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Renewable energy and the environment in South Africa: A way forward

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ABSTRACT

The need to mitigate the adverse environmental impacts of fossil fuel usage, the volatility of fuel prices and enhancement of national energy security, have largely driven a phenomenal growth, around the world, in renewable energy (RE) generation (particularly grid-connected), over the past two decades. The necessity to apply policy support instruments to promote the dissemination of these technologies is now a universally accepted norm. Different countries and societies depending on the prevailing socio-economic environment draft and apply their policy frameworks differently and debates abound as to which mechanisms should have been most suitable under which circumstance. Most of these debates, however, assume the existence of an intrinsic political environment in favour of the process. In South Africa the current political environment is not very conducive to the development of a sustainable RE industry. This paper explores some of the anomalies and barriers and suggests possible options for a way forward to a viable RE industry in the country.

1. Introduction

The need to mitigate the adverse environmental impacts of fossil fuel usage, the volatility of fuel prices and enhancement of national energy security, have largely driven a phenomenal growth, in grid-connected renewable energy (RE) generation around the world, over the past two decades. The necessity to apply policy support instruments to promote the dissemination of these technologies is now a universally accepted norm (Haas et al., 2004; Bird et al., 2005; Agnolucci, 2006). Different countries and societies depending on the prevailing socio-economic environment draft and apply their policy frameworks differently.

These policies can be generally categorized as investment cost reduction and/or public investment and market facilitation. There are also additional refinements to these instruments that include accounting for externalities like the adverse effects of fossil fuels on human well-being through emission taxes and/or tax relief to RE investors.

The success of these policies has varied over the years and differently in different countries and debates abound as to whether one model, and not the other, should have been applied by a certain country or at a different stage (Fristrup, 2003; Lewis et al., 2007). Policy consistency and continuity would also appear to be critical to success as evidence has shown that growth and new investment suffered (in countries with short-term RE incentive regimes) during times of policy gaps, while their renewal remained bogged down in the approval bureaucracy process (Gan et al., 2007; Menanteau et al., 2003).

Most of these debates, however, assume the existence of an intrinsic political environment in favour of the process. In a number of cases, however, such an environment only came about through persistent pressure born on governments by certain lobby groups. In Europe, environmental activism emerged in the early 1960s largely through ecological civil societies (European Greens) that, over the years, helped to sensitize society on the need to conserve the environment. By the early 1980s a number of these had evolved and emerged as credible political forces that contributed in a large part to the formulation of policies that enabled (among other things) the emergence of RE industries in their countries (Arnold Cassola and Per Gahrton, 2003; Bomberg, 1998; Cordier, 1996; Richardson and Rootes, 1995).

The path of these policy implementations has also been generally an evolutional one, riddled with challenges, and systematically refined based on lessons learnt. The largely successful Japanese RE industry, for example, went through some political challenges. In the 1990s a Federation of Diet Members for Promoting Natural Energy was formed by parliament as a response to a background of rising public support in RE (Maruyama et al., 2007). They promptly drafted a bill to promote the enactment of RE-based feed-in tariffs. The bill was, however, subsequently abandoned as a result of political pressure from the Ministry of Economy, Trade and Industry (Maruyama et al., 2007). Only much later (in June 2002) was a compromise found with the enactment of the New and Renewable Portfolio Standard Law. This

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was based on a quota system that required electricity suppliers to generate a certain quantity of electricity from RE resources as a percentage of electricity sold.

In the case of Sweden (Wang, 2006), the biggest challenge for the new RE industry was from an incumbent well-entrenched nuclear industry. In addition, big industry that were apparently nervous about possible changes in tariffs and their impact on industrial competitiveness, as a result of new and untested generation technologies, also supported the status quo. The Swedish RE industry only got some reprieve after the government made provisions to compensate the nuclear-generating industry for loss of revenue.

The dawn of 2008 saw South Africa gripped in a severe shortfall in its electric power generation capacity, estimated at just over 10%. The country is endowed with abundant sunshine and good wind regimes, and these resources would clearly offer the most logical and timely complement to its near exclusive coal-based generation. Most of these resources are in close proximity to load centers, which would help to differ the need to upgrade the transmission infrastructure. On the contrary, however, the country's monopoly utility ESKOM has responded with plans to expand its coal-generating capacity. Additionally, the government does not appear to have any strategy in place to support RE power generation as part of the country's energy mix despite their past proclamations and draft white papers (DME, 1998, 2004). Nor does there appear to be any credible pro-environment civil movement in the country to influence a change in the government's position or at least raise some alarm.

This paper gives a brief history of South Africa's energy policy scenario, explores some of the anomalies and barriers and suggests possible options for a way forward to a viable RE industry in the country. It is not the intention of the authors to provide detailed economics models but rather to point the reader into a direction that would create an environment conducive for a suitable model. Additionally, the paper points out possible future pitfalls for the country in a business as usual scenario.

2. A brief background of South Africa's energy planning challenges

The importance of good and reliable energy data for successful energy policy formulation and planning cannot be overemphasized. The South African Department of Minerals and Energy (DME) recognized this when drafting the White Paper on Energy Policy (1998) (DME, 1998). The paper stated in part, "Government will ensure (that) the necessary resources are made available to establish structures, systems and legislation to facilitate the specification, collection, storage, maintenance and supply of energy data, and energy-related data, according to the requirements of integrated energy planning and international standards."

The South African Government has however acknowledged that it still faces challenges in the area of collection, verification and publication of energy information. In her introductory remarks in the 2005 (tri-annual) Energy Digest (Cooper and Prinsloo, 2000) the Minister of Minerals and Energy, Lindiwe Hendricks, lamented that the supply of energy data was only available on a voluntary basis even to her ministry. She also referred to additional challenges due to capacity constraints and differing formats in data collection. To address these and other related issues she pledged that the DME would (among other measures) be making the provision of energy data mandatory through a new energy bill.

To comprehend the origin of the energy information problem in South Africa one needs to look briefly at the country's history. South Africa was subjected to international isolation, particularly during the 30-year period before 1994. Survival through self-sufficiency during that period became the Government's priority. Energy was a major component of the State Security Machine. Consequently, the South African government severely restricted energy-related information and statistics through Acts of Parliament. These restrictions led to the unavailability of comprehensive energy information and lack of good energy data. This in turn hampered the development of energy policies responding to efficiency, environment, sustainability and other concerns. Consequently, there was hardly any need to develop human capacity in the area. To date, 14 years after 1994, the legacy still lingers on.

In the wake of the late power problem the government has been accused of failing to grant earlier requests by ESKOM to invest in new generation capacity. But given the possibility that the utility was not obliged to divulge all of the details of its operations to policy makers one might understand why the government was indecisive. Additionally, without clear data in energy supply, delivery and consumption, it would be difficult even for a private investor to make an informed decision.

Against a background devoid of reliable archival material and a history that discouraged open public debate on energy issues, the authors have endeavored to put this paper together. Using anecdotal information as well as experience and by comparing these with circumstances elsewhere in the world and/or different contexts, an attempt has been made to draw parallels and make some suggestions.

3. How could South Africa reconfigure itself to kick-start the RE industry?

3.1. Legal and political options

A perusal through the South African White Paper on RE reveals that the South African Government fully comprehends all the standard fine details that are often undertaken to enable a sustainable RE industry. The document elaborates on these as financial and legal instruments, technology development, awareness raising, capacity building and education as well as governance.

This document, as well as the earlier (South African) White Paper on Energy (DME, 1998), derives its mandate from the country's Constitution. It states among other things that everyone has the right to an environment that is not harmful to their health or well-being. It goes on: the environment shall be protected, for the benefit of present and future generations, through reasonable legislative and other measures that prevent pollution and ecological degradation; promote conservation; and secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development.

The most significant stopgap for any serious progress in RE can be found in the White Paper's section on "The Way Forward." It states, "A Strategy on Renewable Energy will be developed, which will translate the goals, objectives and deliverables set out herein into a practical implementation plan." To-date, nearly 5 years after the White Paper on RE was published, no drafting of such a strategy has been undertaken. This, more than anything else, is the clearest indictment that the government lacks the will or capacity to move forward with RE.

The aforementioned Constitution (with its attendant Bill of Rights) is configured to protect individuals or minorities whose rights may be infringed on. An aggrieved individual, as a result of certain practices (or omissions), by government or any entity, may seek redress from the Constitutional Court. Such precedent has been set in the recent past. For example, an otherwise previously little known Treatment Action Campaign group successfully

convinced the Constitutional Court to force the government to change their AIDS treatment policy.

The US Department of Energy ranks the country as the 7th largest emitter of GHG per capita. So apart from the latest energy crisis, environmental degradation remains by far the most compelling reason why South Africa ought to adopt RE in their energy mix. This presents a possible avenue that a concerned party could take to force the government to act, through litigation. The details of what such an action would entail is beyond the scope of this paper. Nonetheless, the option does appear to be viable.

Another option could be found from outside the country. The EU for example has in the past applied political pressure to external entities as a means of promoting energy efficiency and RE. As one of the conditions for accession to the EU, the former East Europeans had to show compliance in these areas (Europa).

South Africa is not a likely candidate for accession to the EU but is a major exporter of, particularly, agricultural produce to the EU. A debate currently underway in the EU aims to enforce the labeling of 'carbon miles' (Hattie Ellis), to reflect the emissions generated during production and subsequent delivery of (mainly) imported products.

In general, international concerns about countries like South Africa, which only pay lip service to environmental protection, are gaining momentum and a number of possible corrective measures are being suggested. They include compliance verification protocols and financial incentives for compliance as well as scientific and trade functions for non-compliance (Environmental Research Web, 2008).

It would therefore be prudent from a South African perspective to create public awareness of such external prospects, as it would clearly be in the interest of the country's economic future to take proactive action to mitigate a possible backlash against the country's interests.

3.2. Technical, administrative and strategic options

The DME and ESKOM have proposed the proliferation of certain types of demand side technologies in a multi-pronged approach to the energy problem. Most popular among these have been solar water heaters and compact fluorescent lights. The media has also reported a pledge by cabinet to deploy photovoltaics (PVs) at the country's numerous traffic junctions. This is undoubtedly a move in the right direction. But with all the good intentions of these pronouncements, progress is unlikely to be sustainable as it will be hampered by lack of a guiding framework that would, among other things, set targets and timelines.

Additionally, this country is largely a free market economy and one is bound to realize more ground (and in a more sustainable way) by creating an enabling environment for investors. The current model of exclusive engagement by government and ESKOM in almost every sector of electric power generation and supply is unsustainable. It is not the most optimum way to utilize the country's human resources to address the country's power supply issues. This author concedes to the fact that (due to a variety of socio-historical factors) ESKOM ought to remain as a strong player in the country's electricity supply industry. And as the Congress of Trade Unions has put it, ESKOM does have a social mandate.

It is however not in the interest of the economy and consumers that ESKOM should continue as a legal monopoly. Quite clearly there are some functions that the government or its agents are ill suited to perform in this country. In particular, experience has shown that ESKOM lacks the will to meaningfully contribute to the area of alternative power generation, particularly in RE. And as witnessed by ESKOM's recent application for a 53% tariff hike (Fin24, 2008; Business News, 2008) neither does it appear to have the resources to seriously venture into this area. Its continued attempts may in fact continue to obstruct and hamper any little prospect for other investors.

Such a scenario has been witnessed before in the telecommunication industry in sub-Saharan Africa. Prior to the industry's liberalization, state monopoly operators were protected by legislation. Typical consumer coverage was of the order of 10 per 1000 and lead times for landline connections to new consumers often exceeded 2 years. When available cellular connections were too expensive for ordinary consumers, subsequent market liberalization particularly in the cellular sector saw connection costs dropping to as low as 10% with some countries like Kenya registering annual growth rates in excess of 300%.

If the South African government were intent on creating a genuinely conducive environment for investment it should promptly draft a RE Strategy. Such a strategy would take a form that is grounded into the South African context. In particular, it should promote those practices and models that have worked successfully in the economy and avoid those that have proved problematic as is illustrated below.

The country's domestic aviation industry provides one model that is worth emulating. The industry transformed from virtually one dominant state-owned operator at the dawn of the millennium to a successful mix of private and public operators today. The model has seen a phenomenal growth in the industry with substantial drop in fares, even as fuel prices have been consistently rising. One major difference between the operation of the South African electricity and aviation sectors is that the latter enjoys a level play field anchored by the Domestic Air Travel Deregulation Act.

Conversely, a purely privatized business model has, in the past, also presented challenges for consumers in South Africa. This is evident from numerous consumer complaints in the media about the banking and insurance industries where a culture of collusion and price fixing has been identified as major challenge. The high profile New York lawsuit (Pressler, 2004) in 2004 when the South African diamond giant De Beers was fined US$10million on admitting to price fixing is just one example. A number of companies from a whole range of industries including food and motor vehicles have in the recent past had fines imposed on them by the Competition Commission of South Africa for price fixing practices (Car Today, 2005; Ellis, 2004; Flanagan and et al, 2007; Reuters, 2007). Currently, the government is in contemplating re-introducing price controls in the hitherto deregulated liquid petroleum gas market primarily for similar reasons.

Thus a deregulated mixed public/private business model would appear to offer the necessary checks and balances for sustainable RE industry in the country.

But clearly new comers would need a supporting hand. Emission tax would appear to be one instrument that is being attempted. During the 2008 Budget Speech the South African Minister of Finance moved to impose a new tax of 2 c/kWh[1] on non-renewable power generation. This is evidently too mild by international standards and there is clearly a lot more room for improvement. It is also not clear what the tax intends to achieve in the short term, since the estimated 2 billion rand[2] that will be realized would not be used to fund research and/or investment in RE. And given that there is only one operator, the utility would not feel the pinch as the cost will be easily passed on to the consumer.

[1] This is cents in rand where 1 rand = 100 cents.
[2] 7.5 rand = 1 US dollar (May 2008).

It is nonetheless a step in the right direction and sets a precedent that has hitherto not been tried in the country.

Another avenue that has thus far been available for a private investor in RE in South Africa was when in 2004 the cabinet approved a draft bill that established a designated national authority. This paved way for the country's ability to trade in carbon emissions. Consequently, the Johannesburg Stock Exchange offers counters that trade in emission futures. In principle, this could be a funding source, through the Clean Development Mechanism (CDM). There is, however, a setback with this model in that it is designed to offset emissions from overseas industries. Secondly, experience has shown that international CDM investors prefer other destinations like India, Mexico, Chile and China (Point Carbon, 2008). The few projects that have been identified so far have had very little impact.

In the EU and the US power traders play an important role in the development and operation of the deregulated electricity markets particularly the RE industry. This can be likened to travel agents who in many parts of the World are seen to provide a vital extension of the aviation and hotel industries' marketing networks. By contrast, the trend in South Africa (particularly in the past few years) has been the phasing out of agents by the operators in various sectors including aviation and insurance. It is argued that such a move is meant to pass the savings on to the consumer. In fact, unlike the practice elsewhere in the world, a consumer who opts to use an agent in South Africa is required to pay for the full fare and then a separate commission to the agent. So judging by these trends one would be persuaded to suggest that the model of power dealers would be equally problematic in South Africa.

In terms of governance the authors have identified some government administrative anomalies. There has been evidence of uncoordinated and at times conflicting approaches by various arms of government, namely the DME, the Department of Science and Technology (DST) as well as ESKOM, which seem to replicate similar activities. For example, the recent creation of the National Postgraduate Program on RE and Sustainability took several years to materialize as officials in DME and DST jostled each other over who was in charge. In the face of a stalemate, both departments subsequently signed the final document. At the same time, ESKOM would appear to be pursuing a parallel RE program that is totally de-linked from any of the above.

On the other hand, the Departments of Health and Environment and Tourism could support the process by providing data that would help to compute the externalities. For example, by highlighting the annual expenditure on pollution-related ailments (and their impact on productivity) the Government would be able to quantify the monetary loss and tax the culprits. Again the revenue from such sources would be better utilized by supporting investments in RE.

Finally, there is a backlog of outdated legislation that needs upgrading. For example, complaints have been raised about complicated and vague building laws that curtail wind farm construction as well as long and inconclusive procedure in environmental impact assessment. All these create a web of bureaucratic barriers that frustrate prospective investors.

4. Currently available opportunities that could kick-start the RE industry

The 2010 World Cup will be hosted by South Africa. Consequently, much of the required infrastructure that includes new stadiums and airport terminal buildings is under construction. Additionally, there is a big backlog of residential housing that is also under construction. These present the greatest opportunity for the country to initiate a respectable scale of grid-connected RE industry, particularly building integrated PVs and possibly wind. The Sydney Olympics exploited a similar opportunity and showcased the power of PV. The advantage of incorporating PV in new construction is that the purchase of certain roofing materials can be avoided altogether and be substituted directly by the PV panels. There is also talk about creating byelaws in the Cape Town municipal district to make it mandatory to include solar water heaters in new residential housing. But this is yet another good concept that is likely to be undermined by lack of a well-strategized plan at the national level.

Finally, it is now recognized that educating children about energy issues is the way forward for a sustainable future. A theme 'Education today for tomorrow's energy users' at the 2007 European Conference on Local Energy (European Commission, 2007) addressed this issue. Suggestions were made to introduce energy education in schools. However, lack of energy trained teachers has been identified as one of the major barriers. Additionally, traditional school curricula often do not offer the flexibility to integrate such subjects in teaching. Although many local authorities and private entities employ well-trained energy advisors, they often lack the access to the education sector to offer their knowledge and experiences, the conference was told.

The follow-up energy education conference during the European Union Sustainable Energy Week EUSEW 2008 (European Commission, 2008) with the theme "Energy education, bringing the energy awareness to schools," primarily addressed those barriers. The participants discussed the opportunities for introducing energy education into national curricula and the role of a pan-European exchange between authorities, schools and energy experts for enhancing teaching capacities. The aim was to develop strategies that would help actors in the field of energy education to get the subject to the children.

South Africa could take cue from such developments. At the moment the only entry point for RE in South Africa is at the postgraduate level. This is obviously an anomaly. By contrast, undergraduate courses are being offered in nuclear energy at the University of Cape Town's Department of Electrical Engineering.

5. Concluding remarks

South Africa is endowed with adequate resources in RE that would offer the most logical compliment to the country's energy mix in order to address both the energy deficit and the heavy carbon footprint. But the development of a RE strategy with clear targets in generation, human capacities as well timelines is necessary before the industry can sustainably move forward. A number of structural and legislative barriers have also been identified.

In particular, the lack of a framework to deliver reliable and accurate energy data to the policy makers presents a major barrier. Given ESKOM's dominant role in the South African electricity supply sector, authentication of most electricity supply information becomes almost impossible without the utility's cooperation. Hence there is need for a transformation from an opaque operation that was necessitated by past history to a more transparent one reflecting the new era.

This paper has also presented a number of possible policy options that could be adopted to realize a viable RE industry in the country. In particular, a deregulated market with a level play field between the public and private sector operators has been suggested as the most suitable model for this country. In order to verify the efficacy of these proposals some start must be undertaken. A few currently available opportunities that could be exploited to kick start the RE industry have been pointed out.

It has further been pointed out that international concerns are gaining momentum about those countries that do not seem to play their part in protecting the planet and proposals, including punitive measures are being contemplated. It would therefore be in the interest of all countries to come on board and at least mitigate possible backlash, if they are unable to be guided by a conscious for our common future.

References

Agnolucci, P., 2006. Use of economic instruments in the Germany renewable electricity policy. Energy Policy 34 (18), 3538–3548.

Arnold Cassola, Per Gahrton (Eds.), 2003. Twenty Years of European Greens 1984–2004. 〈http://www.globalgreens.info/literature/books/20years/contents.html〉.

Bird, L., et al., 2005. Policies and market factors driving wind power development in the United States. Energy Policy 33 (11), 1397–1407.

Bomberg, E., 1998. Green Parties and Politics in the European Union. Routledge, London & New York.

Business News, 2008. Small-business forum objects to Eskom price hike. Johannesburg South Africa. 〈http://www.mg.co.za/articlepage.aspx?area=/breaking_news/breaking_news__business/&articleid=337526〉.

Car Today, 2005. Commission drops price-fixing bomb. 〈http://www.cartoday.com/content/news/singlepage.asp?in=7201〉.

Cooper, C., Prinsloo, J., 2002. Digest of South African Energy Statistics. Department of Minerals and Energy, Pretoria, ISBN: 0-9584376-4-5 See also 〈http://www.dme.gov.za/pdfs/energy/planning/digest_energy_05.pdf〉.

Cordier, T., 1996. Cleavages in green parties: the cases of the Dutch, French and German greens. Innovation 9 (4).

DME, 1998. White Paper on the Energy Policy of the Republic of South Africa December 1998, Department of Minerals and Energy. ISBN: 0-9584235-8-X.

DME, 2004. White Paper on renewable energy. Department of Minerals and Energy, November 2003 Government Gazette, Republic of South Africa, vol. 466, Pretoria, 14 May 2004, No. 26169.

Ellis, E., et al., 2004. Crackdown on car-price profiteering. IOL 〈http://www.iol.co.za/index.php?sf=13&click_id=13&art_id=vn20040506021649183C189776&set_id=1〉.

Europa. Summaries of Legislation. Enlargement 2004 and 2007 〈http://europa.eu/scadplus/leg/en/s40016.htm〉.

European Commission, 2007. Education today for tomorrow's energy users. In: Sixth ManagEnergy Annual Conference 〈http://www.managenergy.net/conference/2007education.html〉.

European Commission, 2008. Energy education, bringing the energy awareness to school. In: Seventh ManagEnergy Annual Conference 〈http://www.managenergy.net/conference/2008education.html〉.

European Greens. European Green Party-History 〈http://www.europeangreens.org/cms/default/rubrik/9/9114.history.htm〉.

Fin24.com, 2008. Eskom wants 53% tariff hike 〈http://www.fin24.com/articles/default/display_article.aspx?Nav=ns&ArticleID=1518-25_2290474〉. Accessed 2 May 2008.

Flanagan, L., et al., 2007. The great bread scandal. Independent Online 〈http://www.iol.co.za/index.php?set_id=1&click_id=15&art_id=vn20071113032327569C735466〉.

Fristrup, P., 2003. Some challenges related to introducing tradable green certificates. Energy Policy 31 (1), 15–19.

Gan, L., et al., 2007. Green electricity market development: lessons from Europe and the US. Energy Policy 35 (1), 144–155.

Haas, R., et al., 2004. How to promote renewable energy systems successfully and effectively. Energy Policy 32 (6), 833–839.

Hattie Ellis, "Food miles" 〈http://www.bbc.co.uk/food/food_matters/foodmiles.shtml〉.

Environmental Research Web, 2008. Improving Environmental Treaties. Editorial 2 April 2008 〈http://environmentalresearchweb.org/cws/article/opinion/33627〉.

Lewis, J.I., et al., 2007. Fostering a renewable energy technology industry: an international comparison of wind policy support mechanisms. Energy Policy 35 (3), 1844–1857.

Maruyama, Y., et al., 2007. The rise of community wind power in Japan: enhanced acceptance through social innovation. Energy Policy 35 (5), 2761–2769.

Menanteau, P., et al., 2003. Prices versus quantities: choosing policies for promoting the development of renewable energy. Energy Policy 31 (8), 799–812.

Point Carbon, 2008. CDM Host Country Rating (Rating 6 March 2008) 〈http://www.pointcarbon.com/category.php?categoryID=323&collapse=323〉.

Pressler, M.W., 2004. South Africa: De Beers Pleads Guilty to Price-Fixing. Washington Post. July 14, 2004 〈http://www.corpwatch.org/article.php?id=11431〉.

Reuters, 2007. Tiger Brands faces Law Suit over Price Fixing. Reuters 13/11/2007 〈http://www.flex-news-food.com/pages/12285/Price_Fixing/Tiger_Brands/tiger_brands_faces_law_suit_price_fixing.html〉.

Richardson, D., Rootes, C. (Eds.), 1995. The Green Challenge. The Development of Green Parties in Europe. Routledge, London.

Wang, Y., 2006. Renewable electricity in Sweden: an analysis of policy and regulations. Energy Policy 34 (10), 1209–1220.