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Climate Change: Risks and Opportunities for the South African Economy

Case Study

Renewable Energy and the Draft IRP 2010: "The Winds of Change"

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List of Acronyms

CCGT	Combined Cycle Gas Turbine
CO_2	Carbon Dioxide
CSP	Concentrating Solar Power
DOE	Department of Energy
DSM	Demand Side Management
GHG	Greenhouse Gas
GW	Gigawatt
IPP	Independent Power Producer
IRP	Integrated Resource Plan
MW	Megawatt
NERSA	National Energy Regulator of South Africa
PBMR	Pebble Bed Modular Reactor
PPA	Power Purchase Agreement
PV	Photovoltaic
REFIT	Renewable Energy Feed-In Tariff

1 Introduction

1.1 Background

The draft Integrated Resource Plan (IRP) for electricity generation was released for public comment by the South African Department of Energy (DOE) in October 2010. While the document is therefore still in draft form, and will presumably be refined in the final stage of public engagement, it is worthwhile to reflect on the state of this draft IRP, a document that marks a turning point in the energy planning process in South Africa.

The process of supporting transparent and accountable electricity planning in South Africa, open to public debate, and reflected upon and refined based on a process of democratic engagement, has hitherto been absent in contemporary South Africa. Indeed, until very recently, dialogue on the makeup and priorities of electricity planning were restricted to a handful of closely knit institutions and individuals, and outside of the breadth of public examination. The IRP 2010, as the latest IRP document is referred to, represents the first in what will hopefully be a long history of transparent electricity planning efforts in the country.

Equally important, the document constitutes the first tangible attempt to commence the process of integrating and aligning South Africa's climate change mitigation objectives on the one hand, through a reduction in greenhouse gas (GHG) emissions associated with electricity usage, and the country's traditional and critically important energy planning functions and priorities related to universal access, economic development, industrial competitiveness and security of supply.

The document marks the first point in the energy planning process in which a scenario containing a GHG reduction limit is the recommended planning scenario for the country. The document also sees an increasing ownership and oversight of electricity planning by the Department of Energy, a process that has been constrained to date. The extent to which this leadership on the part of the DOE is implemented in future planning remains to be seen, with the Department's role as facilitator and overseer of the wider planning process an important part of ensuring a holistic energy plan, cognisant of a range of economic, environmental and social objectives.

In addition, the IRP 2010 arguably provides the most recognisable action to support the regulatory framework for renewable energy in South Africa since the adoption of the National Energy Act in 2008. This is argued given that in principle the licensing of new grid connected generation capacity by the National Energy Regulator of South Africa (NERSA) will need to be aligned with this twenty year electricity plan. Not surprisingly therefore, the contents of the IRP 2010, and its relative allocation to different energy technologies, has been long awaited and hotly contested.

Certainly there will be detractors and those that have lost out, but the space for renewables to enter the electricity mix has never been greater, and wind energy in particular has been given a sizeable allocation and recognition in the current plan. There are a number of important issues that will need to be addressed in the IRP 2010 and its subsequent implementation. Many of these issues have been discussed in some length in the media and in energy circles, relating to ensuring access to the grid for Independent Power Producers (IPPs), the apportioning of risk between the different parties and the finalisation of Power Purchase Agreements (PPAs) etc.

There are, however, additional issues that need to be considered (key elements of which are discussed in Section 3 below) that are also critical to the makeup of South Africa's energy supply and the future carbon intensity of the economy. Nevertheless, it does appear that an important shift has occurred in the planning landscape in South Africa, with a number of forces driving the case for renewables to a greater extent and with greater clarity than before. It would seem then, that the winds of change are blowing, heading to the Southern tip of Africa.

1.2 Overview of the Draft IRP 2010

The IRP 2010 is a planning framework for the management of electricity demand over a twenty year period from 2010 to 2030. A significant emphasis is placed on the timing and costs associated with delivering new generation capacity to the national electricity grid ('the supply side'), but the plan also includes options and interventions related to energy efficiency and demand side management (DSM) ('the demand side').

The IRP document is not set in stone, and is to be reviewed and refined over time, including in relation to new information and the advancement of technologies. Suggestions are noted in the IRP text for a review to take place every two years.

The IRP 2010, in its current draft form, models and assesses a range of potential scenarios to deliver the country's future electricity demand, based on an assumed average economic growth of 4.6% over the twenty year period. The IRP also projects that electricity demand by 2030 will require a massive increase in new generation capacity of 52 248 MW. This substantial increase in capacity is required in order to address projected demand, the decommissioning of a number of existing power stations in the country (commencing in earnest from 2022 onwards), and the need to provide for an adequate electricity reserve margin (DOE, 2010b).

Scenarios modelled and costed include the least cost plan (the Base Case), three GHG emission limit scenarios, a carbon tax scenario and a regional (Southern Africa) development scenario, along with two 'balanced' scenarios.

The final approved IRP 2010 will have undergone a series of stakeholder engagements, including the initial plenary session that took place in Pretoria in June 2010, the release of the draft IRP for public comment for a period of sixty days in October 2010 (with final public submissions due by 10 December 2010), and the final Public Hearings to take place in late November and early December 2010. The latter hearings are to be spread out over 4 days between Durban, Cape Town and Midrand. The scale of the stakeholder engagement process, and the extent to which different role-players and institutions have requested to present their responses to the draft IRP 2010 in public is heartening, and also serves to illustrate the priority afforded by a range of interests to the nation's electricity future.

Pictured above: A Concentrating Solar Power (CSP) facility employing parabolic trough technologies

Modelling undertaken within IRP 2010 included the assessment of options for both including and omitting the Kusile coal-fired power station in the majority of scenarios developed. This approach followed concerns raised related to the availability of finance to deliver the project, as well as stakeholder inputs requesting that South Africa avoid further entrenching its coal based assets without first assessing other options, particularly in the wake of the controversially funded Medupi power station.

The recommended scenario put forward in the draft IRP 2010, as developed by the DOE with support from an Interdepartmental Task Team, is referred to as the 'Revised Balanced Scenario'. According to the draft IRP, the 'balanced scenarios represent the best trade-off between least-investment cost, climate change mitigation, diversity of supply, localisation and regional development' (DOE, 2010b:10).

The Revised Balanced Scenario includes, among other elements, the following proposed new generation capacity in the country:

- Construction of both the Medupi and Kusile Power Stations, with the first Kusile unit of 722 MW coming on line in 2017
- Implementation of Phase 1 of the Renewable Energy Feed-In Tariff (REFIT). This amounts to 1 025 MW drawn from wind, Concentrating Solar Power (CSP), landfill and small hydro
- Total wind capacity of 4 500 MW by 2019, with 700 MW of this delivered under Phase 1 of the REFIT. This figure excludes the 100 MW Eskom Sere Wind energy project, which also forms part of the draft IRP
- Cogeneration and own build generation capacity amounting to 1 643 MW, commencing with 390 MW under the Medium Term Power Purchase Programme (MTPPP) brought on line in 2010 and 2011
- A 600 MW allocation to CSP by 2019, delivered in 100 MW tranches from 2014 to 2019
- Additional renewable energy capacity of 7 200 MW allocated between 2020 and 2030 (made up of an as yet undefined mix of options including wind, solar CSP, solar photovoltaic (PV), landfill, biomass and other potential sources)
- The establishment of a significant nuclear fleet of 9 600 MW, brought on line in the period 2023 to 2029
- Substantial use of imported hydro from neighbouring countries such as Mozambique to the value of 3 349 MW, introduced between 2020 to 2023
- After the construction of the Kusile Power Station, no new substantial coal energy sources are developed until 2027. This subsequent capacity is to be drawn either from conventional pulverised fuel, or fluidised bed combustion and possible coal imports
- More efficient Combined Cycle Gas Turbines (CCGT) brought in from 2019 to 2021 to provide backup power amounting to 1 896 MW
- An assumption of a 35% energy efficiency improvement built into the forecasted future energy demand, driven by higher electricity prices and a gradual shift towards an increasingly secondary and tertiary ('services') based economy

The proposed Revised Balanced Scenario outlined above does not represent a least cost plan, but includes planning decisions to achieve additional policy objectives relating to the reduction of future water consumption, the reduction of greenhouse gas emissions, support for regional development within Southern Africa and the diversification of the energy sources employed. The document is clear in its assessment of the importance of addressing climate change related concerns, stating that 'the primary externality factor that was considered in IRP 2010 was constraints around carbon emissions' (DOE, 2010b: 5).

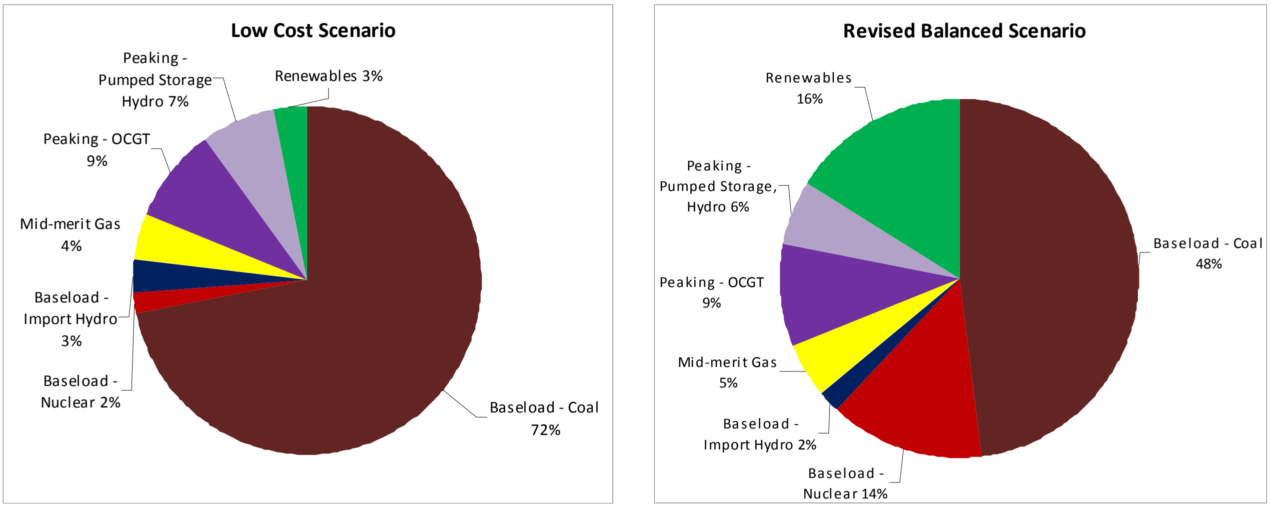
The Revised Balanced Scenario requires 8% more additional funds on top of the R789 Billion already required to achieve the Base Case, but is accompanied by a 30% reduction in GHG emissions and a substantial reduction in power sector water requirements, relative to the Base Case.

2 IRP 2010: Prospects for Renewable Energy in South Africa

Although still technically in draft form, the IRP 2010 presents interesting reading for those concerned with the prospects for renewable energy in South Africa. The manner in which the plan is altered or refined following the finalisation of the public stakeholder consultation process will also be intriguing, as it is likely to test the robustness of the plan, and the relative balance of power between competing energy related interests.

As highlighted above, the recommended Revised Balanced Scenario deviates to a considerable extent from the least cost plan, in favour of low carbon energy sources (renewable energy and nuclear). This is illustrated in Figure 1 below, which contrasts the differences in the national electricity mix in the year 2030 under the two different scenarios:

Figure 1: Comparison of Low Cost Scenario and Revised Balanced Scenario (% of Electricity Mix Per Generation Type – 2030)



Source: DOE (2010b: 21)

As can be seen in the figure above, the contribution of domestic renewables rises from 3% to 16% in the Revised Balance Scenario. Also noticeable is the contribution provided by nuclear energy, which contributes just 2% of the energy mix in 2030 on a least cost basis, but 14% of the generation mix under the Revised Balance Scenario. A 16% contribution to the electricity mix in 2030 is unlikely to be welcomed by all renewable energy proponents, but this proportion represents a significant shift in the allocation for renewable energy envisaged for South Africa.

As shown in the table below, the overall contribution of renewables to *new* generation capacity is the greatest of all energy sources under the draft IRP 2010:

Table 1: New Capacity Allocation Recommended for Draft IRP 2010

Technology	Allocation
Renewables	33%
Baseload - Nuclear	25%
Peaking - OCGT	14%
Mid-merit Gas	11%
Baseload - Coal	9%
Baseload - Import Hydro	4%
Peaking - Pumped Storage	4%

Source: DOE (2010b: 21)

Differentiating between different renewable energy technologies, a further picture emerges. It is clear that **solar photovoltaic (PV)** is a clear loser in the draft IRP 2010. Considering that a Small-Scale Feed-In Tariff is yet to be developed in South Africa (which would support household electricity production with the use of solar panels and the feeding of power back into the grid), and considering that solar PV does not enter the grid connected renewable energy picture until 2020 at the earliest, will clearly alarm certain parties, especially those manufacturers and installers hoping for stronger opportunities as the development of large-scale (1-5 MW and upwards) solar arrays are being developed globally for power generation.

It would appear that **biomass** based power sources such as bagasse are also underutilised, although the allocation in this regard is unclear given the inclusion of a variety of waste gas, discard coal and waste heat power generation options under the 'Cogeneration, own build' component of the plan.

The **CSP** allocation is also less favourable than many renewables developers and proponents may have hoped for, with some 600 MW allocated from 2014 to 2019. However, with a 2 year construction period required, and this technology still at a relatively early stage of development, especially with regards to solar tower technologies, the achievement of this allocation could arguably be looked upon with some level of admiration in the future, whilst potential exists for the scaling up of this technology in the greater allocation to renewables brought in from 2020 onwards.

The DOE has also gone to some lengths to avert fears that the much touted 5 000 MW **Solar Park** project planned for the Upington region in the Northern Cape, which could commence generation as early as mid 2012 onwards in an enabling regulatory environment, is not jeopardised by the IRP document. It is understandable that the Solar Park project has largely removed itself from consideration within the REFIT process – by supporting economies of scale and pooling resources and information, the Park will presumably be able to provide power at rates considerably lower than those allocated for CSP under the REFIT tariffs, whilst also not crowding out the market for smaller generators wanting to take advantage of the REFIT. But it seems highly problematic for the Solar Park process to be removed from the *IRP* process, when the IRP is the mandated electricity master plan under which NERSA is to licence future generation capacity.

Questions therefore remain as to how the Solar Park will go ahead in the near future, given that CSP and possibly solar PV are expected to be the key technologies employed in the Solar Park development. The most plausible means for the Park development to go ahead therefore seems to lie with the greater allocation to renewables from 2020, amounting to some 7 200 MW, but even then allocations to solar energy are not prescribed for this period.

Despite certain statements to the contrary, the DOE itself provides some intimation of this outcome when it states that:

> "The Solar Park presents us with the real arsenal to deploy technology that can replace the fossil-fired power generation. *It must also be noted that in the IRP itself, under renewable energy, there is already a provision for 7200 MW of wind, Concentrated Solar Power (CSP), biomass as well as other renewables. This invariably gives us the ability to deploy renewable energy technologies as and when they mature*" (DOE, 2010d emphasis added).

Wind energy is clearly the big winner for renewables in the draft IRP 2010, and the allocation provided would seem to justify the presence of international players such as Suzlon and Vestas setting up small operations in South Africa. The allocation to 2019 will provide substantial support for the large number of wind energy applications under development at present, but clearly not all wind power projects will be catered for, as per the current government renewable energy procurement process being led by the DOE, National Treasury and NERSA.

It is also important to mention **nuclear** energy, as this technology emerges as arguably the biggest winner in the Revised Balanced Scenario, a situation that could have important implications for the development of renewables, as discussed in Section 3 below. As a single technology, nuclear is the single largest new capacity contributor at 9.6 GW, with power generation only commencing in 2023 largely given to the long lead times required for nuclear energy deployment.

In sum, the IRP 2010 marks a significant step in the promotion of grid connected renewable energy in South Africa, and the Revised Balanced Scenario is a significant deviation from a 'business as usual' scenario in which modern renewables remain on the periphery. Well placed wind and solar CSP developers are likely to be rewarded under the current plan, with sufficient levels of generation capacity allocated for wind to facilitate the localised manufacture of certain wind energy components.

3 Key Issues in the Way Forward

Key issues identified for consideration in the way forward for renewable energy in South Africa, drawing on the draft IRP 2010, are outlined below. A number of these factors will arguably be critical to the success of renewables in the county, for supporting increased carbon competitiveness for a range of businesses in South Africa, and for ensuring that substantial reductions in emissions are achieved.

3.1 Development of a Green Energy Market

The development of renewable and low carbon energy sources over time will assist in decarbonising the South African electricity grid. This could offer benefits for a range of South African companies concerned with the carbon footprint of their organisation, products or services. For a number of companies in South Africa, the high grid emission factor (carbon content) associated with domestic electricity is a problematic and disproportionately important contributor to their business' carbon footprint.

Businesses that could benefit substantially from a reduction in emissions associated with their activities (with the aim to maintain market share or provide a comparative advantage in certain activities) are potentially very broad in scope, but to date includes those involved in a variety of forms of manufacturing, food and beverage producers and related suppliers, those active in the tourism and hospitality sector, as well as a range of companies deriving some form of leverage from an emphasis on their environmental credentials. The report published in May 2010 by Camco and TIPS, entitled *Climate Change: Risks and Opportunities for the South African Economy – An Assessment of Mitigation Response Measures*, provides an in-depth discussion and analysis of this topic, and should be consulted where relevant.

The decarbonisation of the national electricity grid over time will therefore support the overall climate competitiveness of businesses in South Africa, particularly those in trade exposed and energy intensive sectors, while reducing overall vulnerability to the financial implications of current and potential carbon pricing within all sectors of the economy (Jooste *et al*, 2009); (Camco and TIPS, 2010).

Nevertheless, the development of a robust green electricity market in which individual organisations are able to purchase green power, is an important interim step in the short to medium-term, to complement the gradual diversification of the national electricity mix. Green electricity supplies could presumably be purchased at a tariff premium from the Independent System and Market Operator (ISMO) or related entity, a process that would facilitate particular companies gaining a disproportionate access to green electricity as and when this forms part of their wider business strategy.

This places an added emphasis on the management of renewable energy supplies within the grid, to ensure that robust and recordable supplies of green energy are made available to potential buyers. The failure to secure a functioning green energy market will reduce a key benefit of the introduction of clean energy sources into the national grid – the ability of concerned consumers, companies and institutions to purchase green electricity and to derive whatever social, economic or environmental benefits afforded them by this purchase. The introduction of renewable energy into the grid is thus only one aspect in securing reliable green energy supplies linked to a market for low carbon electricity. Such an approach allows for the strategic management of energy and carbon, and also supports the provision of a premium electricity service.

The success of such an initiative will require careful planning, and an effective contractual arrangement to ensure that cleaner sources of energy are delivered to willing customers in as close a proximity to the point of generation as possible.

3.2 Finance and Investment

3.2.1 Private Sector Finance and Investment

The scale of energy investment required to deliver the 52 248 MW of additional energy capacity required by 2030, regardless of the final energy sources chosen, is sizeable, amounting to an estimated R789 Billion for the least cost plan alone, and in the order of R820 Billion for the Revised Balanced Scenario. The sheer scale of financing required emphasises the crucial role that private sector finance and investment will play in bringing the country's desired energy future to reality. The plan thus almost by necessity requires a well regulated liberalised electricity market in which economically desirable energy sources can be implemented at scale.

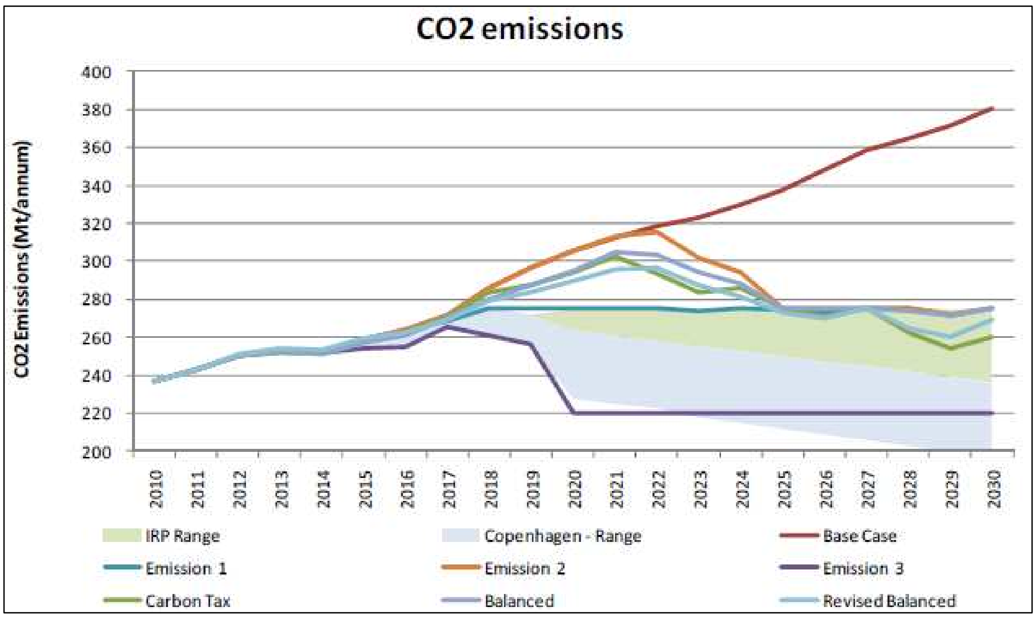
In a number of ways such an arrangement could act as an important driver of demand and impetus for the recommend renewable energy plan outlined in the IRP 2010. Expectations are that wind energy, the dominant renewable energy source earmarked in the draft IRP, could achieve price parity with conventional coal based electricity in South Africa within a relatively short period of time, somewhere in the region of 2015. Given a favourable investment climate and added financial support in assisting wind projects to reach the bankability stage, wind energy development could assist with attracting substantial capital injections whilst delivering considerable carbon, water and fuel savings. This context is reflected in the substantial emissions reductions achieved under the Revised Balanced Scenario in relation to the Base Case, but also achieved at a relatively moderate increase in electricity prices and costs of generation. Internationally there is strong support for the financing of renewable energy at present, with investments having eclipsed those for fossil fuel sources in 2009. By contrast, support for large-scale fossil fuel infrastructure in advanced developing countries could well become a source of concern in the future, as illustrated by the experience of Medupi.

Indeed, in many ways, the question is not whether South Africa as a country should build renewables, or to what extent, but how the country as a whole can afford the massive electricity generation investment required, regardless of the technology employed. With substantial pressures already on the national budget, the question could then be asked somewhat differently: what power generation options are national and global markets eager to exploit and finance in developing countries such as South Africa? Renewable energy, and wind energy in particular, would appear to be a reasonable bet in this regard, regardless of climate change concerns.

3.2.2 Climate Finance

Access to climate related finance is an imperative to support the ambitious conditional emission reduction target announced by South Africa at the Copenhagen Conference of the Parties (COP15) in December 2009. The impact on emissions of a Revised Balanced Scenario, which represents a substantial shift in new generation sources for the country, is illustrated below:

Figure 2: Carbon Dioxide Emissions to 2030 under Various IRP 2010 Scenarios



Source: DOE (2010a: 10)

As can be seen in the figure above, the Revised Balanced Scenario fails to enter the range of South Africa's Copenhagen emission reduction target, but nevertheless represents a significant deviation from business as usual emissions under the Base Case. The role of international climate financing, whether in the form of capital subsidies, support in assisting projects to reach bankability, concessionary loans or guarantees, must therefore be emphasised in any attempts to achieve this ambitious level of GHG emission reductions. This argument, echoed by a recent report released by the Global Climate Network calling for greater developed country support for clean energy investment in developing countries (see GCN, November 2010), is also explicitly made in the IRP 2010 document itself:

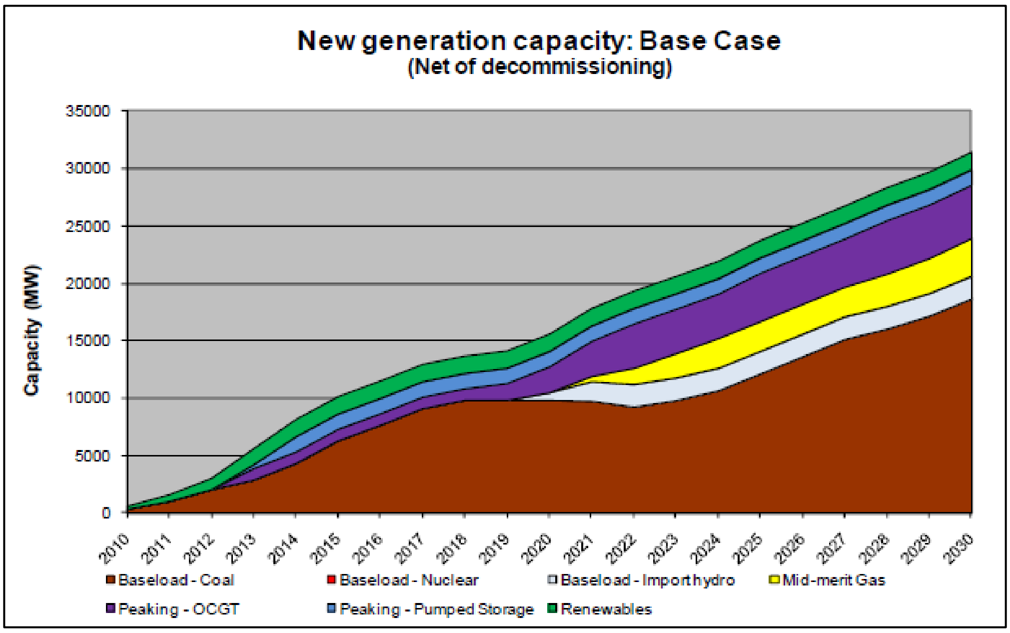
> "The Revised Balanced Scenario… provides a basis to reach the upper bound of the range of emission targets for the electricity sector, but does not provide for the full scope of the Copenhagen targets. The Copenhagen commitment included the proviso that these commitments must be met with international 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" (DOE, 2010b p23-24).

The South African Renewables Initiative (SARi), an initiative led by the Department of Public Enterprises (DPE) and Department of Trade and Industry (the dti), involves one such exercise to identify and consolidate the potential funding streams and financing options, including international climate finance, which could be used to deploy renewables at scale in South Africa. The IRP 2010 is silent on the SARi process, however, and the role that this initiative could play in driving down the cost of grid-connected renewables in the country.

3.3 Support for Nuclear Power and Renewable Energy

While 2% of the overall generation mix by 2030 is expected to be made up of nuclear power, nuclear energy does not make up any contribution to new generation capacity on a least cost basis in the draft IRP 2010. This absence of nuclear power in new generation capacity in the Base Case is illustrated in Figure 3 below:

Figure 3: Makeup of New Generation Capacity under the Least Cost Scenario



Source: DOE (2010a: 8)

Recent international experience has found it difficult to support nuclear power in a liberalised cost reflective market, as a result of the costs associated with nuclear energy. Large-scale governmental support and subsidies are therefore likely to be required to bring the nuclear fleet programme envisaged in the draft IRP 2010 to fruition. Attempts in recent years to bring conventional nuclear energy on line in South Africa have also had to be dismissed, given the substantial costs involved, as noted in the IRP document itself.

Important decisions will therefore need to be made regarding the relevant balance of support for nuclear energy and renewable energy by government for the next two decades in South Africa. Given strains on the fiscus due to pressing socio-economic imperatives, it may well be difficult for government to support renewable energy technologies such as wind until it reaches price parity with coal-fired power generation (or CSP in its earlier start up phases) as well as a nuclear energy programme. The danger here is that support for renewables (and potentially a strong government led energy efficiency programme) could be crowded out by assistance in the rollout of large-scale nuclear energy facilities. South Africa has recent experience in this regard, with investments into the Pebble Bed Modular Reactor (PBMR) largely having overridden any investment in energy efficiency or renewable energy in the country for the substantial period for which the PBMR programme was in place.

A number of lenders including commercial banks, finance institutions and the Industrial Development Corporation (IDC) have made clear their interest and intention to support emerging renewable energy technologies in South Africa. But the question remains – how does the government support nuclear energy in South Africa, to what extent should this be done, how can future nuclear energy be developed in the country without strong government backing, and will this backing not be attained at the expense of support for other low carbon technologies?

3.4 Bilateral Agreements and Local Manufacture

A potentially important mechanism by which renewable energy could be supported at scale in the country could be derived through a bilateral agreement between South Africa and a developed country partner. This could apply most pertinently to support for wind energy, through an associated agreement with one of the leading countries in Europe that have strong expertise in the development and management of wind power systems. Support could include capacity building and training, as well as finance and technology transfer, particularly in relation to components that can be developed locally in South Africa, such as flanges, structural steel, gearboxes and the assembly of blades (DPE, 2010).

A bilateral agreement will therefore need to take cognisance of the skills and experience that can be transferred to support wind energy, whilst employing best practice technologies, and will need to be a negotiated process whereby opportunities for local manufacture and assembly are identified and consistently supported. Combined with the appropriate industrial financing to support readiness in the automotive and steel industries, and broader manufacturing sector, such an approach could provide tangible opportunities for the localising of components where possible.

3.5 Power, Energy and Local Economic Development

The distinction between overall potential capacity (power) and actual output (energy) is important. If technologies such as wind are to be used as a periphery technology only, to support limited periods or phases of electricity demand, then large-scale wind energy adoption and a reduction in emissions will be more difficult to achieve. If on the other hand, opportunities are to be exploited to develop wind as a large-scale electricity resource, based on daily and hourly forecasting, then careful planning will be required in this regard.

The location of wind farms will take on increasing importance, as the development of wind energy in different parts of the country associated with different wind regimes, is one method used internationally to address the variable nature of wind energy output. Linkages with storage technologies such as pumped storage will also be important to consider, as opportunities exist here to employ wind resources as and when these are available, and link them to technologies that can provide stored power on demand.

The geographical location of wind farms will thus need to take cognisance of additional aspects aside from the availability of the grid, but should also give consideration to future load demand management, as well as integration with other existing technologies, including storage options. Opportunities to support local economic development, rural development and the revitalisation of different regions of the country through both wind and solar technologies, will also need to be factored into the above process. NERSA, for its part, has highlighted the relevant contribution to local economic development of projects as one of the REFIT selection criteria (NERSA, 2010).

4 Conclusion

Energy planning in South Africa is marked by an important transition in the development and publication of the draft IRP 2010. The document represents the first meaningful attempt to achieve a participatory and accountable planning process for electricity in the country. The plan also provides the clearest recognition to date of the imperative to decarbonise the national electricity sector, and recommends a national electricity plan that will reduce emissions by 30% against a least cost plan. IRP 2010 also marks a significant opportunity for the Department of Energy to build on its mandate to act as the custodian of energy and electricity planning in South Africa, including in support of a co-ordinated strategic response to climate change.

That said, there are a number of challenges to the implementation of the IRP, the majority of which concern the development of a favourable climate for independent power producers and power sector investment in the South African electricity market. Clearly these challenges will need to be addressed if the aims and objectives of the IRP are to be achieved.

Hiccups and problems can be expected along the way, and it is anticipated that the delivery of renewables at the scale outlined in the draft IRP will take longer than envisaged, but an important foundation has been laid, and interest and investment is likely to be forthcoming should a favourable environment be established.

The IRP 2010 also reveals the wider challenges for the electricity industry in South Africa as a whole, and the scale of finance and investment required to meet the country's broader social, economic and environmental objectives. The question is as much how we can best take up the investment and financing challenge that is required for new generation capacity, and what market related opportunities and funding sources should be best exploited in this regard. Even at a stage when wind energy is cheaper than conventional coal based power, it will be necessary to consider by what means this technology will be funded.

It is also apparent that a number of additional factors such as the development of a viable green energy market, private sector based investment, climate finance, bilateral agreements and the relative support provided by government to nuclear energy in relation to renewables, are important aspects to consider in the development of a successful renewable energy industry in South Africa. Strategic direction and effective planning in this regard will assist in deriving maximum benefit from renewable energy technologies. This range of benefits includes opportunities for enhanced climate competitiveness for a range of domestic industries, technology transfer and local manufacture, job creation and the development of reliable and readily available renewable energy supplies.

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