Sustainable Energy Briefing 10
When will Renewable Energy be the CHEAPER option for electricity generation?

In 2005 the Sustainable Energy and Climate Change Project published an independent research study: '*The potential contribution of renewable energy in South Africa'* (Banks and Schäffler 2005)[1]. The study developed two scenarios to illustrate the potential of renewable resources, which are compared to a base-line scenario derived from existing energy plans. In the 'Progressive Renewable' scenario about 35% of primary energy supply is drawn from renewable resources by 2050, while the 'High Renewable' scenario, which increases the share of electricity within supply, shows how more than 50% of primary supply could be based on renewables.

In February 2006 a supplementary study was presented and published as Appendix D to the original report (see website[2]). It provides illustrative capital costs and cost of energy projections for the electricity generation component of the three original scenarios. The report has also been revised to provide updated information on the assumptions used. The new paper includes additional information on costs of using certain renewable energy technologies (RETs) and a downward revision of the resource availability of landfill gas. As in the original study focusing on resource availability and technology deployment, nuclear power is not differentiated within the "conventional" generation category, so current nuclear generation is hidden in the 'existing fossil' category in projections and the highly contested costs of nuclear power are not considered in this study.

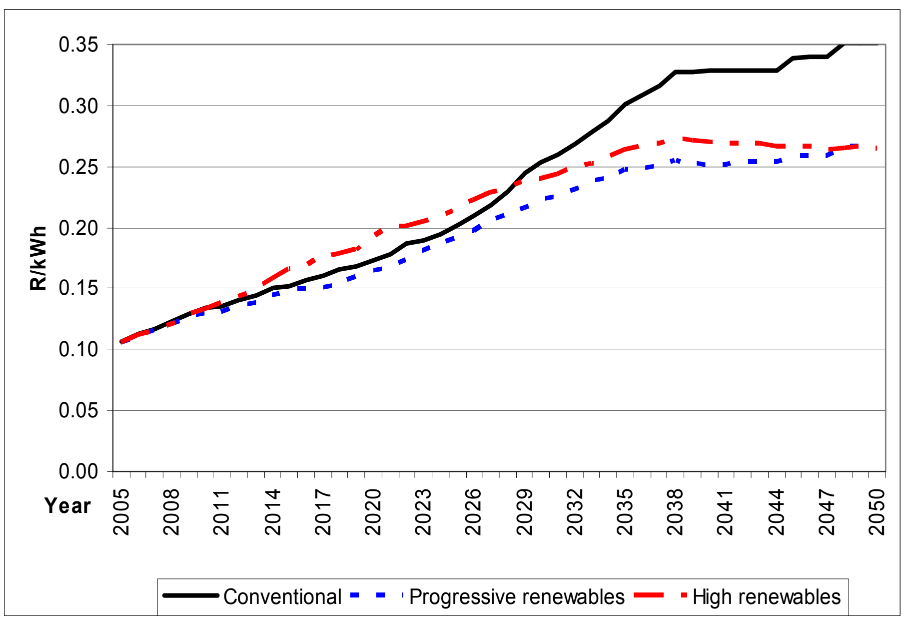
The authors are anxious to note that limited resources required a somewhat simplified approach to developing indicative numbers. The study did not make use of sophisticated modeling tools and the authors advocate more detailed national level modeling, which could take place under the Integrated Energy Planning process currently underway[2]. We are not aware of any more authoritative future energy cost comparisons for South Africa in the public domain and trust that the study will stimulate and enable more detailed analysis and displace the simplistic statements that have characterized much recent public debate and parliamentary presentations.

Key Findings

The key findings of the latest study are summarised by the researchers as follows:

- The renewable energy scenarios are likely to have a significantly lower total cost of generated electricity in the medium to long term.

This finding is illustrated by this graph showing the unit costs of energy (electricity) over time for the three scenarios (the averaged costs of generation: total costs / energy dispatched) as well as the graphs on page 4. The solid line is the Business as Usual scenario, under which electricity becomes more expensive than under the Progressive scenario within ten years, and more expensive than under the High RE scenario by 2030.



[1] The report of this independent study is not an Earthlife Africa position paper and inclusion of any option in a scenario does not impute support for the option, such as imported hydropower from large dams.
[2] http://www.earthlife.org.za/Files/potential%20of%20RE%20in%20SA%20Feb06.pdf (see Research topic under SECCP)
[2] See Sustainable Energy briefing 4: Integrated Energy Planning

- Given the assumptions used, the *Business as Usual* scenario ends up with an annual electricity cost of R125 billion by 2050, while the *Progressive Renewable* scenario has annual costs of about R100 billion.
- Also important is that the *Progressive Renewable* scenario indicates cost of energy savings by 2015 or perhaps even sooner.
- However, these renewable energy scenarios are likely to have a higher *capital investment* requirement, with the total capital investment required being of the order of 760 Billion Rands for the *Progressive Renewable* scenario, as against 660 Billion Rands for the *Business as Usual* case.
- The capital investment estimates presented in the paper also provide a clear illustration of the scale of investment in different technologies that would be required if we are to achieve a significant shift to more sustainable electricity generation in the future.
- The huge scale of required investments indicated in [all] these scenarios also provides powerful motivation to focus on energy conservation and energy efficiency.

Cost of Energy

While some commentators talk about competing electricity generation technologies as though they are simply bought off the shelf, costs of new generation capacity actually depend on a number of variables, including the scale of development, pace of moving to local production, decisions around acceptable impacts (extent to which costs can be externalised), citing of plant and the required 'profit' or rate of return on investment (often referred to as the discount rate). For example, in 2003 a Spanish company proposed local manufacture of wind turbines, with 99% local content, conditional to a government commitment to a 1000 MW project.

Eskom has a fairly conservative approach to generation investment, even under their new strategy, developed following the clear government mandate to take responsibility for ensuring that new supply is developed to meet growing demand. Eskom likes to invest in well-established technologies at minimal capital cost[3] This is why the technology choice for the next proposed coal-fired power station (Matimba B in Limpopo, lately going under the code name Project Alpha), was not subject to any public scrutiny or discussion (despite the legal requirement that Environmental Impact Assessments must consider alternatives to such major projects).

Despite their promotional materials advocating "clean coal" technologies, Eskom decided in-house that it will be a pulverised fuel plant, generating "supercritical steam" (high temperature and pressure) with an efficiency of "up to 40%" – no minimum efficiency specified. They do not intend to fit flue gas desulpherisation equipment, as their studies indicate that this will not be necessary under current air quality management regulations (and such pollution control equipment cab be added later, at a higher, but deferred, cost). However, Integrated Gasification Combined Cycle (IGCC) technology, in an advanced state of demonstration internationally, offers higher efficiencies as well as separation of pollutants prior to combustion, allowing for more comprehensive and cost effective pollution reduction. With South Africa's global leadership position in coal gasification (part of the coal-to-liquids process), it could be argued that IGCC is a more appropriate choice, if public investment options for energy development were debated. It is apparently not a higher cost that leads to rejection of the IGCC option, but the risk associated with a technology that is not yet in commercial operation elsewhere.

Risk is an important factor in energy development, yet the high risk associated with fossil fuel prices has not yet been factored into South Africa's energy planning. It is assumed that Eskom will always be able to buy cheap coal, despite sustained high oil and gas prices (uranium has also recently trebled in price), international growth of the coal-to liquids industry and the approaching peak in oil production. The latest coal-fired power plants have a projected life-span of fifty years – this can be extended by retrofitting, but this is the lifespan on which the projected costs are based. Even so, our energy planning places no value on the fuel price risk avoided through deployment of renewable energy technologies.

[3] This does not apply to the PBMR, but government departments and the Industrial Development Corporation have mostly driven the development of this highly speculative programme – Eskom continues, despite considerable pressure, to resist a commitment to purchase any PBMR units until the actual costs are ascertained with a reasonable level of certainty.

The high up-front capital costs of RETs, compared to fossil-fired generation plant, are generally portrayed as prohibitive, but with their far lower operation and maintenance costs (no fuel required), simply a significant reduction in the discount rate would make RETs far more competitive. In other words, if the state did not require a 10% return on renewable energy spending, the capital costs would look a lot less daunting. It is questionable why this "time value" of money should be any higher than the targeted rate of inflation for a state owned enterprise whose mandate is not to turn a profit, but rather to provide a public benefit. Furthermore, the shorter life-span of many RETs, taken into account in cost projections, provides far earlier opportunities to benefit from technology development, including cost reductions of technology learning.

For technologies such as wind, biomass, landfill gas and hydropower, the cost of energy produced is dependent on the specific resource class. For example, it is cheaper to produce electricity from sites with higher average wind speeds, so these sites will be used first. Thus for the resource-limited technologies, the cost of generation increases as more capacity is installed. This is why the costs of generation per technology differ across the scenarios. However, most RETs are in their early stages of technical development and production volumes being are low, therefore national and international prices are expected to continue to reduce over time. Overall there is a general downward trend for wind and solar energy technology costs, as depicted in the graph (below) showing the average cost of energy (electricity) from different resources, by year.

Fossil fuel technologies have ongoing fuel purchases as a significant component of their output energy cost, especially those powered by petroleum products or gas, such as peaking plant. Fossil fuel prices are expected to increase as a result of growing demand and market speculation, resource scarcity, diminishing energy returns as extraction becomes more difficult and market mechanisms responding to climate change. Furthermore, it is probable that the capital cost of fossil fuel generation plant will increase over time as greater efforts are made to introduce environmental safeguards such as scrubbers. For this reason cost per kWh of fossil fuel technologies steadily increase. The researchers used an increase of 1% per annum for Business as Usual scenario (which has high fossil fuel use) and 0,75% per annum for the other two scenarios, where a lower rate of fossil fuel utilization will help keep prices down.[2] This does *not* assume that the full externalized costs of fossil fuel use are internalized in market prices.

Conclusion

The Progressive Renewable scenario offers the least-cost energy future of the three options considered, based on the assumptions detailed in the full report, resulting in an annual generation "bill" that is almost 35 Billion Rand lower than the *"Business as Usual"* scenario by 2050. Given that this scenario also includes a steady increase in the use of fossil fuels, it is not necessarily indicative of the most cost-effective energy path from a macro-economic perspective. The Progressive scenario achieves over-all cost savings much sooner than the more socially and environmentally responsive 'High RE' scenario, but the value of the greater employment creation (not to mention export potential of resulting local industries), decentralization of supply and avoided pollution and risk may well mean that the highest level of ambition is justified.

The most important observation is that if a concerted effort is made to rapidly develop local industries in renewable energy technologies, they are likely to offer electricity on a large scale at a similar cost to fossil fuels by as early as 2015, and thereafter renewable options are likely to become less expensive than fossil options. Huge investments are required in electricity infrastructure and costs of technologies and fuels are changing, with clear trends that have yet to be factored into long-term planning. The full implications of trends and the consequences of current decisions become a lot clearer when projections are made on a timescale matching the expected life-span of the investments being announced by government. This study demonstrates the promise of as yet largely unexplored local alternatives scenarios and highlights the need for more detailed public benefit work that will seek to quantify trends and impacts with greater certainty.

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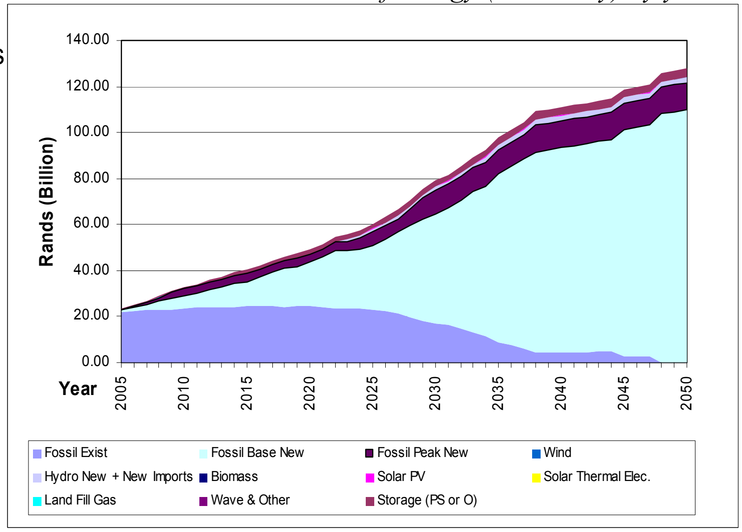
[2] this use of a 0.75% to 1% annual increase in the cost of generating electricity from fossil fuel is arguably the most critical assumption in the study. Some will argue that the rate of increase should be higher; others that fossil fuel prices may decrease in the near term. A significant global shift to energy conservation and renewables will help to restrain prices.

Scenarios of future energy costs

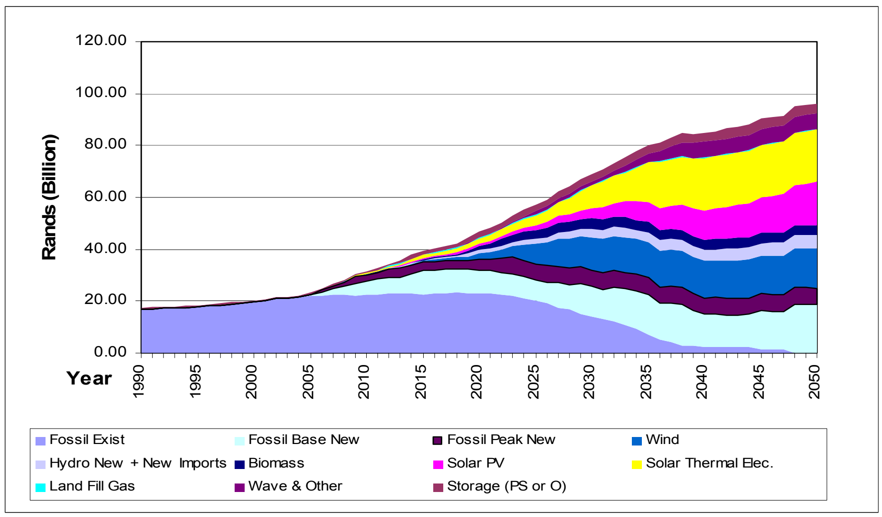
The study presents the annual cost to the country of generating the electricity required under each of the three scenarios. All scenarios assume the same moderate growth in total national energy consumption (i.e. assuming major improvements in efficiency and conservation). The contribution of electricity to total energy is the same in the first two, however, in the High Renewable scenario more electricity is produced, allowing some of the fossil fuels used for transport and industry to be replaced by renewably generated electricity. By 2050 electricity production has increased to 600 TWh, compared to just under 400 TWh of electricity in the other scenarios. This means that there will be lower costs for the balance of energy supply under the High Renewables scenario.

Business as Usual Scenario: Total cost of energy (electricity) by year



The main message of these graphs is that Business as Usual costs more.
The total cost of generation is higher (the crest of the slope) in the top graph than in the second (note also that the scales are not the same in the graphs) and higher total costs in the third scenario deliver 50% more electricity. For example in the High scenario R100 billion per annum is already being spent in 2030 because the renewable component is being pushed harder and starting to displace other fuels, while under Business as Usual this level of spending is only required after 2035 and under the Progressive scenario this level is not reached even in 2050.

Progressive Renewable Scenario: Total cost of energy (electricity) by year



High Renewable Scenario: Total cost of energy (electricity) by year

These costs take into account that the renewable energy scenarios require extra generation capacity in order to cater for their intermittent operation, as well as increased storage capacity.

The shading within the 'slope' indicates the contribution of the different generation technologies. This may be hard to correlate in black and white, but the total cost under different scenarios is our focus here. Colour versions of the graphs are available in the downloadable Pdf file on the SECCP website (under Research), see: http://www.earthlife.org.za