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Struggling to wean a society away from a century-old legacy of coal based power: Challenges and possibilities for South African Electric supply future

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ABSTRACT

The challenges faced by the socio-political economy of South Africa when attempting to diversify away from a legacy of over a century of near exclusive dependence on cheap and abundant coal for its energy needs, particularly electricity, are discussed in this paper. Existing government policy documentation would appear to advocate for energy resource diversification. In addition the National Energy Regulator of South Africa (NERSA) published renewable energy feed-in-tariffs (REFIT) for renewable energy generation (during the first quarter of 2009) which were billed by the media as well as a range of stakeholders as very promising. Notwithstanding these seemingly appropriate measures there is still a near total lack of real progress on the ground in terms of serious renewable energy (RE) investments. The authors subsequently attempt to make some recommendations as to what might have probable chance of success in terms of overcoming the barriers to the adoption of a more diversified energy resource environment, in particular renewable energy (RE).

1. Introduction

This article discusses some of the challenges faced by the socio-political economy of South Africa when attempting to diversify away from a legacy of over a century of near exclusive dependence on cheap and abundant coal for its energy needs, particularly electricity. The authors will then attempt to make some recommendations as to what might have a probable chance of success in terms of adopting a more diversified energy resource environment, in particular renewable energy (RE).

This approach will be underpinned by examining the projected mid-term electricity demand for South Africa and the supply shortfall that is likely to continue particularly given the long lead times necessary for the planned new coal plants, [1,2]. The prospects for renewable energy will have to be contrasted along with the other short to medium term solutions such as demand side management (DSM), energy efficiency and load shedding. The authors are also cognizant of the possible impact that international environmental imperatives could have in favour of accelerated RE technology uptake. However, judging from past experience and given that there is a near total absence of a potent local environment advocacy movement, it's quite possible that the Government of South Africa could easily weather external political pressure as a determinant in resolving whether to diversify or not. In addition the country's estimated 300-year stock of coal reserves means that the popular motivations for RE uptake such as the eminent depletion of fossils, volatility of prices and the uncertain security of supply clearly do not apply.

On the other hand existing policy documentation would appear to advocate for energy resource diversification [3,4]. In particular the adoption of RE has been singled out with set targets. In recent months (March 2009) the National Energy Regulator of South Africa (NERSA) has even gone as far as publishing renewable energy feed-in-tariffs (REFIT) [5,6]. Although the selection is still restricted to specific RE technologies, the tariffs were billed as very promising by a range of stakeholders as well as the media. Notwithstanding these seemingly appropriate measures there is still a near total lack of real progress on the ground in terms of serious RE investments.

2. ESI – current power generation technologies and utility operational strategy

South Africa's electricity supply industry (ESI) is a centrally planned one where the National Utility, Eskom, is responsible for the generation, transmission and distribution of electricity within the country's borders. Being vertically integrated and having the sole shareholder as government, Eskom's vested and strategic interest is the provision of electricity for consumption with special

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emphasis placed on extending services to areas neglected in Apartheid planning scenarios.

Costs for service are spread across the entire consumer base with some portion of cross subsidization taking place. For industrial rather than commercial and domestic consumers this method of apportioning costs across the asset base translates into relatively cheap electricity per unit produced. The fair degree of cross subsidizing across the user base for example, the Free Basic Electricity (FBE) [7] that certain consumers are entitled to, is paid for by others through higher tariffs.

This phenomenon of 'cheap' electricity is possible due to a number of factors. Having paid off most assets, the Utility's expenditure was limited to low running costs. The other factor is the near absolute reliance on coal as the fuel for generating electricity. With coal being extracted locally, where the ESI is responsible for consuming the bulk of domestic coal demand, Eskom is in a position to negotiate favourable long-term contracts with mining houses with prices fixed over the life of the coal mine. Other contractual arrangements do occur, but when the goal is to avoid purchasing the feedstock for power stations on the spot market, both the utility and producers can look forward to fairly stable income and revenue for decades in a business-as-usual scenario. So, in addition to the paid up assets is the low average operating costs consisting of fuel as well as labour. Thus revenue could remain stable over time if generation could continue to meet projected demand. This vantage position held by Eskom apparently served to keep other entrants from entering the market as the unit cost of electricity was deemed too low to allow an Independent Power Producer (IPP) to operate and make a reasonable return.

The white elephant problem of the eighties – where, as a result of an overbuilding of capacity the country had a number of stranded assets in the ESI – was solved through temporarily mothballing certain power plants. The national utility even went so far as offering electricity to municipalities at cheaper rates than the latter were able to produce for themselves. The City of Cape Town serves as a case in point. The Athlone power station used to provide some portion of total electricity to the city. Using coal, the feedstock had to be transported in by rail or road from the mining centers in the North of the country. This added to the cost of producing a unit of electricity. By contrast the majority of Eskom's coal-fired stations are located in Mpumalanga where the coalfields are also found. When Eskom was faced with the reality of mothballing certain generating assets, it still saw to it that it would remain the least cost supplier in the country.

With the clear majority assets paid up and the company having no statutory mandate to declare profit, the utility effectively undercut other service providers even when this meant operating at a loss. Such costing was in part justified through an old but now internationally discredited pricing model that is so-called 'postage stamp' [8]. The model basically ignores the costs involved in delivering power over long distances and thus has the effect of obscuring the actual cost benefits of generators that are located in close proximity to the loads. For example, while the price of petrol at a filling station in Durban (a port city) is cheaper than in Johannesburg, due to transport costs, such a differential is not reflected in electricity tariffs across South Africa. Subsequently the City of Cape Town shut down the Athlone power plant and was followed by the City of Johannesburg, which later sold its Kelvin plant. As least cost provider, it was not in the National Utility's interest to enter into off-take agreements with IPP's where the power received would cost more than what Eskom could produce for itself.

Additionally dividends made by Eskom from the nineties were responsible for a considerable proportion of government budget. This re-enforced by its aforementioned historical legacy provided to fortify the strength of Eskom to trump any policy intent on introducing other players into the ESI. This was despite the numerous government policy documents that advocated for the diversification of the country's energy resources as highlighted earlier. The policy documents had, in fact, apportioned a 30% slate to be sourced from non-traditional sources.

Historically energy information dissemination was prohibited through Acts of Parliament enacted during the Apartheid era that are still on the statues [9]. With its status as a historical sole monopoly Eskom has the custody of all the country's electric energy data that would be vital for a new investor in the sector. But the Utility frequently invokes the confidentiality clauses and puts paid to any such endeavour. This situation has further undermined the country's capacity by other government agencies such as Statistics South Africa to collect professionally acceptable energy data, particularly the electric sector.

Coupled with the policy the 30% of new generating capacity that would come from the IPP sector is the requirement that Eskom is the sole buyer, which puts further doubt that the entrenched monopoly power could actually be seriously challenged. This game continues to play out. Even being short of funds, having little recourse to any more government injection of cash and facing stiff resistance from trade unions and consumers for the new rounds of double digit tariff increases, the national utility monopoly remains entrenched.

3. Energy security – resource diversification: a brief background

Security of energy supply in today's charged geopolitical context can entail diversification but not always for reasons of transitioning to a low carbon economy. It can also mean local resource championing, spelling self-sufficient dependency strategies when national resources can warrant this approach or where relying on diverse supply options means sourcing these resources beyond one's borders. South Africa's Apartheid history alludes to this approach. Given the wave of sanctions and growing isolation that the old Apartheid Government was subjected to, the decision to rely on coal for both electricity and liquid fuel needs, stemmed from the pariah status that South Africa experienced. In this context, the relative abundance of the local resource, coal, coupled with the acquiring of technology rights to transform coal into fuel oil provided the basis for a policy on security of energy supply that relied heavily on one resource where in the interest of state hegemony, diversification was not a priority.

The historical legacy of this reliance on coal has brought with it consequences. The Electrical Supply Industry (ESI) remains exclusively invested in the century-old, centrally based, coal power generation model. Historically embedded subsidies along with the age-old asset base designed specifically for utilizing low-grade coal have served to deliver an extremely cheap consumer tariff. Additionally the exclusion of externalities in the costing for power has skewed the impact made by fossil fuel generation both as an environmental and economic concern. Economically, other resources or technologies are unable to compete particularly as the mineral energy-complex that is a major support for the coal industry also remains subsidized [10,11]. This status quo has also meant that the technical skills pool in the ESI has not evolved beyond the requirements of the traditional power system. This further makes it harder for any change even when it involves adopting modern approaches to power delivery within a coal based environment, let alone a resource diversified one.

Environmentally, the allocation of resources including water and the degradation felt through mineral extraction and release of pollutants into the atmosphere is well documented [12,13]. This

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peril is receiving increased international recognition but there still appears to be little attention paid to its significance by South Africa policy makers. So while more developed and emerging economies signal the strategic shift to greener economies, South Africa's ability to undergo such a shift with seamless transition is questioned as all indications point to a continued reliance on a near single resource for energy security. In fact the current focus is almost exclusively on how to fund the expansion of Eskom's coal based generation and distribution capacity [14,15].

Planning assumptions that segue into market forces further hamper resource diversification. The Energy Security Master Plan [16] for example, is explicit in the assumption that guides it. The Plan states in part, 'It must also be emphasised that this Plan represents the least cost approach to achieving a demand–supply balance'. It specifically excludes other government policy imperatives like renewable energy and nuclear technology. With the overarching objective being the meeting of energy requirements for the poor, in a country where a majority of the population are low-income earners, one immediately understands the reasoning that effectively seeks to keep supply as cheap as possible. Eberhard [17] observes, 'A close examination of the South African ESI shows that low prices and the ability to fund electrification have emanated in part from very low coal prices'.

The National Integrated Resource Plan (NIRP) [18] under the custodianship of the National Energy Regulator, NERSA, also advocates for a least cost approach to planning capacity expansion but takes cognizance of what the cost benefits of each supply scenario modeled would entail. With one of its objectives being diversification of supply, it includes energy imports, renewable energy, nuclear energy and energy efficiency & demand side management (EEDSM) options in its scenario planning exercises. The NIRP2 report drew conclusions that warrant a review of how South Africa plans to meet the challenge of sustainable resource consumption and diversification where energy is concerned. It states in part, 'Options for diversification are insufficient to meet all of the forecast demand for electricity over the next 20 year planning horizon. Coal-fired options are still required for expansion during this period'.

Based on these observations, one could ponder where the forecasted demand is expected to come from. For the short to medium term, NIRP2 assumptions allow for large industrial projects with accompanying high levels of electricity intensity. Electrification is said to make a small impact. It also assumes low DSM penetration due to barriers involved. On supply side options, NIRP2 allows for Return-to-Service of (mothballed) coal stations, new coal, pumped storage and hydro.[1] It should be noted that NIRP2 criteria for inclusion of supply side options amongst other considerations require them to be 'socially, politically, environmentally acceptable', 'economically viable' and 'in line with World Bank emission standards'.

The reference plan results with a 10% reserve margin have new capacity being met primarily with coal. The alternative plan 1 with a 15% reserve margin accelerates return-to-service station commissioning and new coal. The alternative plan 2 modeled for sensitivity also accelerates return-to-service options. The NIRP2 document however observes that, 'It will be difficult to justify diversification on an economic basis unless (austere) measures such as penalties for not doing so are included in future analysis. As the cost for diversification is becoming increasingly more expensive these penalties (or opportunities for emissions trading) will need to be substantial to offset the economic benefits of remaining with coal'.

Little regard is given (by the document) to emissions or other effects of continuing to rely on coal. It does make mention of the need to make clean coal technologies to be more cost effective as well as raising the efficiency of new plants. Given the above observations the earlier statement dousing the outlook on options for diversification appears to be rooted in an economic context. This pretext also favours the present system that local finance houses are used to.

4. Socio-economic strategy and outlook

In Table 1 are depicted some selected South African economic indicators according to the Department of Minerals and Energy (DME) [16]. These figures however do not constitute the complete picture and need to be considered along with other pieces of information. Economic growth and the type chosen are seen as a way to manifest development and eradicate poverty [19]. Since the advent of democracy in 1994, the strategy adopted has been one where the country's mineral resources served as the bedrock from where other sectors of the economy could be given 'wings' to seek flight [20,21]. This perspective has as an apparent underlying notion that increased material extraction, production and consumption is a method with which to foster economic growth.

Given the minerals-energy-complex as a salient feature of the economy, the energy component comes under the spotlight and the possibilities for transitioning to a low carbon economy are greatly influenced by the type of energy sources used. The prevailing expectation is that demand for energy will continue as South Africa continues to be marketed as an industrial hub. So long as this demand is conditioned upon cheaply available power, the use of coal as the feedstock fuel for power generation within the current structure of the Electricity Supply Industry (ESI) is supported. Even with the anticipated above inflation tariff increases by the National Utility, Eskom, for the medium term South Africa can still be expected to attract industrial plant investors if low industrial tariffs remain the primary consideration.

5. Present and future electricity demand

Despite the current (2009) global economic contraction and lower year-on-year electricity demand and production, South Africa's forecasts for future demand expect growth in the medium term. Demand for electricity is often closely linked to GDP growth and therefore the key determinant for electricity demand over the forecast period will be the growth in GDP of South Africa and the nine provinces [22].

At the dawn of 2008 the country was gripped by an electricity supply shortfall and major blackouts. The shortfall was just over 10% [23,24]. In the aftermath of the crisis Government of South Africa has seen it necessary to plan for a capacity expansion in power generation assets which would raise the installed capacity base by as much as 50%. This is in line with the expectation of South Africa's GDP (previously expected) to grow between 4 and 6% per annum. The economic recession has however required a re-evaluation of these growth projections [25–27]. Up and through 2010, 2011, growth of GDP has been revised to around the 1% mark. From a planning perspective, it is still timely to continue with the capacity expansion so as to not impose any infrastructure constraints on the economy when growth picks up again. This method of counter cyclical government-led investment is central to keeping South Africa socio-economically above water in such trying

[1] Return-to-Service is the term for decommissioned coal power stations being brought back online. New coal power stations would have emissions lowering technologies, e.g. scrubbers. Pumped storage refers to large hydro inter basin schemes where electricity is pumped to the higher basin in times of low demand and released when demand peaks to produce near instantaneous electricity.

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Table 1
South Africa economic indicators [15].

	2001	2002	2003	2004	2005
Real GDP	2.7%	3.6%	2.8%	3.7%	4.3%
CPI	5.7%	9.2%	5.8%	1.4%	3.9%
CPIX	6.6%	9.3%	6.8%	4.3%	4.3%
Unemployment	29.5%	9.3%	28.2%	26.2%	25.3%
National debt (%GDP)	41.4%	37.1%	35.7%	35.8%	35.1%
External current account balance (%GDP)	0.1%	0.7%	−1.5%	−3.2%	−3.7%
External debt (%GPD)	26%	29.5%	22.4%	19.8%	19.1%
Gross reserves (in months of total imports)	2.9	2.8	2.2	3.1	3.7
Int. Liquidity of SARB (in US$-billion)	−4.8	−1.6	4.8	11.4	19.8
US$ exchange (in rands)	12.3	8.64	6.64	5.64	–

times. The power generation expansion is a central component of this investment strategy.

In the interim period (as new capacity is being commissioned), there would be need for a series of initiatives to ensure that the country continues to have its electricity demand adequately served. As noted earlier shortfalls would have to be sourced from a variety of alternatives such as imports, peaking power plants on the supply side and demand side management on the consumer side so as to avoid load shedding leading to a complete system blackout. A major load recovery is currently being achieved through a regime of NEGAWATTS, that is, by shutting down large industry through bilateral arrangements. A special Eskom/Industry Partners Programme is dubbed Power Buy-back and Demand-Market Participation (DMP) [28]. The program is approved by the National Energy Regulator (NERSA) and allows high-energy intensive customers such as furnaces and smelters to offer Eskom flexible loads on a year-ahead or day-ahead basis, at predetermined prices. Alleviating this balancing act requires the setting up of an appropriate 'reserve margin' which is defined as the amount of spare capacity as a percentage of the whole system. Globally a benchmark of 15% (or thereabout) is viewed as an ideal reserve margin.

Thus while the new capacity expansion program will be undertaken, the country's generation capacity will continue to lag below demand. Extending a regime of Negawatts as a means of addressing the problem clearly does not auger well with sustained economic growth and job creation. Finally getting back to the acceptable reserve margin of 15% will also depend on a number of variables such as the actual lead times to new plant commissioning, the extent to which non-invasive DSM can trim down consumption, the state of the economy and to what extent its appetite for increased material consumption would keep growing. Lastly how the existing generation capacity is managed for maintenance and dispatching. Fig. 1 shows past and projected electricity consumption by sector. Industry is responsible for the lion's share of consumption and with the current macroeconomic strategies this scenario is expected to continue.

Drawing from the above, evidence points to an Electricity Supply Industry (ESI) that is low on reserves and prone to load shedding in times of extreme duress. It is in this context that the role that could be played by RE to complement the traditional systems warrants closer examination. Can the South African traditional socio-economy be altered to fit more in line with the RE resource paradigm?

6. Policy and strategy considerations

Keen followers of renewable energy development globally would be well versed in the support and policy mechanisms that give rise to sustained uptake of these technologies in certain regions. Some commentators have espoused belief that simply adopting policy instruments designed for a different operating and economic conditions overseas would suffice to see a large uptake of renewable energy in South Africa.

If the goal is simply to have these technologies enter the market and operate with a view to giving investors and project developers a return and profit then developed world policy packages adapted for local conditions might just well do the trick. But one is then faced with a further question. What impact would the use of these technologies in such a narrow scope have on the country, its economy and ultimately the well being of society? Given the global nature of trade flows, information and technology exchange, in the scenario described above, South Africa could find itself with a high import bill for the various components, needed for the ESI market to produce power whilst lowering emissions and the entire consumer base as a whole being responsible for the cost of such a program. The transfers in skills, know-how and technology would most likely be limited to small clusters with the resources to raise project finance that could see profit making as the goal in itself.

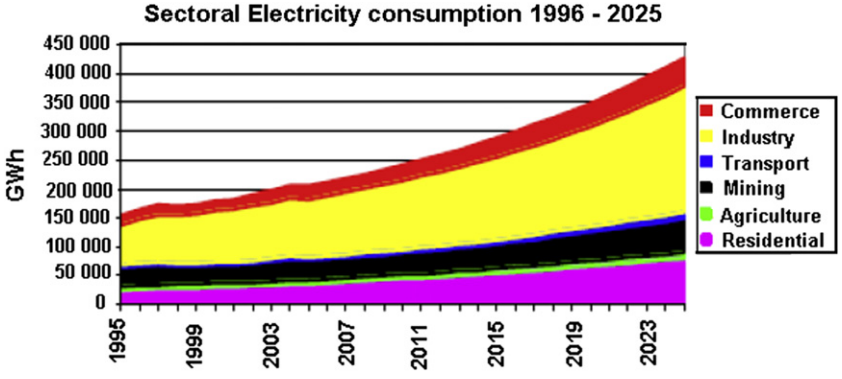

Fig. 1. Courtesy NERSA National Integrated Resource Plan Stage 2 Report.

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Development of a sustainable type with real upliftment in quality of life for the disadvantaged would be low on the periphery of priorities and consequently marginal in actual gains made. In the end the powerhouses of renewable energy technology development would more likely remain within the auspices of the current economic order. The price tag for such a large rollout of RE would therefore not be justifiable if the goals intended or approach sought are as described above.

The financing of such a scenario might well see a stream of foreign investors coming into the country to invest in these projects initially, then selling of the assets to a local entity and exiting with profits in hand. The local entity might well be one of the familiar South African black empowered conglomerates whose skills lie more in the setting up and managing of an investment portfolio rather than the operation and management of a renewable energy power project. Even though investments would be made into productive capacity, the country would be left with only the assets once deal making is complete. The authors' notions are premised by the current absence of an in-country base of talent to see such projects through from concept to financial closure and engineering procurement and construction. The premium paid for the sourcing of such talent would inevitably be high and on par with the international going rate overseas.

Renewable Portfolio Standards (RPS) and Feed-In-Tariff (FIT) schemes in the developed world have worked well to the degree in which renewable energy technologies have entered the market and competed if not evenly. But this is premised by the fact that manufacturing, know-how and intellectual property rights are also co-located and have been growing in scope and application for some time before such schemes were introduced. This is quite evident in all emerging RE energy powers such as India, Spain, Brazil, and Germany just to mention a few. The schemes serve as an outlet for the years of research and development that has allowed these technologies to be commercially applied. In this context, countries like South Africa are essentially periphery outlets for the high value technology produced elsewhere.

China for example, has been able to develop a manufacturing base for these technologies for export to developed economies much along the line of its previous strategy to serve as the factory floor of the world. As its carbon emissions take the spotlight away from the OECD combined with its growing upwardly mobile population base, they are well placed to now introduce these technologies into the domestic market with a critical amount of value added activities and benefits accruing to China. On the other hand South Africa for which globalisation has seemingly, been a zero sum game, does not enjoy this luxury. Now more than ever, the stage is set for upheavals in the economic order that accompany shocks to the system as witnessed in the global economic and financial crisis.

What then should South Africa do in an attempt to make a case for RE to serve energy demand? Credit must be given for the policy makers and technocrats that enabled South Africa to become a cheap and reliable source of power, which combined, served to establish the minerals-energy-complex that the country still relies on to this day. However the thrust of this article sees historic legacy as becoming increasingly irrelevant. Lest South Africa wants to wake up one day and find its economy made extinct at speeds much like the demise of dinosaurs, policy prescriptions need to speak to transitioning the minerals-energy-complex into at 21st century economic force that will see a more egalitarian form of development introduced throughout the country and region. But how? One should take note that South Africa's solar (and to a large extent wind) resource potential is very good, and needs to be seen as a valuable a resource much like the minerals. This resource potential coupled with the technological transfer opportunities that are possible pre-concludes that strategy and policy should focus on market entry into the ESI as much as attracting the manufacturing and intellectual know-how that should accompany any uptake of the technology.

The bridge between the two areas of policy lies with a human development strategy. Before any real coordinated thrust is made to introduce RE on a large scale, a needs assessment of the capacity and skills base has to be conducted. In particular the skills needed are those in the areas of project design, financing, installation and maintenance and management. Some of these require technical training, the others vocational training. The institutions that would be assisting project developers and companies in implementing the RE rollout will also require some staff being skilled up to deal with oversight, approval, monitoring and reporting back. The lessons learnt from the solar water heater subsidy program by Eskom [29] and previous rural electrification projects by solar home systems [30,31] is that besides customer affordability, adequate business, installation and maintenance experience need to be properly nurtured for a considerable amount of time so as to not have system failures and businesses collapsing once government support is withdrawn.

7. A way forward

As mentioned earlier the National Energy Regulator (NERSA) announced feed-in-tariffs (REFIT) for wind and concentrator solar power (CSP) generation at the end of the first quarter of 2009. (Figs. 2 and 3 show the distribution of solar and wind resources in South Africa.) Notwithstanding a generally complementary feedback (particularly from the media) following the announcement, however, investor response would appear to be more muted. A possible implication for such response (or rather the lack of) is that sentiment still interprets the market environment as still not conducive. So what could be still lacking?

Apart from the aforementioned issues pertaining to the role and status of Eskom, a look at the history of RE technologies in South Africa might offer further insight. In the recent past RE have by and large only been deployed in off grid rural locations mainly as PV solar home systems (SHS) as well as service-for-fee systems [32,33]. The latter involved the connection of consumers to a service provider installation for a monthly fee. The performance track record of this technology however has been, at best, dismal. The history of wind has even been worse [34]. Shortage of technical skills carried the bulk of the blame.

Drawing from such experiences therefore one could make the following propositions. The first step in a policy package should be government support for training. Certifications of installer training would subsequently have to be in place to ensure proper system installation with warranty and guarantees. A program with a government SETA[2] (Sector Education and Training Authority) or through an industry association would need to be involved so as to give credibility. In the area of project design, once again a national diploma or equivalent certificate in a relevant RE discipline would have to be the entry point for anybody potentially interested in the field. Management and financing expertise could perhaps be drawn from the existing pool of the workforce if it is deemed adequate. The aim here would be to market the education incentive at certain segments of the labour pool. For installation and maintenance training, school leavers with vocational interests might be a good pool. Also targeted should be existing electricians with or without

[2] The Skills Development Act (1998) provided a framework for the development of skills in the workplace. Amongst other things, the Act makes provision for skills development by means of a levy-grant scheme, and the establishment of 27 sector-specific Sector Education and Training Authorities – or Setas.

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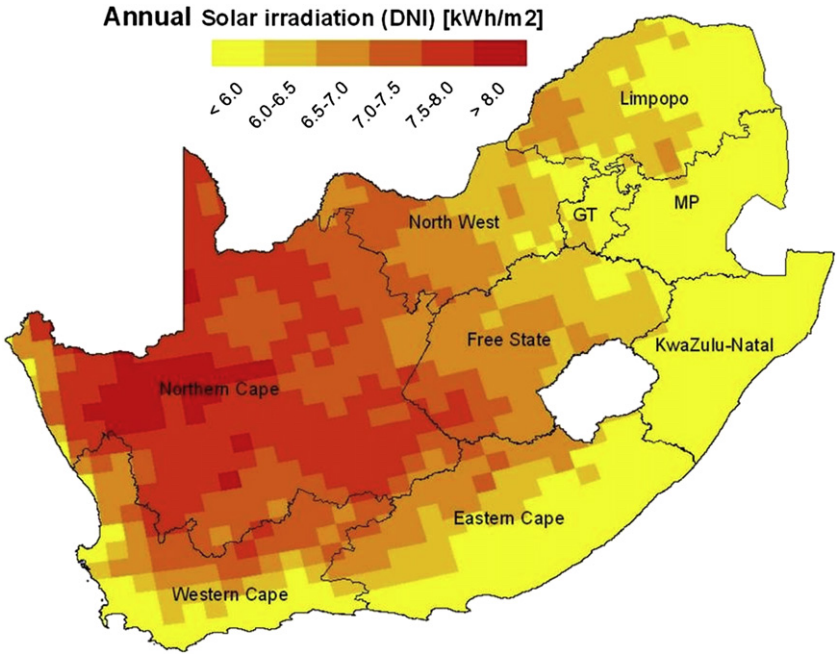

Fig. 2. Annual direct and diffuse solar radiation (Source: DME, Eskom, CSIR, 2001).

national diplomas. This would probably be the single most active area in employment terms, as the industry would need a substantial installer base given a national target set.

A guiding principle in setting up any large-scale RE training program would be to avoid the industry becoming a hole for casual labour with no skills to show, as is currently prevalent in many sectors of the economy. National government might see it fit to incentivise RE companies to contribute to the cost of training through tax breaks in return for clear commitments. Conversely if government were to go it alone and industry essentially absorbed the trained individuals at no cost, they probably would have to guarantee wages at levels able to afford those employed a decent quality of life.

The next step in the policy package would be to address the procurement of components for RE. Agreements would have to be sought with overseas suppliers willing to locate factories here in the event that demand shows good projected growth potential. They might have to be assured of favourable terms to compete so as to lower their cost to export to South Africa. In return, a fairly predictable import bill would greatly limit the chance for price fluctuations and equipment shortages due to unforeseen events outside of the South African market. As nearly all supplies are expected to be imported to start with, the drive here should be to create enough of a scale to warrant local manufacturing of as much of the value chain as is possible. Local manufacture without the necessary demand for the product might be futile. The above strategy alone however, may not necessarily provide a panacea as evidence abounds suggesting that even in the presence of such services challenges can be encountered [35].

Another option would be to offer government rebates or grants towards installation costs whereby electricity produced and consumed or fed into grid is offset against supplementary electricity drawn from the grid. This is known as Net-Metering.[3] In this scenario, the aim would be to have the customer/consumer lower their bills paid to the utility as much as possible and using these monies saved to calculate payback time of the installation cost. This is particularly important, as recent experience has shown that utility tariffs as are set to keep rising at least in the medium term. Installation business viability would thus be dependent upon the readiness of government to subsidise or compensate homeowners and business to install systems. Without a dedicated fund for such a program, its chances of success would be low.

RE installation businesses own the systems installed on (or near) homes and business. In return for electricity savings accrued from deferred load as a result of not drawing power from the grid consumers would pay a portion of those savings back to the installation business for a period of time up until the system is fully paid for.

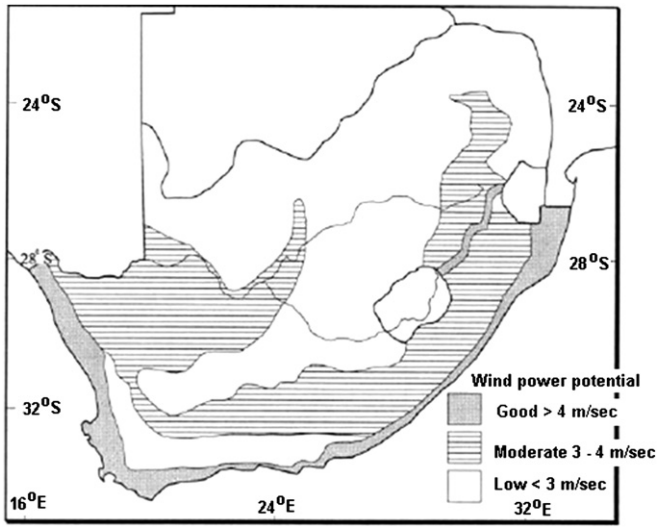

Fig. 3. Annual wind distribution levels for South Africa (Source: ESKOM).

[3] This option does not appear in the current NERSA tariff schedules and neither does the use of PV, a technology most widely used for the model.

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Recent developments in the developments such as the blackouts experienced particularly during 2008 and the rapidly increasing tariffs could initiate an unexpected cultural revolution in the way affluent South African urban consumers look at renewables such as photovoltaics. Whilst cheap uninterruptible ESKOM supply was readily available [36] the general feeling was that renewables belonged to the impoverished remote rural. It is becoming increasingly viable for these consumers to seriously consider investing in own backyard generation power. The absence of an enabling legislation however still hampers this option

In laying a case for the three schemes described above, no consideration has been made of the readiness of the Insurance Industry and National Credit Agency to be involved. Only government support has been considered. The viability of each option warrants careful consideration of the country economic conditions juxtaposed against time to rollout such a scheme in response to the shortage of electricity. Long-term viability also rests on the scheme(s) chosen being continuously supported when new build conventional capacity comes online. Policy and decision makers would have to exercise foresight in choosing the appropriate scheme as the costs involved would mean the country would probably have to go for at least a decade before real benefits spread beyond the energy industry and accrue to society as a whole. Abandoning such a strategy halfway would most likely result in massive misallocation of taxpayer money. Whichever of the schemes described above is chosen would have to be coupled with the two previous recommendations of human capacity development in the preliminary stages and setting up manufacturing facilities in the medium to long term. This social, economic and industrial strategy would have to compete with state support for existing industries.

Making the case stronger for RE requires consideration of the questions raised in the earlier section of the article. With the pace of the new conventional plant commissioning experiencing delays along with the lower than expected savings achieved through DSM initiatives, space has opened up for RE to play some role at least in the short to medium term. All things being equal the modular nature of these technologies and relative ease of installation translates to much shorter lead times. Market penetration from this vantage point is possible. This proximity to the load point or ability to situate RE electricity generation at the point of consumption means immediately upon installation the system serves the load requirements. The impact this electricity produced would have can also be measured against the reduction of the overall expansion in both conventional plants and grid infrastructure. The degree to which this scenario is suitable for South Africa as opposed to the current one requires demonstrative applications.

Having said all the above however one ought to keep a clear sight of one fundamental obstacle namely the state of near military style legal fortification that the national utility ESKOM enjoys. This obviously grew over time but was largely re-enforced by the draconian legislation enacted (for its protection) during the time that the country's political liberators were active. The overwhelming advantage that these laws give to the parastatal will continue to hamper any measures to attract serious investors in the power supply industry unless this legislation is fundamentally overhauled. These include the non-disclosure of energy related information such as market related statistics and tariff costing models that would be so vital for a prospective investor.

One possible option that has proven very successful in South Africa is the model employed by the country's civil aviation industry. The model is anchored by the Civil Aviation deregulation Act of 1991 which creates a fundamental difference between how South African Airways, SAA (a large governmental parastatal) operates in a deregulated market as compared to ESKOM. This model has seen unprecedented growth particularly in domestic traffic over the past decade. Under the model a large state owned carrier SAA operates along with a modest private sector complement. A different authority with no conflict of interest operates the supporting infrastructure. However such a suggestion has on occasion been politicized as an unveiled attempt to privatize ESKOM.

8. Concluding remarks

Energy is a major factor impacting the growth of economies as well as environmental sustainability. In the era of increasing environmental sensitivity and climate change it is now generally accepted that the most prudent way forward is through integrated energy resource planning, with RE as a major component. This article has sought to identify the odds against diversifying South Africa's primary energy resource, particularly due to a number of historical factors. The structure of South Africa's ESI and its vision for a cheap and secure energy supply would appear to favour continued use of the traditional centrally based coal power system.

The prospects for RE to enter into such a market and compete on equal terms is questionable in the current environment. It has in fact been observed that despite the National Energy Regulator (NERSA) announcement of new tariffs for renewable energy, the response from investors remains quite muted. The awakening to possibilities in green technologies and the strong resource potential of the country, therefore, necessitate an approach that is pragmatic to what can be achieved at least in the short to medium term.

It has however been suggested that current shortfalls in electricity supply, the long lead times for new large coal plant to come online and, to a lesser degree, environmental concerns could help in reducing the odds against the uptake of RE. Additionally a number of alternative financial and human skills development models have been suggested to augment this effort. With this in mind, the strategy and policy offered is one to focus on the rollout of RE at least in the short term to shore up any deficit between electricity demand and production for the targeted sectors whilst also reducing the total required new installed conventional capacity. The spin-off and benefits to this approach would be the high job creation potential due to modular installation requirements on a plethora of sites and locations as well as a longer-term possibility of locating manufacturing facilities within the country with the associated technology and knowledge transfers. The enabling of human agency and capacity is seen as another draw giving RE merit in this period of mass retrenchments.

The widespread application of RE in the country could be the point through which South Africa and the region as a whole would transition to a low carbon economy albeit in slow gradual steps. Policy and support mechanisms are a salient feature but need to be underpinned by what the greater social and intangible benefits would be. The best example is of giving electricity to those with no access to it. But in order to have more of such stories, an economic basis from which to pursue RE needs to be made.

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