA?)
- Apply an externalities cost or carbon tax, without exemptions or thresholds for modelling and analysis purposes, at a rate of R200 from 2015, increasing to R300 from 2020 and thereafter at least tracking inflation;

an additional Test Case should use the same discount rate as those already modelled, but should also be given a sensitivity analysis with application of a truly social discount rate (no higher than 5%);

Schematic diagram of IEP methodology (Fig 1.2)

This need to be done a.s.a.p.
- before evaluation of alternatives



Some other Gaps

- Demand Modelling Report?
- Sensitivity analysis?
- Consideration of impact of chosen discount rate Recognise the right of Treasury to stipulate the discount rate, but contest the assertion that 11.3% is a “social” discount rate – IEP should assess impacts on costs of applying e.g. 3.5% (an internationally recommended social discount rate)
- E
- Need explanation of single discounted cost assessment -
  levelised cost of supply and capital costs over time also NB
- EROEI – Energy Return On Energy Invested - at least in noting further work needed: benchmark EROEI - integrated energy planning needs to consider full life-cycle resource efficiency and how this can be optimised…
- Optimal development pathways for RETs and interplay of industrial development and strategic technology growth rates

WAYS FORWARD

Integrated Planning is not passive or just reactive - as is well elaborated in the Report’s introduction - it is actually a cyclical and a learning process.

The IEP Report should identify key interventions that could advance the realisation of policy objectives. For example:

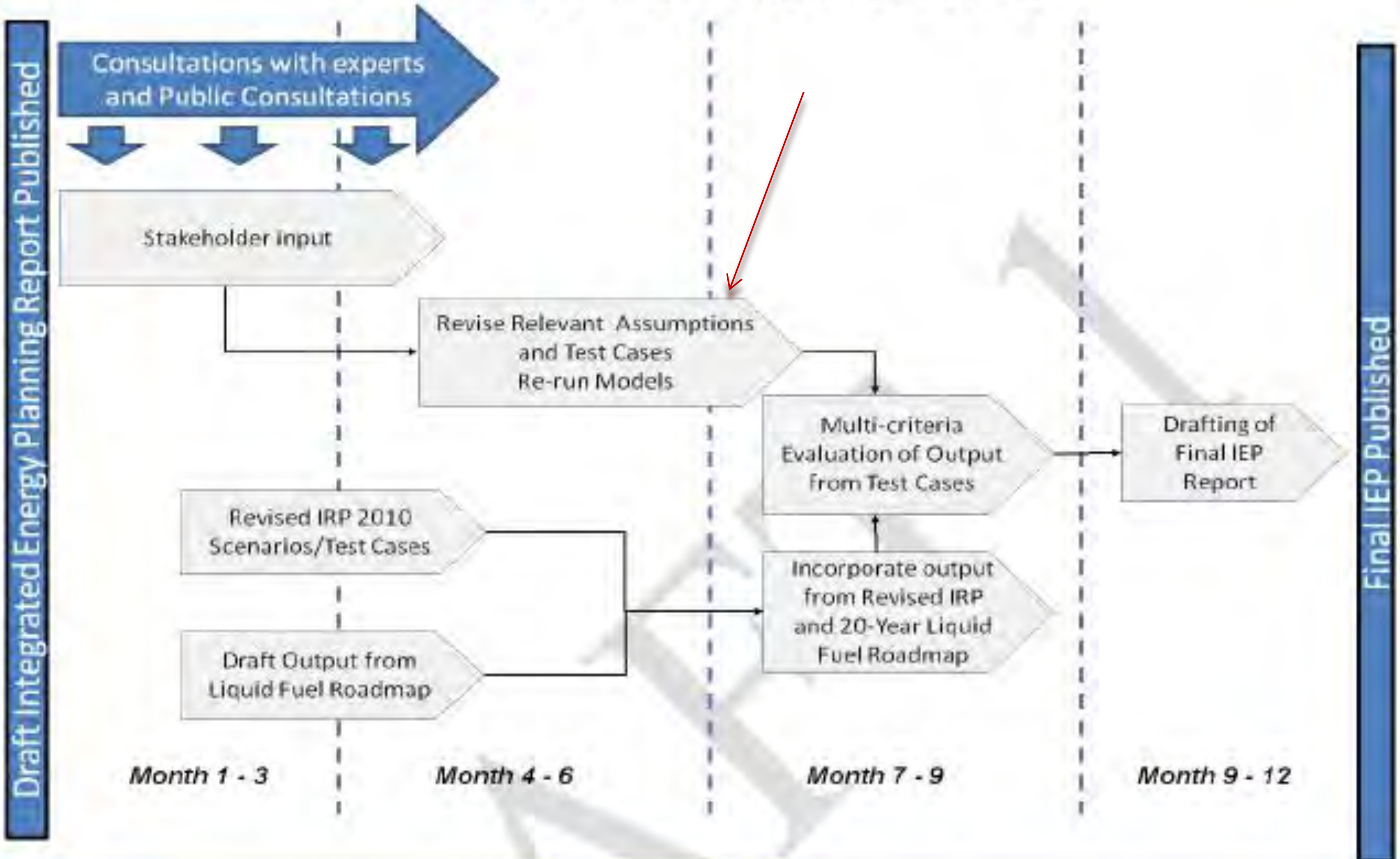
in seeking to manage costs (full economic costs) over time and decarbonise energy supply and promote regional cooperation and water security, it would make sense to develop a regional biomass energy (particularly biofuel) strategy;

to support job creation and resource efficiency it would make sense to apply Feed-In Tariff provisions for CSP with storage, yet the Draft Report simply mentions the solar park concept, without considering the opportunities for supporting localisation and the most appropriate scale and rate of deployment that would support this, and with it realising cost reduction earlier in the planning process.

Way forward

A great deal of value could be added, with relatively modest additional work, through inclusion of a test case that broadens the range of energy development pathways that will be considered, for a more inclusive and rigorous analysis of the policy and investment options that will underpin massive public investments.

HIGH-LEVEL ROADMAP



White Paper on the Energy Policy of the Republic of South Africa, December 1998; Section 7.7 (p. 79):

“Government policy on renewable energy is thus concerned with meeting the following challenges:

- ensuring that economically feasible technologies and applications are implemented;
- **ensuring that an equitable level of national resources is invested in renewable technologies, given their potential and compared to investments in other energy supply options**; and
- addressing constraints on the development of the renewable industry.

Government policy is based on an understanding that renewables are energy sources in their own right, are not limited to small-scale and remote applications, and have significant medium and long-term commercial potential.”