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Wind energy landscape specialist study

Testing and development of methodologies for landscape assessment

1. Background

The proposed specialist assessment flows from work undertaken by the Department of Environmental Affairs and Development Planning (DEADP) of the Provincial Government of the Western Cape. This work is summarised in the document "Strategic initiative to introduce commercial land-based wind energy developments to the Cape West Coast". This document set out the vision for the Western Cape"…to establish a policy on the implementation of regional criteria for the identification of areas suitable for the establishment of wind energy projects."

The approach has been to undertake a desktop study investigating international approaches to promoting wind energy developments in a sustainable manner, and a stakeholder participation process. Regional guiding criteria for selecting suitable areas for wind energy developments were based on the study findings and stakeholder inputs. These criteria are summarised in the document.

The motivation for the approach taken is the inadequacy of information to exclude landscapes in terms of their conservation and cultural sensitivity, and that sensitivity analyses are resource and time intensive. This reflects the status of South Africa as a mid-income nation, with significantly less access to capital for both data collection and analysis, than the countries that have adopted wind-power on a relatively large scale.

2. Proposed project objectives and Terms of Reference

The proposed project is a specialist assessment, utilising two different methodologies, one developed by the Department of Environmental Affairs and Planning (DEADP) of the Provincial Administration of the Western Cape, and the other a landscape assessment. The project has the following objectives:

i) To undertake a detailed landscape assessment of the study area, evaluating sensitivity of the area to wind energy developments, based on specific cultural, biophysical and social characteristics of the area.

ii) To amend the criteria and thresholds developed in the Strategic Initiative document, utilising findings from the landscape assessment, and to apply the amended criteria spatially to identify areas that are either suitable or unsuit-

ERRATUM

In Vol. 11 No. 1 (March 2005) the article 'ERC determines Cape Town's energy future' could have been misleading to some readers. The Energy Research Centre (ERC) modelled some possible scenarios for the energy future of Cape Town, rather than determine the energy future. The article also should have given recognition that the ERC work was partly based on the work of Sustainable Energy Africa's (SEA). The Editor regrets the error and any inconvenience caused.

IN THIS ISSUE

able for wind energy developments throughout the Western Cape.

iii) To compare the two methodologies and evaluate the suitability of using either as an acceptable method for identifying areas either suitable or unsuitable for wind energy developments throughout the Western Cape (see below – additional ryder).

iv) Dependent on the outcome of the comparison of the methodologies, if a landscape assessment is needed for all new areas, the development of a clear methodology for undertaking regional landscape assessments.

v) The proposal of a basic method for use at the Environmental Impact Assessment (EIA) stage for assessing specific sites for a particular development, in the context of the surrounding landscape.

There is a ryder to objective 3 above. This states that the ideal outcome of the comparative study would be that the areas derived by both methods would coincide closely. The use of the amended criteria method would thus be acceptable and this would negate the need to perform time consuming and expensive landscape assessments for each new wind energy development introduced into a new geographical area.

The terms of reference of the project flow directly from the objectives set out above. The terms of reference were discussed and clarified at a pre-bid information meeting with DEADP. The project scope for the last-mentioned

Terms of Reference is worded "Developing a methodology to perform landscape assessments at project level."

The scope does not include:

- Formulation of the guideline or policy based on the preferred methodology.
- The roll-out of the rest of the Western Cape.
- Incorporation of the findings of the study into the draft report *Strategic Initiative to introduce commercial land based wind energy development in the West Coast.*

3. Study area

The study area is indicated on the map on this page.

4. Critical issues identified in 'Strategic Initiative to introduce commercial land based wind energy development in the West Coast' (the 'Draft Working Document')

The document that forms the basis of the tender admirably synthesizes a huge amount of information relating to wind energy development and, in particular, to siting and landscape issues. The findings of the document are an essential input in shaping the proposal. Of critical importance are:

a) the conclusions based on international experiences;

b) the applicability of the international experiences to the Western Cape; and

c) the derivation of a set of criteria for the development of wind farms in the Western Cape.

Section 4.6 of the document sets out the conclusions based on international experiences. These are summarised below:

- There is significant overlap and similarity in approaches worldwide in facilitating the establishment of wind-energy facilities and a strategic proactive approach to identify suitable areas has emerged.
- The importance of landscapes has emerged, and the social and strategic value of landscapes is acknowledged leading to the realisation that the intangible value of landscapes (and living environments) must be addressed in the spatial identification of areas of suitability.
- There is a move internationally towards detailed planning, including the use of criteria and thresholds to designate areas of suitability, and the linking of these criteria to regulatory instruments to ensure effective implementation and enforcement.
- Designating areas of suitability for wind energy developments promotes implementation of projects and enhances integration with other land-uses. Environmental and spatial issues can be addressed early in the siting process by introducing them at the strategic regional level.
- Planning approaches internationally are not reliant on the availability of technical information, although approaches are enhanced by the inclusion of this information. Technical considerations are generally addressed by the applicant as part of site-specific environmental impact assessment processes.
- In spite of commonality of environmental concerns internationally, the criteria developed to address them vary significantly, due to differences in between countries of geographical size, biophysical and cultural characteristics, and degree of landscape modification.
- Sensitive areas or landscapes had already been identified in leading countries, prior to the development of wind energy regional siting criteria.
- The process of identifying sensitive areas usually entailed analysis by specialists of a defined geographical area on a broad scale, based on regional-level biological, environmental and landscape factors, to define areas of sensitive landscapes to exclude wind energy developments.

Section 5.2 deals with the applicability of international siting issues to the Western Cape. This section sets out:

— *The ecological context of the study area – namely the biomes and veld types*

— *Differences in approaches between leading international countries and the Western Cape Government:*

- Leading countries follow a regional landscape assessment process of identifying regionally sensitive exclusion areas at a preliminary stage of strategic planning.
- This entails a specialist sensitivity analysis, or where not undertaken, regional landscape designations had already been undertaken.
- After assessing landscapes, criteria and associated thresholds are applied to the remaining areas to

exclude further areas for wind energy development. The criteria used worldwide are identical but thresholds vary.
- The Western Cape would prefer not to follow the international approach as sensitivity analyses are resource and time intensive.
- The alternative Western Cape Government approach has been to develop a robust set of criteria to identify regional-level sensitive areas. These criteria and thresholds are more restrictive than those used internationally, as these are the sole means of identifying sensitive areas.

— *Applicability of international siting issues to the Western Cape*
This section sets out:
- The ecological context of the study area – namely the biomes and veld types.
- The developmental context.
- Landscape classification and visual impact- noting the difference between the open low vegetation of the Western Cape and countries with large trees as elements in the landscape, allowing for visual intrusion without major visual impact. In addition, the difference in levels of development and the availability of space.
- This section also sets out current thinking on areas from which wind energy developments should be excluded, such as in landscapes of high intrinsic value, such as within the coastal plain, on hills and ridges etc.
- The section introduces a matrix of visual assessment ratings to apply to wind energy developments to assess the potential visual impact.
- A scale of 1:10 000 is proposed for the assessment of landscapes in the Western Cape.

The document sets out the criteria and the associated thresholds for landscapes, biological resources, archaeological / historical heritage, noise, shadow flicker, electromagnetic interference, aircraft, restricted areas and cumulative impacts. It introduces a proposed set of criteria that will identify sensitive areas on a regional level, without the need for sensitivity analysis. These are tabulated in the document as Table 7, and form the basis of methodology 2, and are contained in appendix 1.

5. Project description
The project entails a significant amount of work, some of which is highly complex, and is to be undertaken in three stages. The first is a preparatory stage that lays the groundwork for the later stages.

The project firstly entails the acquisition of substantial amounts of information and data, compiling this data into a logical framework and preparing a digital elevation model. The initial stage of the project also entails the clarification of the process, revision of the brief (if required) and the sharing of ideas and information between the project team and the client.

The project then entails the detailed development of the methodology for the landscape assessment (methodology 1), obtaining a range of input data including landscape element data from the field, and assessing the value of the landscape. This is followed by the delineation of areas of special and specific significance, areas of ecological importance and a range of areas of concern. The outputs are the study area divided into areas of exclusion and inclusion for wind turbine development, an analysis of the potential for wind energy developments and a factor sensitivity analysis.

The second sub-stage is the application and refinement of the regional guiding criteria and thresholds (methodology 2). This entails the input of the initial criteria and associated thresholds, as set out in the Draft Report into the GIS framework. An initial set of areas of exclusion and inclusion are generated. This is followed by an iterative process of adjustment of the thresholds. The guiding criteria are then amended and extended, and thresholds adjusted, in the light of the landscape assessment. A final set of areas of exclusion and inclusion for wind turbine development, an analysis of the potential for wind energy developments and a factor sensitivity analysis form the outputs.

The second sub-stage is completed with the comparison of methodologies 1 and 2. This entails the development of a single surface of comparison in which the output layers of the two methods are compared. This is followed by an analysis of the factors contributing to the difference, and by a small-scale test of a notional wind energy development site. A resource, cost and benefit analysis follow and the study is then completed by a synthesis that summarises the impacts of both methods on wind energy development, the development of choice criteria, and the application of these to choosing between methodologies 1 and 2.

The extent of the third stage of the project is determined by the outcome of the comparative assessment in the second stage. If methodology 2 proves robust and agrees largely with the results from the landscape assessment, then the development of a regional landscape assessment is not required. If not, then this will entail the development, costing and extension of the landscape assessment method, to link with EIA level processes.

The project is completed with the development of a site-level landscape assessment method. This entails investigation of the method requirements, and the development of a method based on checklists and simple site surveys to assess ecological context, impacts and visual impacts.

6. Key issues
Some of the key issues that emerge at this stage are:
- There is a paucity of data as expected and much spatial data is not available in any consistent GIS format and will need to be transformed.
- The environmental data and layers are critically important if the landscape is to be regarded as a living entity. The ecological importance method used generates a layer of objective value of the vegetation and hence habitats in general. This is not a composite index (unlike the CAPE layers) and is a good fit with the landscape assessment method proposed.
- Developing quantitative assessment methods for scenic impacts that measure the contributions of specific landscape elements to overall preference is a critical task. Preference measurements are limited in South Africa, and some interaction with the reference group in this regard is essential.
- There are numerous sub-outputs of the project that will be of value. The collected layers could thus be provided to interested parties.

7. Team and programme
A high level, multi-disciplinary team has been assembled to undertake the project. Skills include energy analysis, landscape architecture and landscape

interpretation, ecological sensitivity and biophysical impact analysis, data management, GIS and DEM development, visual impact analysis and Photo-montage.

The work programme is to be completed in four and a half months.

Contact: Ms Raudhiyah Waggie
Department of Environmental Affairs and Development Planning
Environmental Planning Policy
3rd Floor, 3 Dorp Street
Cape Town 8001
Tel: +27 21 483 5561
Fax: +27 21 483 4527
E-mail: Rwaggie@pgwc.gov.za

Reinhold Viljoen
CNdV Africa
E-mail: planning@cndv.co.za

Appendix 1: Quantitative criteria for the development of wind energy developments along the Cape West Coast

Noise	
See distance from housing / residential areas and distance from roads and railway lines	
Noise limit during the night	35 dB(A)
Noise limit during the day	50 dB(A)
Ambient noise level	May not be exceeded by more than 7dB
Shadow flicker	
See distance from housing / residential areas and distance from roads and railway lines	
Distance between turbines and separate wind farms	
Distance between consecutive turbines	The sum of the height of 2 turbines plus the radius of the 2 rotor blades
Distance between consecutive wind farms	2.5km
Maximum number of wind turbines within a wind farm	10
Maximum number of wind turbines within a wind farm	25
Distance from housing / residential areas	
Distance from temporary /seasonal dwellings (e.g. chalets)	350m
Distance from single dwellings	500m
Distance from isolated settlements / hamlets	750m
Distance from urban areas	1km
Distance from a city centre	5km
Distance from transportation routes	
Distance from railway lines	2.5km
Distance from well known scenic routes of significance to local tourism	2.5km
Distance from secondary / municipal roads	500m
Distance from National Roads	3km
Distance from well known scenic routes of major (national / international) significance to tourism	4km
Distance from high voltage lines	250m
Distance from radio communication, radar and navigation beacons	500m
Distance to historical sites and buildings	50m
Distance to natural reserves and other protected areas	
Distance from Provincial Nature Reserves	500m
Distance from Declared Mountain Catchment areas	500m
Distance from areas designated open space III	500m

Distance from National Parks	1km
Distance from Provincial Nature Reserves	1km
Distance from Protected Natural Environments	1km
Distance from RAMSAR sites	1 km
Distance to water bodies	
Distance from the 1:50 year flood line	200m
Distance from wetlands and water bodies of local importance	300m
Distance from perennial rivers	400m
Distance from wetlands and water bodies of national importance	1km
Distance from the coast	4km
Distance to forests	
Distance from indigenous forests	500m
Protection of fauna, flora (excluding forests) and avian species	
Distance from habitats and nesting areas of protected avian species and fauna	At least 500m
Distance from flight paths of protected species	1km
Defence constraints	
Distance from sites of national security policy	15km (must be confirmed with such agencies)
Aviation constraints	
Distance from international airports	15km (must be confirmed with such agencies)
Distance from private airfields	
Gas transmission and distribution pipes	The sum of the height of 2 turbines plus the radius of the 2 rotor blades
Mountains, hills and other elevated features	
Maximum height of elevated feature in relation to topography	A height 25m above the local topography

The Draft Report also states that: 'It is recommended that a criterion delineating the maximum height of wind turbine structures in relation to local topography be added in order to mitigate the impact of visual obtrusiveness to our unique landscapes in the Western Cape.' (p 94)

Earthlife Africa establishes Energy Policy Unit

Limited input from civil society into current energy sector developments has necessitated Earthlife Africa (ELA), Johannesburg, to establish an Energy Policy Unit (EPU), whose objective is to inform and mobilize civil society with the intention of addressing the latter's knowledge and skills gap in engaging in energy processes and policy advocacy.

The EPU has appointed as Energy Policy Officer, Sekgametsi Mandhlazi, who has previously worked with the Department of Minerals and Energy, the Minerals and Energy Policy Centre as well as the GTZ/SADC Programme for Biomass Energy Conservation. The EPU will be implemented as part of the Sustainable Energy and Climate Change Project (SECCP), and is funded by the Heinrich Boll Stiftung (HBS).

The project will run for two years, and will produce analysis of policy and implementation from the perspective of benefits to civil society.

The EPU aims to raise civil society's awareness and skills on energy policy, and provide support to advocacy through the provision of information and analysis, and making inputs to policy process and debates at national level. The unit's focus will not only be concentrated on national energy issues, but will look at how international, including SADC and NEPAD's developments, are influencing South Africa's energy sector.

On 18 August 2005, ELA/SECCP hosted an inception workshop for the Energy Policy Unit at the Elijah Barayi Training Centre, Yeoville, Johannesburg. The purpose of the workshop was to introduce the EPU and its objectives, form a Reference Group and inform the Project Implementation Plan.

Contact: Sekgametsi Mandhlazi
Energy Policy Unit
Earthlife Africa
Tel: +27 11 339 3662
Fax: 0860 686 8434
E-mail: Sekgametsi@earthlife.org.za

Harbour facility upgrades set to increase power capacity and consumption in Cape Town and Saldanha Bay

INTRODUCTION

There is a major revamp and upgrade program scheduled for areas of the port facilities in Cape Town and Saldanha Bay. The availability of facilities required to service the Oil and Gas industry in South Africa, is presently quite limited to service small and medium size vessels requiring standard repairs. With the increased facilities, much bigger vessels could be serviced at a greater level of expertise.

The implementations are that Cape Town and Saldanha Bay would see an extensive increase to profits generated from this service industry process. The closest major service hub is in Newcastle, UK. This fact would swing large drilling / mining companies favourably towards Southern Africa for their major overhauls, reducing overall repair time. The target market is mainly West Africa, but includes areas as far afield as the USA and Europe.

CAPE TOWN

A-Berth in Duncan Dock, Cape Town Harbour, was built on reclaimed land prior to the Second World War. The available quay space at this dock is approximately 200m + 50m straight quayside at a water depth of roughly 8m. The potential clients for this site are some of Cape Town's long established marine shipping and fitting companies such as DCD-Dorbyl, Globe Engineering (recently bought by Dormac) and SA5. These clients would be responsible for keeping the production yard in operation. Large drilling / mining companies would commission the site for repairs.

The National Ports Authority (NPA) has a large responsibility to keep port fees down to inspire these companies to utilise the facilities. As the main security and customs authority for the harbour, the NPA is primarily concerned with import-export, but also control the availability of quay space as well as rates levied on all ships in dock.

The City of Cape Town is also in the process of supplying power to harbour facilities, where this was previously the responsibility of the NPA. Council has taken over the supply of all commercial areas in the harbour, freeing up capacity for the NPA to extend the container terminal. The NPA currently utilises 12.5MVA and supply only the industrial shipyards and container terminal. They intend to increase this supply to 18MVA by early 2006, and are applying to Eskom for a maximum utility of 45MVA to be capable of supplying Industry for the next couple of years.

This dock will continue to service medium size vessels and drilling rigs. A list of facilities includes: lighting, warehousing, bonded stores, a general purpose fabrication shed, shore power, general purpose site power, offices, ablution, security, storage, contractors, new mess and surveillance.

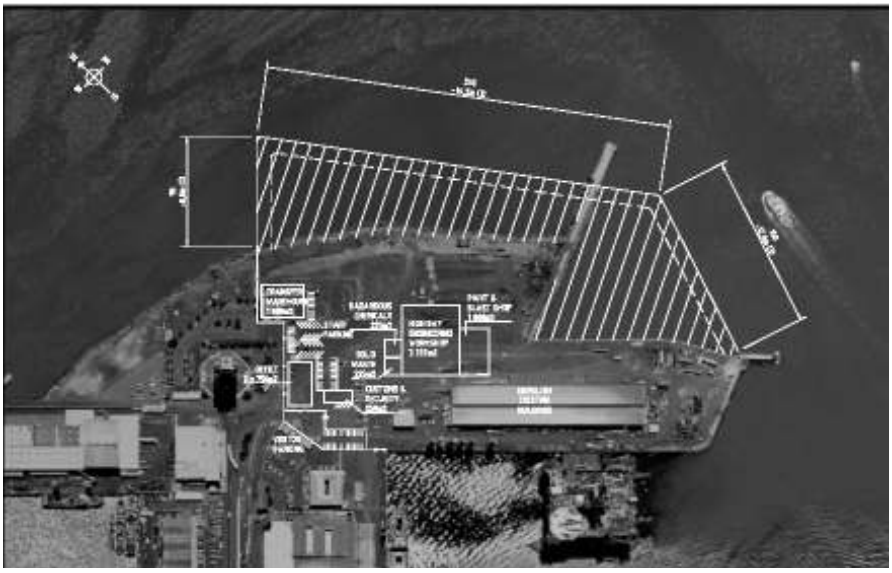
The first stage of the A-berth revamp project is scheduled for early 2006 and sees 2.2MVA supplied by the City of Cape Town. The 1st stage includes upgrading facilities and increasing the capacity of the dock. The second stage of development sees land reclaimed from the sea, the doubling of existing quay space and an additional 2MVA to cater for this double dock. The new yard will be capable of heavy repair work and lifting. It is essential to have heavy lift cranes on a site as described for loading and, while they do not consume the majority of the power, the capital outlay for such equipment is a large part of the budget.

SALDANHA BAY

The site in Saldanha Bay that is scheduled for revamp is the old Mossgas Jacket Fabrication site on the Northern Apex of the Bay, which was decommissioned years ago. Presently the NPA use the site for office space to control the surrounding steel and commercial harbour.

The site is significantly larger that Cape Town's A-Berth, and comprises large laydown areas and heavy load-out to incorporate repairs to large Floating Production, Storage and Offloading (FPSO) vessels. As the site falls inside the Saldanha Bay Council's licensed area of supply, they were asked to supply power to the site. The Council is only willing to supply 5.5MVA for the 1st stage temporarily to the site, while the Eskom is requested to increase the bulk supply to Council to accommodate the increased loads in this area.

The 3-stage development of this site will see power consumption equal to that of the entire current Cape Town harbour. As a heavy industry site, the facilities will include: a heavy welding line, additional storage as well as the facilities at A-Berth but in larger scale to manufacture stand alone pieces of equipment up to 130m in length. The



A-Berth in Duncan Dock, Cape Town Harbour

main concern with this site is the load-out. The site currently uses a skid beam to load off a very small quay space. The idea is to increase quay space to accommodate a large vessel docking alongside.

The second stage doubles the manufacturing capacity, but has no additional load-out. The third stage reclaims land from the sea to effectively triple the amount of usable quayside.

The revamp is scheduled to start early next year, and will greatly increase South African capacity to service the oil and gas industry. The NPA will continue to control customs orientated operations, and are also heavily involved in the process of upgrading the steel terminal to provide a better quality and efficiency of operation.

The initial and obvious reason for the electrical upgrade is that each site is currently rated to 500kVA, which is entirely insufficient for heavy manufacturing. There is no energy efficiency or auditing planned for either of these sites. This type of process requires an extremely large amount of power to operate for which the industry is expected to pay. They require large amounts of good quality power with convenient connectivity.

From the design perspective, Ring-Main reticulation is used on both sites as apposed to a single large power LV node. The 11kV ring main reduces losses and minimises copper in trenches, both of which can be costly. The other major benefit of ring main reticulation is redundancy. A fault on the supply line can be isolated and power returned to all facilities while repair takes place, thus outage time is virtually eliminated.

Cape Town's A-Berth uses three mini-subs for each of the 2 stages, and Saldanha uses five mini-subs and a 2MVA Transformer for stage 1, and two mini-subs and three transformers for stage 2.

WHAT'S IN THE PIPELINE?

The future sees more expansion and greater capacity for the ports of South Africa. Along with this is coupled the re-commissioning of many Spoornet rail lines to supply the areas, the merge of Eskom and Council supply authorities to form Registered Area Distributions (REDs), and a much larger throughput of shipping traffic at a relatively cheaper cost to the consumer.

This will in turn see more foreign investment and a greater willingness to trade with South Africa, while employing and educating South Africans to all levels.

Contact: Stephen Cox
Tel: (021) 510 2550
Cell: 083 540 1878
E-mail: sparkysteve@gmail.com

What was eventful at the World Petroleum Congress?

More than 3 100 delegates attended the 18th World Petroleum Congress (WPC) at the Sandton Convention Centre, Johannesburg, between the 25th and 29th September. The WPC also saw the largest Oil and Gas Exhibition alongside the congress, using a total of 15 000 square metres and making it the largest international exhibition that the centre has hosted too date.

Dr Eivald MQ Roren, President of the World Petroleum Council said: 'The Southern African International Oil and Gas Exhibition is the largest of its kind the continent has seen.'

There were a total of 231 exhibition stands of which approximately 90% were international exhibitors. Some 3 000 day exhibition visitors clocked in and out of the Sandton Convention Centre for the duration of the conference.

Three levels of exhibitors kept Gearhouse South Africa's Project Managers busy over the duration of the congress. Themed as 'Shaping the Energy Future: Partners in Sustainable Solutions', the congress featured significant global participation and, dealing with communication barriers, was just one of the challenges faced by the technical team onsite.

Having secured preferred supplier status with ITE for the WPC Congress, Gearhouse started fielding technical enquiries from exhibitors around the world from as early as June, and ended up supplying 25 stands with plasma

screens, cube walls, DVD players, audio systems and exhibition lighting in the exhibition areas, as well as lighting, power and trussing in the Ballrooms.

The main ballroom opened with the congress in the morning and then was partitioned off into three breakaway rooms during the day, requiring the lighting and trussing design to have the same capabilities. For a cleaner look, trussing was hung off 6mm steel cable rather than chain hoists and configured in a series of box trusses, with each truss carrying a separate lighting system to service the individual breakaway room.

The lighting also accommodated the Spanish design for the Closing Ceremony, which opened with a South African act and featured a symbolic handover to the Spanish team which will be hosting the next World Petroleum Congress.

Contact: Robyn D'Alessandro
Gearhouse South Africa
Tel: (011) 216 3000

Louise Marsland
Bizcommunity.com
E-mail: editor@bizcommunity.com

The potential contribution of re

Sustainable Energy and Climate Change Project (SECCP) recently commissioned independent research that made forecasts about South Africa's future energy demand, and how this could be met, particularly through renewable energy. This research is unique in that instead of making forecasts 20 years into the future, the researchers plotted the various contributions renewable energy can make over 45 years.

WHY RENEWABLE ENERGY?

Renewable energy offers South Africa a number of benefits; most notably that it can reduce our reliance on fossil fuels such as coal and oil:

- Current energy supply in South Africa is primarily coal-based and, although these resources will last for more than a century if used at current rates, large power plants will need to be replaced over the next 30 years.
- Coal has many other uses, and we need to conserve this resource for future use.
- Coal and other fossil fuels, including oil, produce carbon dioxide when they are burned to produce energy. Climate change caused by human-generated carbon dioxide and other greenhouse gases represents an extremely serious environmental threat to the world as a whole. Human-induced climate change is already being blamed for the higher-than-usual incidence of extremely damaging weather experiences (e.g. storms and droughts).
- Local air pollution is strongly related to energy supply options, with coal and oil products being major contributors to urban and rural air pollution and acid rain. Human health effects of air pollution include damage to childhood development and the respiratory system, including the increasing incidence of asthma.

Other advantages of renewable energy include employment creation[1], proximity to point-of-use and, in many cases, less reliance on concentrated sources of energy (and political power). Greater use of renewable energy would also reduce South Africa's economic vulnerability to the variable and escalating costs of imported fuels.

International and local communities are increasingly trying to find ways to shift economies towards greater reliance on renewable energy. Clear policy and regulation, including environmental fiscal reform, is needed to provide increased support for an expanded role for renewable energy in the economy, since we can't rely on voluntary schemes such as the 'Clean Development Mechanism' to prompt a significant departure from business as usual.

CURRENT AND FUTURE ENERGY DEMAND

South Africa has an energy-intensive economy, currently using more than 4 000 Petajoules[2] primary energy per annum. The economy relies on low-cost electricity and coal to power energy-hungry industries such as mining and metals processing. The renewable contribution to energy supply is relatively limited, with biomass being estimated to contribute 9 to 14 percent of energy needs (often not sustainably) and hydropower about 1 percent.

In the next 50 years, as economic development takes place, energy demand is expected to grow significantly. However, the population growth rate is expected to reduce during the next 50 years. This coupled with a greater awareness of energy efficiency and a shift away from an energy-intensive economy could reduce the rate of increase in energy demand. The researchers have therefore used a total energy demand of 6 700 PJ by 2050 against which to explore the potential contribution of renewable energy. This is just an illustrative scenario, since concerted attention and incentives for energy efficiency could deliver the same outputs from far less energy input.

SCENARIOS FOR FUTURE ENERGY SUPPLY

The researchers developed three scenarios for energy supply in 2050: *business as usual*, *progressive renewable*, and a *high renewable* scenario.

Business as usual scenario

The 'business as usual' scenario assumes very little support from decision-makers for renewable energy technologies. The scenario clearly shows that if South Africa continues along the current path, it will still need a lot of money and resources to meet the demand for energy e.g. it would need to build an Eskom 6-pack every 30 months during the years up to 2036.

This raises major environmental and economic warning flags. It also highlights the opportunity that we have as a country to prepare for the capacity crunch, and to have alternative solutions in place for implementation on a large scale. The renewable energy contribution in this scenario would be limited to a maximum of 4 percent.

Progressive renewable scenario

In the 'progressive renewable' future, the researchers tried to grow renewable energy (RE) as realistically as possible, through the growth rate of about 20% per annum. In this future, renewable energy plays a moderate role in electricity generation by 2020 (about a 13.3 percent contribution) and contributes about 70 percent by 2050.

Both the above scenarios illustrate how short time really is, particularly in light of the required growth rates for emerging industries such as solar PV, wind and solar thermal electricity. Effective large-scale industries will take time to develop and at a 20 % annual growth rate, it will take several years before they can start to add energy capacity to the grid on the scale required.

The researchers also found, somewhat surprisingly, that renewable energy options are likely to be the most cost-effective options for energy supply in the future, if rapid local development starts now. Fossil fuel pricing is particularly difficult to predict (e.g. the oil price in 2004/5), but if prices do continue to rise, it will not be long before solar thermal electricity generation technologies in particular present a large-scale, economically competitive power supply option.

newable energy in South Africa

High renewable scenario

A third scenario called the 'High renewable' scenario was then developed. This scenario looks at the options to achieve a net reduction in fossil fuel consumption by 2050, and could be considered as a climate change driven scenario. It differs in two primary ways from the 'Progressive renewable' scenario:

- It is assumed that a larger proportion of the current non-electrical energy demand in South Africa (e.g. transport, coal or oil based process energy supply in industry) can be met by electricity (produced using *renewable* resources).
- It is assumed that hydrogen can be generated from renewable resources on a large scale, starting within two decades. This can be stored, transported and used as required, much like coal, oil and natural gas – thereby replacing a significant part of the remaining non-electrical demand.

In this scenario, the researchers modelled significant growths of RE – showing that it would be possible for between 90% of South Africa's electricity and 60% of South Africa's total energy mix to be generated from RE sources. To achieve such a long-term transition requires that South Africa start to develop the foundations in the short term. While considerable costs will be involved, they will be investments in the local economy that have massive social and environmental benefits.

As shown in Figure 1, renewable energy has the potential to meet 60% of South Africa's total energy mix by 2050. In particular, the researchers grew the potential of biomass and hydropower, while noting that there are environmental and human rights constraints that would need to be taken into account.

The illustrative increase in supply allows scope for economic growth, particularly given South Africa's enormous potential for efficiency improvements.

The researchers regard achieving the *progressive renewable* scenario to be very challenging. For South Africa, to make the necessary shifts in the energy economy to achieve something like the *high renewable* scenario would be significantly more difficult. However, if the total energy requirement of the country is allowed to increase to 6 700 PJ by 2050, then investments in energy supply will in any event be very large. It is possible to develop the economy using approaches that do not require such an increase in energy consumption, and if energy efficiency can be effectively promoted at all levels, then the average annual growth in energy demand could be reduced, or even pushed into the negative. This would obviously make it far easier to reduce the total fossil fuel contribution, without stretching the renewable energy resources and technology production facilities as much as indicated in the *progressive or high renewable* scenarios.

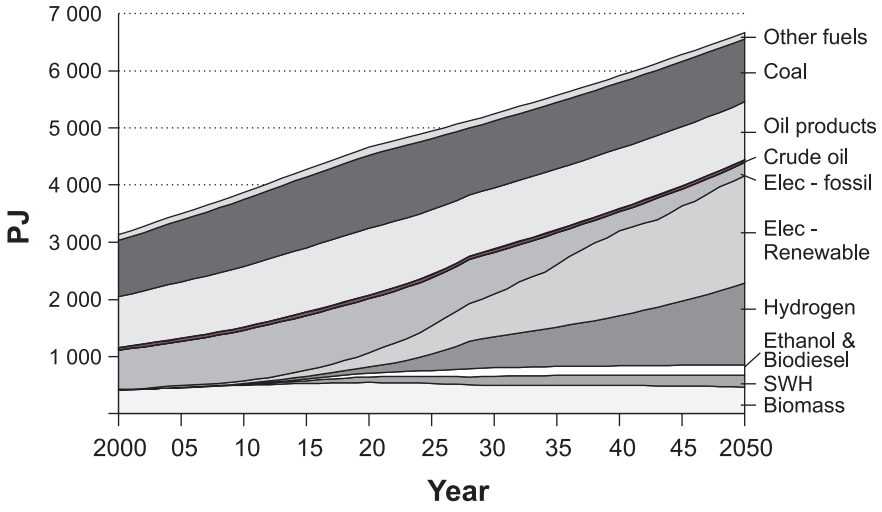


Figure 1: High Renewable Scenario: Total energy supply mix

CONCLUSIONS

The researchers concluded their findings with four points:

Firstly, they highlight that this research provides clear evidence that there are sufficient renewable energy resources in South Africa to provide for 13 to 20 percent of the electrical demand by 2020, and easily 70 percent or more by 2050.

Secondly, they identify two key weaknesses in existing energy plans:

1. Very little long-range planning is being undertaken in South Africa. Given the possible large-scale changes in the energy supply system indicated in the scenarios, they feel that this is a critical oversight.
2. Although the recent National Electricity Regulator's (NER) Integrated Resource Plan did take some account of large-scale renewable generation potential, it seems to have been done as an afterthought. It appeared to rely on a very limited range of technologies and cost / resource analysis that lacked detail. Electricity and energy planning should anticipate longer-term cost and policy trends, and seek to integrate sustainable energy planning more fully into the process.

Thirdly, the three scenarios illustrate how short time really is, particularly in light of the required growth rates for emerging industries such as solar photovoltaic (PV), wind and solar thermal electricity. Effective large-scale industries will take time to develop. Even at a 20% annual growth rate, it will take several years before these industries can really start to add generation capacity to the grid on the scale required.

There is an interesting development of the technology selection process in the scenarios. Initially, lower cost options, such as biomass, landfill gas

and selected wind sites, are more attractive than solar and large-scale wind. However, because these low-cost options have a limited resource base, it is very important to balance development efforts – first harvesting the lowest cost resources, but at the same time developing the necessary technical capacity to harness the larger scale solar and wave technologies.

Finally, although not specifically explored in detail, energy efficiency is clearly identified as a crucial element in energy planning. If the South African economy is allowed to grow in such a way that energy intensity per unit of GDP remains similar to current levels, it will have adverse environmental and economic implications. Even the current growth rates used by the Department of Minerals and Energy (DME) and the NER for planning would result in a tripling of energy demand if extended through to 2050. The scenarios explored in the report assume that total energy increases by slightly more than double by 2050. It would be prudent to use energy efficiency measures that allow economic growth, but with more limited energy demand growth.

Notes

1. The employment potential of renewable energy, shows that 36 000 new direct jobs would be created if just 15% of South Africa's electricity was generated from renewable energy.
2. One Petajoule is equivalent to 277 777 777 kWh – an enormous amount of energy.

Contact: Claire Taylor
Sustainable Energy and Climate Change Project
A project of Earthlife Africa – Johannesburg
P.O. Box 11383, Johannesburg, 2000
Tel: +27 11 339 3662
Fax: +27 11 339 3270 or 086 686 8434
E-mail: claire@earthlife.org.za
Website: www.earthlife.org.za/seccp

Monitoring South Africa's renewable energy target

The South African government has established a target for the role that renewable energy will play in the energy generation mix in South Africa. This target is documented in the Cabinet approved White Paper on Renewable Energy, (Nov 2003). The target is stated as 'an additional 10 000 GWh of renewable energy contribution to final energy consumption by 2013'. The renewable energy is to be utilised for both power generation and non-electric technologies such as solar water heating and biofuels.

Progress towards achieving the target will need to be monitored on a periodic basis, to determine the effectiveness of measures and technologies employed through policies such as the national renewable energy strategy. Therefore, an effective monitoring model needs to be developed and put in place.

As part of the DANIDA funded Capacity Building in Energy Efficiency (EE) and Renewable Energy (RE) (CaBEERE) initiative within the Department of Minerals and Energy (DME), a project was initiated to set a renewable energy target monitoring endeavour underway. This project is being undertaken by a consortium led by Nano Energy. As part of the project, a stakeholder workshop was held on the 26 April 2005, to present a draft data collection methodology, identify both data providers and information recipients and capture their inputs on a target monitoring system.

Most workshop participants were not yet producing (or consuming) renewable energy but developing projects. As potential data providers, their inputs were valuable for at least two reasons. The first is precisely for their inputs on their preferences as future data providers. The other is in terms of the broader monitoring framework's need to capture the non-numerical aspects, such as reasons for the lack of uptake of renewable energy, and the feedback of these into the design of implementation strategies supporting renewable energy.

The workshop highlighted that the monitoring system should seek to be more concrete or official than that through which data is currently garnered through individual relationships and on an ad hoc basis. The responsibility for data collection rests with the DME and use of external service providers is one of the options explored in terms of collection of data.

Contact: Brett Dawson
Director – Renewable Energy
Department of Minerals and Energy
Tel: (012) 317 8617
E-mail: brett.dawson@dme.gov.za

Helene Gron
CaBEERE Project
E-mail: Helene.Gron@gov.co.za

Is there a future for oil?

In June, Peter Vernon asked 'Is there a future without oil?' He had fallen under the spell of Richard Heinberg, a persuasive Californian academic. Heinberg, says Vernon, 'gives particular attention to the economic, social and political consequences of a decline in the availability of petroleum.' In other words, he has an axe to grind, and it is very necessary that he be challenged. I hope to do that.

Petroleum, claims Heinberg, is a finite resource. That, of course, all depends on what you mean by a 'resource.' A common definition is 'A body of a potentially valuable mineral or hydrocarbon.' In contrast, a 'reserve' is 'A resource from which it is generally economic to produce valuable minerals or hydrocarbons.' At any one stage, we are able to calculate our reserves, because they have an economic base – but how do you estimate the resources, which are only potentially valuable? You may have some oil in your back yard, but it is a wasted resource unless you can find some means of making use of it. In a nutshell, the claim that we have finite resources is a chimera – because the resource is unquantifiable, it is in essence infinite. We have finite reserves, which is something quite different.

How is it different? Well, for one thing, it has to be 'generally economic' if it is to be part of the reserve. That means that if the price you are willing to pay for something goes up, then some of the uneconomic resource will become part of the reserve – the reserves will increase. This is just what happens with petroleum. In Figure 1, I show the data on the proved reserves of crude oil over the past 25 years, which have increased from a little over 600 to nigh 1200 billion barrels of crude oil. The surge from 800 to over 1000 billion barrels was a reflection of the high oil prices in the early '80s.

During this time, consumption initially dropped, a reflection on the increase in the price of oil in the late '70s/ early '80s. Since the mid-80s, it has risen fairly steadily and now amounts to about 80 million barrels a day. However, in spite of all this consumption, the increase in the size of the proved reserves has meant that we have moved from less than 30 years of reserves in the early '80s to over 40 years today.

Now if you want oil, you have to go out and drill. You need geologists to tell you where to drill, and big machinery to do the drilling. Oil drilling technology is expensive and surprisingly sophisticated. Holes go down at surprisingly high rates, and they not only go down, they go round and can be guided horizontally to and accuracy of less than 1m. These are modern developments, and one of the reasons why our success rate has gone up.

So you have to spend money to find oil, and if you are going to spend money finding it, you will want a return on what you have found.

Have pity on the people who found those thousands of billions of barrels that are in our present reserves. They are going to have to wait over 20 years, on average, before they see any return on their investment in finding the oil. Some will have to wait 40 years, if the consumption doesn't increase. So people aren't going to dash off to find more oil just because Heinberg says we are running out, because they might be dead before they start to get their money back.

But there is another reason why our reserves have gone up and up and up. That is better methods of getting the oil out of the ground. It was not unknown, fifty years ago, for as little as 10% of the oil-in-place to be recovered. Today, we have developed methods for squeezing more out of each well, and 50-60% is not uncommon.

Suppose Heinberg was right. What might stimulate the search for further reserves? One thing for sure – a higher oil price. In Figure 2, I show the world-wide oilrig count and the number of rigs in active exploration, over the past 30 years.

In the late '70s/ early '80s, exploration peaked with nearly 6000 rigs active. Oil was found – lots of it – and by the mid '80s, it was in production as well as being part of our proved reserves, as Figure 1 shows. Having hovered around 2000 rigs for the past 15 years, the recent crude price increases have seen the number of rigs move up closer to 3000, and we should soon see our reserves move up again.

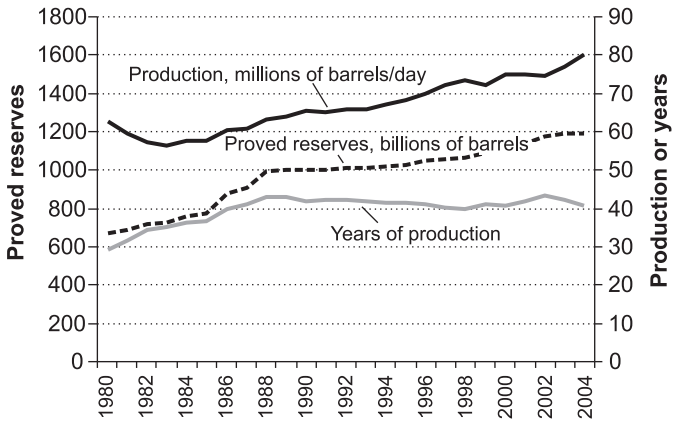


Figure 1: Proved reserves, daily production, and years of current production in reserve
Source: BP Statistical Review of World Energy 2005

Is there any indication we are reaching the end of the resource, as Heinberg would have us believe? I think not. We are about to see another huge surge in the proved reserves. The present oil price is such that alternatives such as tar sands have moved from resource to reserve status. In Canada alone, there is something of the order of 250 billion barrels of oil equivalent in tar sands.

If we are awash with oil, how come the price is so high? One of the problems is that there has been little investment in new refining capacity worldwide in recent decades. South Africa's crude oil refineries now average over 45 years of age. Figure 3 shows how slender the reserve is in the US. A little hurricane or two makes the picture really bleak. If America has to import large quantities of refined products, petrol and diesel, it will push up the price for all of us.

Much of Heinberg's gloom arises from the fact that the US really has seen an enormous drop in its production potential. However, this has to be seen against the backdrop of exploration for oil in the continental US. Figure 4 gives the global density of oil and gas wells. There are areas with over 6 per km^2. Elsewhere on the globe a well every 10 km^2 is a lot.

Am I being unduly optimistic? Isn't Heinberg the sort of authority who must command attention? Well, if you doubt my analysis, hear what the US Energy Information has to say (US Energy Information Administration 'Long term world oil supply – a resource base / production path analysis' www.eia.gov 2002):

> Using a relatively simple algorithm, peak production years were estimated. The peak production year estimates ranged from 2021 to 2112 across the 12 scenarios. For example, using the USGS mean (expected) resource base estimate (3 003 billion barrels) and an annual production growth rate of 2 percent (similar to the current rate), the estimated peak production year is 2037.

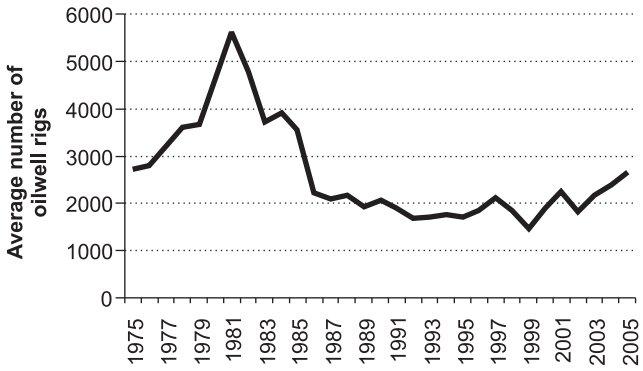


Figure 2: Annual average oil rigs in service
Source: Baker Hughes Inc: Worldwide Rig Count, Aug 2005

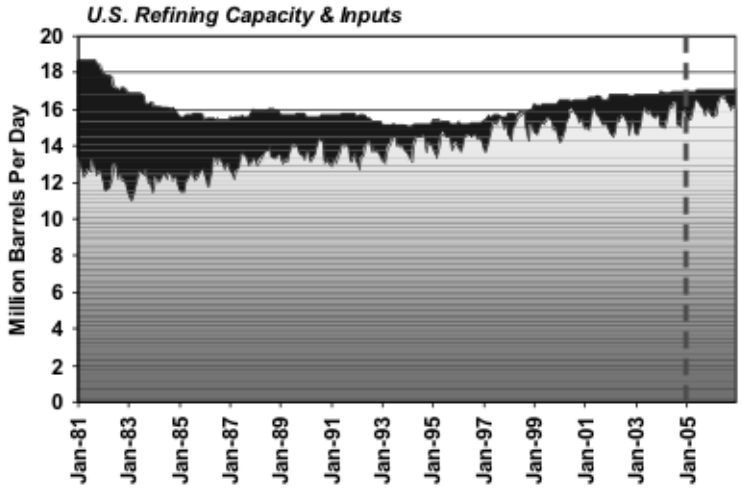


Figure 3: US refining capacity (upper curve) versus demand (lower)
Source: U.S. Energy Information Administration

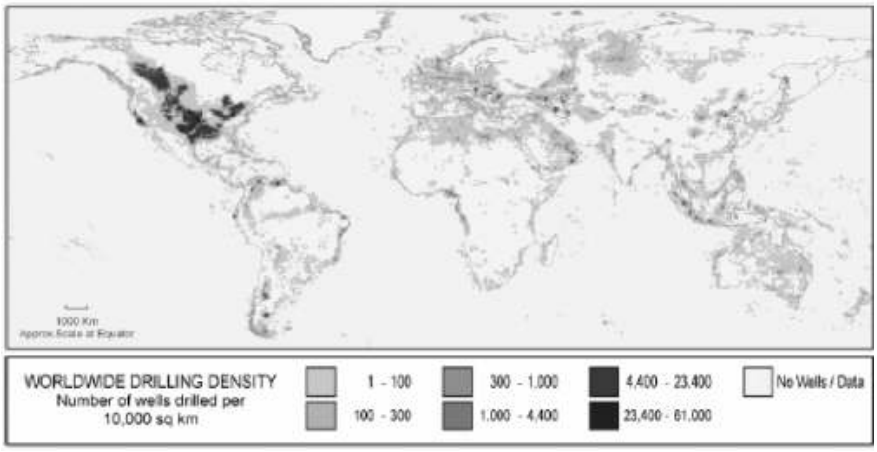


Figure 4: World oil and gas well distribution and density
Courtesy of IHS Energy

● *Contact: Dr Philip Lloyd*
Energy Research Centre (ERC)
University of Cape Town
E-mail: plloyd@eng.uct.ac.za

Oil and the future: some problems to contend with

Fears of crude oil depletion, with dire economic, social and political consequences, are by no means new. Following Malthus's classical work on immutable and universal law governing the relationship between population and resources, there has been a series of works on the apocalyptic vision of the future of mankind as oil resources run out. High crude oil prices often provoke 'pessimists' who warn of a finite stock of crude oil resources whose reserves are known with certainty and which cannot be augmented.

Heinberg hums this doomsday chorus, and his presentation is in harmony with that of the 'Club of Rome' and the other prophets of doom. The underlining message Heinberg heralds is that oil production will soon reach its peak and the world will one day run out of petroleum thus posing a threat to modern civilisation and economic development.

Heinberg argues that the governments, business leaders and economists of the world deny that any problem exists and that they behave as if 'business is as usual' and market forces will produce adequate solutions. It is not surprising that one of his books is entitled 'The Party is Over', followed by another 'Powerdown'. This situation may seem more threatening given sustained economic growth and high growth in oil consumption in India and China.

Heinberg's position cannot be left unchallenged and without questions. Are we facing a catastrophe and are the economies about to grind to a halt with grim prospects of 'the Last Man Standing'? And is there any comfort in his 'Sermon on the Collapse'? Rather than answer these questions directly, we revisit the pessimistic position on resources, discuss the optimistic school, and point out some problems in resource modelling from which results are drawn. This will give us an insight about some pitfalls in Heinberg's arguments.

THE PESSIMISTIC POSITION

'Pessimists' contend that oil resources are finite. Reserves are seen as static and the peak period for making new discoveries is viewed as long past (the 1960s), and from that time the discovery of new oil deposits have been in a steady decline and estimates of reserves yet to be found being low. The rate of new discoveries, on the other hand (particularly during the 1990s), is too slow and decline in production is imminent. Furthermore, improvements in recovery rates are accelerating, exhausting of ultimate reserves.

Convinced by the results in world models, Heinberg and other pessimists argue that doom lies ahead unless we act to avert the crisis. Key to the pessimist thinking is the view that oil production starts to decline at about half the reserves being produced, an assumption that production will follow a variant of the Hubbert curve. But there are technical reasons why production may follow this curve and then become uneconomic. In essence, this suggests an economic rather than a physical limit to production, implying the resource is still in the ground but that it is not economically feasible to extract it.

Obviously, fixed oil supply plus demand growth spells danger, and can be equated to depletion and increasing economic scarcity. This can only be frightening if the assumptions and models yielding these results take into account all the variables that influence resource availability and relax the rigid assumption of resource fixity. Faced with a dynamic resource base and comprehensive models for estimation, the alarmist threat of the need to cut industrial production now and to force the developing countries to forgo industrialisation would be down played.

THE OPTIMIST SCHOOL

There are many central issues concerning the nature of production which are completely overlooked by the pessimistic school. For example, they overlook the powerful interaction of dynamic forces such as the role of price mechanism, technological progress in resource availability, goverment policies, and the fact that resources are also a product of social choice – all making the resource base simply enormous. Higher prices make high cost resources economically feasible, with high prices resulting in stronger financial incentives for resource producers to seek and develop new supplies. But this requires both geological and economic factors to be in favourable balance since no oil can be produced if it is not available geologically and unless extraction technologies reduce costs.

As prices increase and technology improves, so previously uneconomic resources become part of an effective reserve. This is because high prices and improvement in extraction tech-

nologies encourage a resource movement from 'probable' to 'proven' reserves and from 'possible' to 'probable' reserves. Similarly, as oil resources become scarce, their prices rise, and this encourages entrepreneurs to search for cheaper substitutes. Of course, there is always some degree of uncertainty about the success of this search. In this light, resource availability is positively correlated to consumption.

The important point is that the market generates signals and incentives to ensure that discovery and substitution are carried out with sufficient intensity, indeed not ruling out the complications associated with the behaviour of markets under uncertainty and endogenous information. The search for new oil fields may even be at places that have been previously avoided, such as the Arctic region or in deep waters. Reserves and resources are not absolute as in the thinking of 'optimists', but are also functions of the state of knowledge, expanding capital, and economic conditions at the time estimation, and these variables are never constant. Furthermore, reserves are known to shrink with war, strife, taxation and other access restrictions. Since we cannot determine future oil prices with absolute certainty, precise quantification of reserves becomes hazardous.

RESOURCE MODELLING

It is therefore not logical to take current proven reserves as the limit of resource availability. It is further misleading to use a life statistic index that if available known resources equal to Z, and annual consumption equals to Y, reserves will peak in year X* and eventually run out in year X = Z/Y. These deterministic models give a static physical dimension to the dynamic resource concept, and are essentially Malthusian in nature.

Like other deterministic models, which may enable calculation of optimal extraction rates, they do not give a prominent role to dynamic forces (already mentioned above) that influence resources availability. Such models make a naive assumption that the response mechanism to resource scarcity, with a potent danger to economic development, does not exist or acts slowly, in contrast to the optimist's position that the market system would respond automatically to prevent the problem of exhaustion. Responses take the form of market responses and the role of substitution.

Increased production costs (either because of scarcity or high extraction costs) would make producers to supply less to the market at existing price levels, with prices rising until equilibrium between supply and demand is re-established. This higher price sets in train a series of demand, technological and supply responses: cheaper substitutes to oil are encouraged; the high price provides an incentive to innovation with technological changes increasing the availability and reducing the cost of substitutes thus reducing pressure, via the price mechanism, on the scarce commodity; higher prices lead to the exploitation of previously uneconomic resources, a search of new supplies and development of extraction technologies. Substitution can take various forms: some current dominant source of suppliers can be replaced by new ones; alternative energy sources (e.g. gas) may claim an increasing share in the production of goods and services; and lifestyle demand changes may alter the mix of final goods and services. Heinberg's notions of physical scarcity or 'Powerdown' with catastrophic collapse of society therefore seem ill founded.

CURRENT OIL PRICES

A significant proportion of the world supply of oil is controlled by OPEC. Oil pricing strategies have changed with time, were determined by international oil companies up to about 1974, then passed on to OPEC up to about 1986, and ultimately determined by future markets from then on. Historical price spikes of crude oil can be better understood in terms of a cartel of oil producers, deliberately cutting back on production in order to raise the world price or in terms of other market factors. The price spikes have never been a depletion signal.

Crude oil prices are high currently because the petroleum infrastructure is over-stretched and because of refinery constraints in processing heavier crudes, and these high prices are not triggered by a global shortage of crude oil. The fundamental control by OPEC producers still cannot be disputed, since these economies are depended on oil export revenues. As in any rational sense, unless some revenue objective is met, oil will not be supplied. Whether this is rationalised as a 'holding value' against the alternative of future production or simply described as a 'royalty', the point is that some elements in price are governed by politics as much as by economics. This also holds for non-OPEC as high cost producers with low holding values. Most low cost producers (for example, Gulf OPEC) have high holding values and will shut in supply to achieve them. Mexico and Norway, other non-OPEC producers, demonstrated in 1998-99 that they are likely to act the same way given very low prices.

FINALE

At the extreme, any continual reduction in the supply of oil is represented by a series of shifts of the supply curve to the left and an associated move along the demand curve, with the new equilibrium price at a higher level with reduced output. This will make the market for gas attractive.

Even with the emergence of gas on a wider scale, there will still be plenty of oil in the ground, but consumers will be having a choice of an alternative that makes more economic sense to them.

Contact: Dr JC Nkomo
Energy Research Centre
University of Cape Town
E-mail: jabavu@erc.uct.ac.za

NEPAD develops short term action report

NEPAD has circulated a short-term action report, which includes an energy focus. This article summarises this report.

1. INTRODUCTION

One of the main priorities of NEPAD is the promotion of regional integration on the African continent, because individual African economies are typically too small to generate the economies of scale that can be found in larger markets. Bridging the infrastructure gap has been identified as an important element in promoting regional integration in Africa.

In developing the action plan, the approach adopted by NEPAD is two-pronged: a short-term action plan has been developed based primarily on a survey of the infrastructure projects and initiatives in the countries, and included in the programs put forward by the regional economic communities (RECs). For the short term plan, the main emphasis has been on selecting projects and initiatives, with a strong facilitation element.

The project selection process was guided by the following criteria: projects that are at an advance stage of preparation and that can be fast-tracked; projects that support both a regional approach to infrastructure provision and regional integration; projects that have stalled for political reasons and where NEPAD's intervention could be expected to make a difference; and initiatives that offer solutions to regional policy, regulatory or institutional constraints to infrastructure development. The Short-term Action Plan will be linked to and complemented by a Medium- and Long-term Action Programme that will take up projects and initiatives that require more time for preparation and development.

The role of NEPAD in ensuring the successful implementation of the Short Term Action Plan will be: a) Mobilising political will and actions to implement policy and institutional reforms in the sectors; b) Facilitating the mobilization of resources for regional projects; and c) Facilitating knowledge sharing, networking and dissemination of best practices among countries, RECs and technical agencies.

2. ENERGY SECTOR

The challenge for NEPAD's Energy Infrastructure Initiative is to develop fully the energy resources of the continent in order to deliver affordable energy services to economic and social sectors. This will enhance economic and social development and improve the standard of living for the continent's population.

Under the Initiative, the continent's rich energy resources will be developed through regional cooperation. Guaranteeing a sustainable supply of affordable energy will contribute to a significant reduction in poverty, inequality and environmental degradation.

The projects identified in the Short Term Action Plan include the following:

- Mepanda Uncua Hydropower
- West Africa Power Pool (WAPP) Program
- Algeria-Spain Interconnection & Algeria Gas-fired Power Station
- Mozambique-Malawi Interconnection
- Gas / Oil Transmission Projects
- Kenya-Uganda Oil Pipeline
- West Africa Gas Pipeline (WAGP)
- Libya -Tunisia-Gas Pipeline Studies
- Grand Inga Integrator
- DRC – Angola-Namibia Interconnection
- Nigeria – Algeria Gas Pipeline
- Cooperation in oil and gas trade, and refining

Two sustainable energy activities:

- Cooperation in new and renewable energy
- Cooperation in improving energy efficiency and reliability of supply are noted, though no further details are given.

The list of projects also includes:

- Capacity Building, which `is intended to operationalise and strengthen the African Energy Commission (AFREC) and build capacity in the sub-regional organizations. As regards AFREC, it is intended to transform the institution into a legal entity through the ratification of the Convention and operationalise it through the appointment of the Board and the Technical Advisory Body by providing the appropriate technical support to discharge its responsibilities.'
- Facilitation Projects, which `will promote reforms and cooperation among African countries, donors and the private sector for energy infrastructure development.'
- An Energy Protocol, which `will assist in attracting more, less costly investment, as it will include establishing legal, regulatory and institutional frameworks, assisting in providing the necessary enabling environment to attract investors. This will help to reduce the risks and enhance the perceptions of investors with respect to private sector investments.'

Contact: Claire Taylor
Sustainable Energy and Climate Change Project (SECCP)
P.O. Box 11383, Johannesburg, 2000
Tel: +27 11 339 3662
Fax: +27 11 339 3270 or 086 686 8434
E-mail: claire@earthlife.org.za

DEAT addresses sustainable development

Two recent workshops were held by the Department of Environmental Affairs and Tourism (DEAT) to address sustainable development.

The first was to get input to South Africa's Country Report to the Commission for Sustainable Development (CSD 14 & 15). The themes of the next 2-year cycle are Energy, Atmosphere / Air Pollution and Industrial Development. The way forward proposed a revised version of the report in early August. The final report was due in New York before the end of August. The report will try to balance a positive image of national progress, with an account of challenges and needs to provide motivation for development assistance. Review activities under CSD 14 (2006) will provide the basis for outcomes to be decided at CSD 15.

A national commitment under the Johannesburg Plan of Implementation (JPOI) adopted at the World Summit on Sustainable Development (which was the tenth sitting of the CSD in 2002) is to produce a National Strategy for Sustainable Development (NSSD) by the end of this year. DEAT held a `high-level expert roundtable-discussion' north of Pretoria on 4 August to take input into the document, a draft of which should be ready in advance of a national stakeholder workshop to be held in November.

It seems clear that the final text will try to please all stakeholders but avoid treading on the toes, or affect the competencies of other departments. The greatest challenge remains for a relatively minor department to forge the kind of inter-departmental co-ordination and broad political commitment that is a prerequisite for a decisive shift towards sustainability.

The NSSD will contain: a vision and mission statement; trends analysis (with 20 years considered as the long term); assessment of risks and opportunities; a plan of action (which will `seek to identify clear goals and targets'); a framework for monitoring and evaluation; a Compact and a declaration or statement of intent.

Perhaps the most interesting component for NGOs to engage will be a set of sustainable development indicators as part of a framework for `evaluating corporate social responsibility and sustainability'. A concern of several delegates was how to influence major infrastructure investments, such as Coega and its proposed aluminium smelter (which will make our economy even more energy and carbon intensive) and Eskom's proposed new 4 800 MW coal-fired power plant, using conventional technology.

Contact: Blessing Manale
Department of Environmental Affairs and Tourism
E-mail: Bmanale@deat.gov.za

Building Energy Audit Training Course

18 – 21 October 2005, Emperors Palace (Caesars), Gauteng

The Energy Training Foundation (ETF), in conjunction with the North-West University, is presenting a new Building Energy Audit Training Course. This is a four-day skills development programme that was developed by the Department of Minerals and Energy (DME). It is registered with the Energy Sector Educational and Training Authority (ESETA).

Target groups that will benefit from the training are:

- Energy Service Companies (ESCOs)
- Service providers
- Facility managers
- Building managers
- Maintenance personnel
- Property owners

The building energy audit training consists of two elements:

1. The Building Energy Audit Training Course aims to develop the skills and knowledge required of individuals that conduct energy audits in government and other commercial buildings.
2. The Supervising Engineer's Course aims to develop the skills and knowledge required of engineers, who will manage and monitor the audit programme.

The first three days for both courses are exactly the same. Trainees for both courses attend the same class. On the fourth day, the trainees for the building energy audit training course will have a theoretical exam and practical evaluation session. Trainees attending the supervising engineer's course will continue within class training.

Course contents:

- Basic principles of energy
- Overview of building energy audits
- Historical energy assessment
- Analyzing the demand profile
- Energy assessment methodology and approach
- Energy efficiency in electrical and thermal building systems
- Business case development and reporting
- Audit quality assurance (supervising engineer's course only)
- Project development cycle (supervising engineer's course only)
- Measurement and verification (supervising engineer's course only)

A discount will apply to The Southern African Association for Energy Efficiency (SAEE) members only.

Contact: Christina den Heijer
Cell: +27 (0) 82 334 0923
Fax: +27 (0) 18 2947 174
E-mail: cemanager1@intekom.co.za

Establishment of the Matimba B power station

This project proposes the establishment of a new coal-fired power station in the Lephalale area, Limpopo Province. The power station may ultimately have a maximum installed capacity of up to 4800 MW, but the first phase will be approximately half that installed capacity.

The exact output will depend on the specification of the equipment installed and the ambient operating conditions. Bohlweki Environmental Consultants are currently undertaking an Environmental Impact Assessment (EIA) in order to identify an appropriate site for the establishment of the proposed new coal-fired power station, and to assess the potential impacts associated with the project. The footprint of the proposed new power station is still to be determined through final engineering and design, but would be approximately 700 ha for the power plant and associated plant (terrace area), and an additional approximate 500 - 1000 ha for ashing facilities (ash disposal options are currently being investigated).

Screening and feasibility studies undertaken by Eskom identified the Waterberg Coalfields, Limpopo Province, as the most viable option for the sitting of a new coal-fired power station. The Lephalale area in the vicinity of the existing Matimba Power Station ranked as the most favourable site for the establishment of a new coal-fired power station because:

1. Land availability is in close proximity to the primary coal source.
2. Coal in the area would be competitive with current coal prices, and the availability of alternative ash disposal options.

A Stakeholder Consultant Meeting was held on 27 June 2005 at the Eskom Convention Centre. The EIA meeting aims to provide information to and get input from Interested and Affected Parties (I&APs) on the proposed 4800 Mega Watt coal fired power station to be built in Lephalale, Limpopo. There were fifteen participants at the meeting, the bulk of which comprised Eskom and Bohlweki Environmental Consultants. No documents were made available to the stakeholders, except for a background information document describing the project sent to I&APs.

A full set of minutes and presentation was to be sent to the I&APs in July, and the following is a summary of the meeting:

- Bohlweki Environmental Consultants emphasised that a full Environmental Impact Assessment process will be followed as laid out by legislation.
- The assumption is that the plant with an estimated 50 year life span will be constructed in 2007 and be operationalised by 2010.
- Regarding the technology to be utilised, Eskom has decided on pulverised fuel technology based on economic and technical considerations, despite the fact that the project is still in the stage of environmental scooping.
- Although the Terms of Reference for specialist studies will be circulated to Interested and Affected Parties, the report on the pre-feasibility studies will not be made public.

Bohlweki Environmental Consultants noted that all the issues raised by the I&APs present in the meeting, will be taken into consideration. The minutes of the meeting would be sent to I&APs and be made public.

● *Contact: Nkosana Rakitla*
E-mail: nkosana@earthlife.org.za
Website: http://www.bohlweki.co.za/

Open Day at the Namibian Habitat Research and Development Centre

The Habitat Research and Development Centre (HRDC) hosted an Open Day on 23 July to which it invited the general public. The Open Day aimed to raise awareness about alternative energy technologies for Namibian homes, in the light of Namibia's uncertain energy future.

The event attracted over 15 Namibian companies exhibiting their products, which ranged from solar electricity systems, solar water heaters, solar cookers and solar water pumps, to wood saving cooking technologies and conversions of petrol car engines to run on LPGas. These technologies would decrease the expenses on current conventional energy consumption, provide modern energy services to unelectrified households and reduce the negative environmental impact of energy generation and usage.

The HRDC is a result of cooperation between the Ministry of Regional and Local Government and Housing and Rural Development, the National Housing Enterprise and the City of Windhoek. The Centre incorporates a wide range of appropriate building designs, low-cost building materials, cost-effective waterless sanitation, renewable energy technologies and energy efficiency applications. The event offered hourly guided tours of these facilities, which were conducted by Dr Andreas Wienecke, Research Manager at the HRDC.

Dr Wienecke stated that 'The HRDC clearly demonstrates how materials, discarded as waste by others, can be utilised as efficient building materials.' According to Dr Wienecke, the HRDC is unique in Southern Africa, because it incorporates so many features under one roof. Dr Wienecke expressed disappointment with conventional building designs, since they incorporate very little sustainability considerations, are too expensive to maintain and are wasteful. 'We should consider offering an annual award for the most inappropriate buildings in Namibia,' Dr Wienecke proposed, 'Similar to the South African Annual Corpse Awards offered to South African corporations for categories like 'Sustainable Catastrophes', Picking the Public Pocket' and 'Failing the Future''.

Research conducted at the HRDC intends to promote sustainable living and the Open Day incorporated two short presentations on `Low-cost insulation techniques for housing' and `How to save money with energy efficiency'. The insulation presentation, by Mr Mncomi Mawisa, HRDC Researcher, showed how the indoor temperature of a house can be effectively insulated from fluctuating external temperatures. This results in cooler temperatures during hot summer months and warmer temperatures during winter nights, without consuming energy.

The energy efficiency presentation was conducted by Mr Robert Schultz, an independent energy researcher associated with the HRDC. Schultz incorporated energy efficiency at his house and his average electricity consumption over the last 32 months cost him an average of N$ 120 per month, while still using every modern electricity appliance. Furthermore, his consumption continues to decrease three-times faster than the increase in electricity tariffs. Schultz's presentation highlighted the excessive hidden costs for credit meters at households. 'Prepayment metering allows you to monitor your consumption and be financially rewarded for saving electricity. It also allows you to buy electricity in advance at current tariffs. This offers some protection from tariff increases. It is like using your electricity next year, for the price you paid last year!' A significant energy saver is the use of energy saving lights, which pay for themselves in less than half a year, but operate for

Ms Secilia Nashudlame receiving a Tso Tso wood saving stove from Mr Robert Schultz. The Open Day offered wood saving stoves and battery-free torches as prizes to the public
(photo: J Korrubel)

Rakkel from Valombola Vocational Training Centre receiving a Tso Tso wood saving stove from Mr Jacques Korrubel, Director of the HRDC
(photo: R Schultz)

Solar Water Pumps and Solar Water Heaters were amongst the different technologies displayed at the HRDC's Open Day. Solar Water Heaters are effective electricity savers and have a break-even point of 3 to 6 years in Namibia. The heating of water accounts for about half of a household's energy consumption.
(photo: J Korrubel)

three to five years. With the incorporation of a solar water heater, Schultz calculated that he would save an additional N$ 90 every month. 'My personal ambition is to have a monthly electricity expenditure of less than N$ 50, without compromising in any way on my lifestyle. I will have achieved this within the next 2 months.'

Schultz maintains that 'We urgently have to learn to invest our money in things that save money. We have to invest in assets and not in liabilities!'

The Open Day was a great success according to the HRDC Director, Mr Jacques Korrubel. Korrubel envisages that the event will be held at least bi-annually, so that more of the Namibian public can be exposed to the work that the HRDC is doing.

Contact: Robert Schultz
PO Box 40765, Windhoek, Namibia
Tel: +264 (0)61 268 222
Fax: +264 (0)61 268 201
Mobile: +264 (0)81 244 3063
E-mail: energy@r3e.orG

Preparing Namibia's solar future

The Ministry of Mines and Energy, through the Namibia Renewable Energy Project (NAMREP), released its findings on a recent study conducted to establish the current level of implementation of various solar energy technologies in Namibia. This was done during a stakeholder workshop held in late-July in Windhoek.

The workshop attracted the participation of solar energy suppliers, civil society organisations, NGOs and solar technicians from across the country. The workshop was opened by the Deputy Director of Electricity, Ms Selma-Penna Utonih, Ministry of Mines and Energy. Ms Utonih emphasised the abundance of solar energy in Namibia, and that this resource still remains largely untapped. NAMREP was established through funding by the Global Environment Facility, and aims to identify and resolve the most pertinent barriers to the greater implementation of solar energy and other renewable energy technologies.

The study revealed that solar energy technologies such as solar water pumps, are already more cost effective in the medium to long term and, under some conditions, are indeed cheaper to purchase and install than conventional energy systems. There are an estimated 15 700 boreholes in Namibia for which the initial costs of a solar energy option would be less expensive than for a diesel operated water pump. This applies specifically to boreholes with a requirement of less than 5 m³ per day, and with water levels less than 150 m deep.

The study surveyed the majority of Namibia's regions, and found a profound lack of information about solar energy technologies. There is a highly centralised supply structure with most solar suppliers being located in Windhoek, which results in limited technical personnel in rural areas.

Participants at the workshop stressed that high subsidies are provided for grid electrification, while renewable energy technologies are required to operate under market conditions. Furthermore, grid-based rural electrification is becoming increasingly economically unfeasible and Namibian tax payers are required to pay these costs, while more cost effective renewable energy solutions are largely ignored.

Some participants maintained that rural unelectrified schools are electrified at a painfully slow rate, because of the high grid electrification costs, but that solar energy solutions, like those implemented by SchoolNet Namibia, are not adequately considered. Robert Schultz, who is an independent energy researcher and participant, also noted that the Rural Electricity Distribution Master Plan of 2000 is outdated and that electrification of rural areas is based on political agendas, rather than on the transparent and equitable approach established by the Master Plan. 'Namibia's renewable energy sector still quotes the Namibian White Paper on Energy Policy from 1998, which contains a good renewable energy section, but they are the only ones. It seems that none of the high level decision-makers in Namibia actually consider that section as relevant', said

Solar box cookers reach temperatures of up to 150°
(photo: Robert Schultz)

Schultz. One participant challenged NAMREP to investigate the actual subsidisation figures for grid electrification.

The workshop concluded with stakeholders drafting a number of policy-related statements and interventions that would facilitate more growth in the sector and greater security of supply for Namibia's energy needs.

Contact: Robert Schultz
PO Box 40765
Windhoek
Namibia
Tel: +264 (0)61 268 222
Fax: +264 (0)61 268 201
Mobile: +264 (0)81 244 3063
E-mail: energy@r3e.org

Solar energy water pump
(photo: Robert Schultz)

Commuters saving energy

To educate South Africans on energy efficiency, the Department of Minerals and Energy, the National Electricity Regulator and Eskom have embarked on a joint national educational and awareness campaign, and ComutaNet has been tasked to encourage commuters to start contributing to a national discipline to conserve energy. ComutaNet's Interactive Gazebos, situated in transit hubs around the country, were selected to increase energy conservation awareness, reduce consumption and to promote the efficient use of electricity.

Promotional staff used the gazebos to educate and advise commuters on how to use energy smartly. ComutaNet promoters handed out brochures demonstrating energy saving concepts, and encouraged members of the crowds to pass this vital information on to family and friends.

ComutaNet incorporated a competition to reinforce the promotions. The message called for a national discipline to integrate the smart use of energy to conserve natural resources such as coal, gas and liquid fuels. The competition required commuters to answer questions based on the Energy Efficiency Month leaflet and those that answered correctly, received exciting prizes.

'The awareness campaign generated 'electrifying' exposure for the Eskom Energy Efficiency initiative, as millions of commuters, mass consumers of electricity, were reached through ComutaNet's campaign. We are always keen to be involved in initiatives that educate and improve people's lives and were delighted to have contributed to the energy conservation awareness campaign,' says Kenneth Maomela, ComutaNet's Executive Chairman.

Contact: Louise Marsland
Bizcommunity.com
Editor@bizcommunity.com

Will Africa go up in smoke?

A call to rich countries to cut green house gas emissions beyond the levels set under the Kyoto Protocol and the new and additional funding for Africa to adapt to global warming are amongst the recommendations of the report, *`Africa – Up in smoke?'* which had appeared ahead of the G8 Summit that took place in Gleneagles, Scotland, in July 2005.

The report, which has been produced by a coalition of 21 environment and development organizations, including Oxfam, Friends of the Earth, the WWF and the International Institute for Environment and Development, says that Africa's vulnerability to global warming calls for a new model of development in which strategies to increase human reliance in the face of climate change and the stability of ecosystems are central. "Climate Change is happening and when all impacts are added up, everyone will lose out sooner or later," says the report.

ENERGY

Africa has enormous potential for Renewable Energy and Energy Efficiency technologies. The challenge is how to create access to clean, affordable energy resources, which allow Africa to avoid the `dirty' energy path those others have gone down, while meeting real development needs.

Various initiatives have been established to support sustainable energy, including the Johannesburg Renewable Energy Coalition (JREC), the Renewable Energy and Energy Efficiency Partnership (REEEP), the European Union Energy Initiative (EUEI) and the Global Village Partnership (GVEP), and there is current proposal to set up an EU Energy Facility for Africa worth □250 million Euros. However, a coherent strategy needs to be developed by leading industrialised countries to reorient global investment away from a fossil fuel intensive infrastructure, into low carbon and carbon-neutral technologies, which can lead to poverty reduction.

As recently as 2003, fossil fuels projects represented 86% of the World Bank's spending on energy, compared to funding for Renewable Energy at 14%. It is necessary now to ensure that sustainable energy commitments, be better integrated and better resourced.

The G8, at the very least, should work with Africa and other developing countries to promote a meaningful follow up follow-up to the Renewable Energy 2004 Conference, to ensure that ethnology transfer and development approaches are better co-coordinated and that voluntary commitments made at the Bonn Renewable Energy Conference are implemented. At present, the credibility of those programmes in delivering meaningful outcomes is open to question. Worse than that, the face of fossil fuel industries in Africa are smeared with exploitation, pollution and bad development practice.

African people want greater access to energy. The continent has abundant natural resources but these are often under-used, badly exploited or exported to other countries. Africa needs the means to develop local solutions to meet local needs, and increased access to clean, sustainable energy to support health and education services, households and enterprises.

RECOMMENDATIONS

The following recommendations are made for Africa:

- Dramatically increased support is needed for small scale agricultural as well as an approach to farming based on maximum appropriate diversification.
- Rich countries need to cut green houses gas to the level commensurate with halting global warming, and so that temperature rise is kept well below 2ºC above pre-industrial levels.
- There should focus on local needs first, with the greatest challenge of securing livelihoods at the local level.
- The international community should help map the health impacts of global warming and ensure that the resources are available to tackle them.
- International donors and financial institutions should switch investments from fossil fuels into promoting renewable and sustainable energy. Obstacles should be removed to technology transfer, and adopt targets and timelines to achieve those objectives.
- Disaster risk reduction should be integrated into relief, reconstruction, development programming and poverty reduction plans.
- More efficient systems are needed to ensure that aid is released quickly, and that humanitarian aid is well targeted when disasters strikes.
- The international community should implement the agreement made at the World Summit on Sustainable Development (WSSD) to help Africa prepare for and mitigate disasters at both a community and national level.
- All policies and programmes should be subjected to testing as climate change – friendly and climate proof.
- All funding to help Africa adapt to global warming should be new and additional to existing funds, and not seen as aid but as an obligation of the rich countries.

● *Contact: Nkosana Rakitla*
E-mail: nkosana@eartlife.org.za
Website: www.lied.org

Mathematical modelling in the deregulated South African electricity market

Abstract
More than ten years of international research exists in dealing with the transition to competition and deregulation of electricity markets worldwide, though little to no research has been done in the realm of the South African market. Herein, a model is described and presented from the perspective of a Generator/Producer participating in the Eskom Power Pool (EPP) in the day-ahead auction. The model aims to mimic the trading mechanism in a competitive market, while negotiating the difficulties of supplying power to a system which exhibits uncertain hourly demands, prices and costs, and which is subject to real-time production of the physical commodity. A pumped storage scheme is used as the basis for formulating a generic model of the competitive trading environment. The model is applied descriptively, to facilitate understanding of the system and simulate profit outcomes according to a set of parameterised sensitivities.

INTRODUCTION

Recent developments in the markets for electrical power worldwide have been characterised by a transition from regulated monopolies to deregulated competition, resulting in (among other changes) an unbundling of generation, transmission and distribution assets. The change in governance has led to a plethora of market designs, where the day-ahead market for electricity is the predominant medium for trading the commodity. Moreover, the power commodity is one that is, in general, non-storable, and is also subject to many complex physical production constraints. In much of the research, Generation is the principal area of concern and the challenges relate to understanding the dynamics and to attaining optimal engagement in the daily auction and power pool. The challenges constitute – among other themes – devising strategies for generating companies (Genco's), regulators and other market participants. In addition to the basic trade and dispatch of electricity, there is the rapidly evolving field of financial and tertiary markets for electricity. These markets have developed in response to the additional risk exposures that have arisen in the competitive environment, and the resultant need to manage the exposures.

Researchers of electricity markets have been interested in price formation, supply function analysis and optimal offer / bid strategies. Modelling techniques are drawn from many disciplines in the mathematical sciences, with a strong tendency toward the development of simulation tools. A great deal of research has concentrated on the markets of the developed world, though little has been done in the developing world, or in the South African context.

The work here aims to give a fresh approach to understanding competitive electricity markets, and also to provide a basis for the development of methods of enhancing the trading strategies for a participant in the EPP. Figure 1 shows the current structure of the EPP through which most of the country's electricity production is sold. In order to facilitate unbundling and to prepare the generators for competition, Eskom's generation assets have been divided into seven clusters, with 80% of production hedged with the holding company. The hedging is a temporary feature so that individual clusters do not bare the full brunt – nor take untoward advantage – of the new market conditions.

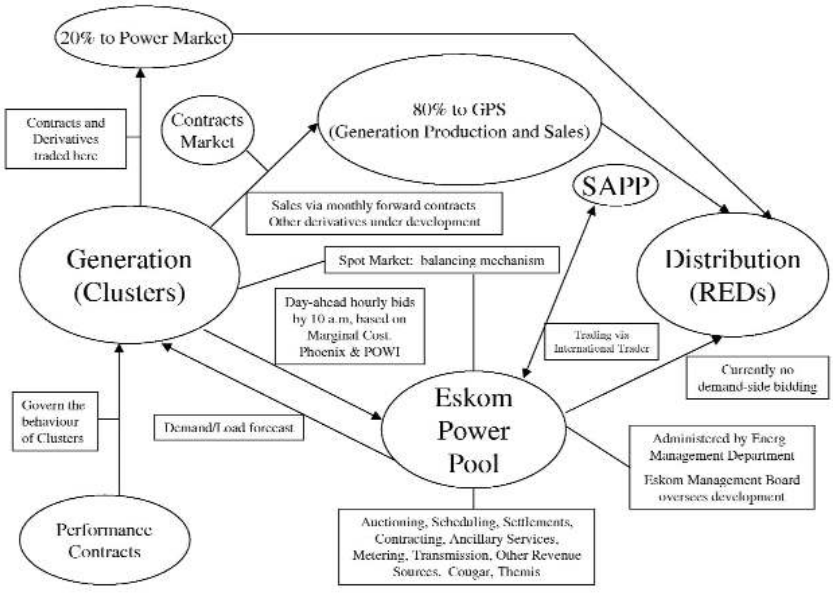


Figure 1: Eskom Power Pool

MODEL AIMS

The model described below aims to simulate a generic version of the trading process that takes place in the EPP day-ahead auction for electricity. The model is developed from the perspective of a single Genco, trading on behalf of one of its generating units, and can be used to gain an understanding of the trading process and facilitate further learning and understanding of the system.

Once validated, the model can be used to examine the effects of various strategies adopted by a trader, and the robustness of the trading outcomes to a variety of external influences. Ultimately, a model of this sort could be implemented in a normative manner for devising an optimal trading strategy and/or supply function, however, the implementation presented here is purely of a descriptive nature. Exploratory analysis using the model will also enable a critical evaluation of its potential usefulness in a real-life situation.

SIMULATION OF DAILY TRADE

In the following, let t be the hour of the following day in which we are attempting to make a trading decision. A trading decision constitutes a decision of whether to enter the market at all, and if so, at what prices to offer a specified volume of energy. In other words, we are trying to parameterise the supply function for each hour of the following day. Market clearing takes place one day in advance, and simultaneously for all the 24 hourly trades for the following day. The System Operator clears the market by determining the price at which the forecast of system demand equals the aggregate supply function of all the suppliers in the pool. The clearing price is known as the System Marginal Price, or SMP. The trading is therefore prospective, and settlement of trades occurs retrospectively once the true system values have become known. The three key variables considered by a trader in the daily market are System Demand, SMP and Marginal Cost (MC). In the model, each of these assume the actual values:

$$g_A(t) = \mu_t + \gamma_t$$

where $g_A(t)$ represents the logarithm of the 'true value' of the variable to be realised at time t. The first component, μ_t, represents the deterministic component of the actual value to allow for known seasonal, daily or hourly effects, all of which may be estimated from historical data. The second component, γ_t, represents the stochastic element (to allow for randomness in the variable values). The γ_t's in turn depend on parameters that allow the modeller to control the inherent variability of the system through a series of first-order correlated stochastic errors.

In the modelling process, the trader can predict each of the system variables with a degree of accuracy that we endow to him / her. The logarithms of the forecast values, $g_F(t)$, are defined such that:

$$g_F(t) = g_A(t) + \varepsilon$$

The trader's conjectures for each variable in hour t of the following day consist of the true value plus a forecasting error. The error, ε, is sampled from a statistical distribution whose parameters depend on the expertise of the trader.

SPECIALISATION

There are a variety of plant types represented by the seven clusters in the EPP, and each plant type will have characteristic trading behaviour in the Pool. For example, a coal-fired plant will generally contribute to base load generation, and will operate more profitably if it can supply on a continuous basis. It will also be the price-setter in periods of low demand. A coal-fired plant will also have MC's that depend largely on the spot price of coal commodities and / or reserve volumes of coal.

Contrastingly, a peaking unit will want to operate in peak periods, and becomes a price-setter in periods of high demand or grid instability. For this study, we have chosen to mimic the behaviour of a participating peaking unit, more specifically a pumped-storage scheme. Such a scheme exhibits interesting characteristics with regard to price-influence, and also has a marginal cost structure that depends on SMP's in periods of low demand. In order to fill its upper reservoir, a pumped storage scheme will generally purchase pumping energy from the pool in periods of low system demand, and will generate electricity in peak periods, depleting its upper reservoir's volume in the process. A key parameter in the scheme's marginal cost is the efficiency with which it can restore its reservoir volume levels through pumping.

Since costs are modelled as a function of forecast SMP's, we need only define parameters for the forecasting precision with respect to Demand and SMP; the MC's are simply calculated as a function of SMP's in the lowest forecast SMP hours, the number of hours auctioned for, and the efficiency. MC forecast precision is indirectly a function of SMP-forecast precision. Consequently we define parameters to represent the forecasting bias and precision for Demand and SMP respectively (i.e. we specify the distributions of the traders expertise, ε, for each of the two system variables).

DECISION MODEL

A key component of the model is the trading decision process. This has two components:

1. When (i.e. in which hours of the following day) to offer electricity production? The model assumes that hours are chosen for potential trade when forecasts of demand for the relevant hours exceed some threshold, and when the SMP forecast is greater than a cost-dependent threshold in the selected hours. The cost threshold depends on a threshold parameter and on the forecast of MC for the following day. Furthermore, the number of permissible trading hours is also controlled through an appropriate parameter, restricting the maximum number of trading hours in each day to a prespecified maximum.
2. At what price to offer the electricity? The price offered is determined with reference to an additional parameter. This offer price parameter specifies the proportion of the interval between the forecasts of MC and the SMP. It therefore defines an offer price within a reasonable range of values.

For this model, we assume a fixed capacity is offered, and all of this capacity is generated in the event of a successful offer (this represents an obvious departure from reality and a simplification of the supply function). Additionally, we assume the actual SMP outcome will be affected by this generator's offer in the auction. The influence is controlled in the model by introducing a parameter that may take on values from 0 to 1, where 1 implies that this Genco has complete control, and 0 implies no influence on the final price outcome.

Having defined the trading, variability and precision factors above, we now summarise all the relevant parameters under their appropriate headings in Table 1.

Table 1: Model parameters

Parameter descriptions
Endogenous – strategy
• Number of hours for pumping (and for generation)
• Demand threshold for offer strate gy (MWh)
• Relative proportion of forecast MP to forecast MC for offer strategy
• Proportion of interval between fore cast MC and forecast SMP for offer price
Exogenous – fixed
• Number of simulation iterations
• Investigation horizon (days)
• Fixed capacity offered and generated
Exogenous – proficiency
• Estimation bias for demand
• Estimation bias for SMP
• Precision for estimate of demand
• Precision for estimate of SMP
Exogenous – contextual
• Price-influence parameter
• Efficiency parameter for pumped-storage scheme
• Smoothing parameter for Actuals' stochasticity
• Standard deviation of stochasticity in Actuals

THE MODELLING PROCESS

Firstly, a set of parameter values was chosen in such a way as to provide an informative and realistic range of results. For each parameter, a low value and a high value were chosen (largely through a trial and error application of the devised simulation algorithm).

The simulation algorithm was programmed in VBA with an Excel interface for the relevant inputs and outputs. A stable distribution of results was achieved with 100 simulation iterations for each parameter set. Since running time was a limitation, a 1 month period was chosen for the term of the simulation, and a fractional factorial design was employed in order to mitigate running time without compromising the interpretability of first and second order influences of the parameters.

The design was chosen in such a way that the effects of individual parameters, as well as the effects of significant second order interactions between these parameters, could be analysed. The design and analysis of the simulation experiments were performed using STATISTICA. Analysis of Variance was conducted on the results to determine the relative significance of the parameters and interactions. The mean effects were evaluated for the significant parameters and for significant parameter interactions.

The simulation algorithm was sufficiently versatile to permit evaluation of outcomes on different response variables. First, Mean Profit was analysed, followed by Mean Offers Accepted. The results of the Mean Offers Accepted were then used to qualify the results of the Profits, and this analysis led to be one of the key insights gained from the modelling process. Through analysing and comparing the two response variables, one can glean a great deal of information about the profitability of various trading strategies under various precision and variability scenarios.

RESULTS AND INTERPRETATION

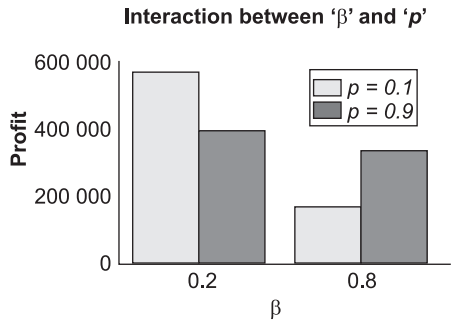
The results led to validation of the model's design, however, it was also possible for more subtle insights to be gleaned from the results and subsequent analyses. A summary of the first order mean effects on the two response variables for a selection of factors is given in Table 2 below. The table serves to illustrate the types of results that are obtainable from the model.

As expected, poor information (i.e. reduced trader proficiency) resulted in reduced profitability. Increased stochasticity resulted in larger profits, reflecting the value of extra inherent optionality in the trading process. Additionally, it was confirmed that a trader is able to offer higher prices when the Genco commands a greater price-influence. The latter result is demonstrated in Figure 2, which shows the interaction between the offer-price and price-influence parameters. The symbols p and β in the figure represent the offer-price and price-influence parameters respectively; the SE in the key next to the bar graph is defined as the standard error of the relevant mean.

The results also demonstrated that price-setters are able to offer prices closer to their expectations of SMP, and price-setters would prefer to offer closer to their expected marginal cost. These examples are just a few of a variety of insights gleaned from the full set of results. A full description of the evaluated results and insights is not given in this article.

Table 2: Analysis of results on two response variables

Factor	*Mean profit*			*Mean acceptances*		
	Low value	*High value*	*Change*	*Low value*	*High value*	*Change*
Demand threshold	483 853	237 415	-51%	119	62	-48%
Price influence	476 277	243 990	-49%	91	90	-1%
Scheme efficiency	251 321	468 947	87%	75	106	41%
Cost threshold	424 636	295 632	30%	125	56	-55%
Demand forecast precision	415 771	304 497	-27%	94	87	-7%
Maximum hours	412 347	307 920	-25%	94	87	-7%
Stochasticity of Actuals	318 688	401 580	26%	86	95	10%
Smoothing parameter for Actuals	373 387	346 881	-7%	92	89	-3%
SMP forecast precision	357 420	362 848	2%	88	93	6%
Offer price	361 848	358 420	-1%	119	62	148%



	β = 0.2	β = 0.8
p = 0.1	563 872	159 824
(SE)	(54 032)	(17 500)
p = 0.9	388 683	328 156
(SE)	(42 027)	(37 905)

Figure 2: Example of a significant interaction

IMPLICATIONS

A few of the key implications of the above model follow.

- It may be observed that a thorough scrutiny of the effects of the model parameters can lead to greater understanding of the system, as well as to model validation.
- Furthermore, interactions can be analysed in order to explain system subtleties and facilitate additional understanding and learning.
- Analyses of multiple response variables can be conducted, leading to descriptive insights of the system and results can be used to validate existing literature.
- Significant value lies in the learning that arises as a consequence of the modelling process.
- Simple suspicions can be confirmed or highlighted, so one should not underestimate the usefulness of simple confirmatory analysis.

MODEL CRITIQUE

A number of obvious advantages and disadvantages of the simulation exercise arose:

1. Advantages

a) The model is good for exploratory analysis and understanding the system since it encourages learning and provokes thought.
b) There are a few meaningful parameters whose meaning can easily be interpreted.
c) The model has a versatile design that can be easily modified for further investigation or real-life adaptation.
d) The inputs and data requirements are relatively simple.

2. Disadvantages

a) The model is based on a somewhat generic and fictitious system.
b) A modeller may experience a moderate amount of difficulty pertaining to the selection of parameter values in the design of the simulation experiments.
c) Data limitations were experienced, however, this could be improved by further cooperation with a real-life client.
d) Simulation running time was a problem and some streamlining of the program would have been possible given additional time resources.

FUTURE WORK

The model described above has proved to be very useful in many respects, and is sufficiently versatile to facilitate further experimentation and refinement. An obvious example would be to conduct 3-level (i.e. 3 values for each parameter) factorial designs for the experiments, rather than the simple 2-level experimentation.

A further (although somewhat more complex) modification would be to incorporate the history of previous trading successes in addition to the following day's forecasts rather than the 'fresh-new-day' approach described in this model.

The simulation could be repeated as a metasimulation in which the optimal trading strategy for a particular period may be devised. This would constitute a normative adaptation of the existing model.

The model could be modified to include the realities of contracting and derivative positions, and their effect on the profit outcomes and trading strategies. More generally the model could be adapted for use as a tool for risk management in conjunction with trading strategy.

Models of individual Genco units could be amalgamated into a system-wide model to represent a generic power pool (as is common in the literature). Such a model could be used to aid regulatory decision making, and in structuring an appropriate design or improvement to the auction and pool mechanisms. Similar models can and have been useful for monitoring of participant behaviour by regulators and advisory bodies.

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Contact: Stephen Davis
Department of Statistical Sciences
University of Cape Town
Private Bag, Rondebosch, 7701,
South Africa
Tel: +27 (0) 21 650 2501
Fax: +27 (0) 21 650 4773
Cell: +27 (0) 82 508 9750
E-mail: sdavis@stats.uct.ac.za

Prof. Theodore Stewart
Department of Statistical Sciences
University of Cape Town
Private Bag, Rondebosch, 7701,
South Africa
Tel: +27 (0) 21 650 3224
Fax: +27 (0) 21 650 4773
E-mail: tjstew@stats.uct.ac.za

Courses prepare officials for energy choices

When you're about to take some make-or-break decisions on national energy resources – and maybe you don't just want to take the word of the suits from the multinationals – it would be useful to have an idea what the likely outcomes of those decisions will be.

It goes without saying that energy is not an exact science, but two short courses offered for years now by the Energy Research Centre (ERC) at UCT help prepare policymakers, planners and energy engineers for those big calls. In late August and early September, delegates from, among other places, government departments in Ethiopia, Kenya, Zambia and South Africa (the Department of Minerals and Energy) attended the 2005 run of these ERC programmes.

Essentially, the courses show delegates how to get the best out of two invaluable modelling tools, both well used around the globe. The first piece of software is the Long Range Energy Alternatives Planning (LEAP) model, designed by the Stockholm Environment Institute with input from the ERC. With LEAP, delegates can run scenarios on issues such as energy demand, the provision of energy to rural areas and electrification in general, and on greenhouse-gas emission and pollution control.

The second course is on the MARKAL 'technical-economic equilibrium' model devised by the International Energy Agency (IEA) for its Energy Technology Systems Analysis Programme (ETSAP), software also adapted by the ERC. As with LEAP, the more high-tech, information-richer MARKAL allows for analysis on hot potatoes such as the reduced emissions of greenhouse gases, energy security and efficiency, and the uptake of new technologies.

'For most developing countries, these kinds of decisions are absolutely vital, and can change the direction of a country,' says Mark Howells, ERC senior research officer, who runs the courses led by another research officer at the ERC, Thomas Alfstad. '[LEAP and MARKAL] are powerful tools that can help them make those decisions.'

Contact: Megan Morris
Department of Communication and Development
University of Cape Town
Tel: (021) 650 3735
Fax: (021) 650 3780
E-mail: memorris@bremner.uct.ac.za

Mark Howells and Thomas Alfstad
Energy Research Centre
University of Cape Town
E-mails: markh@eng.uct.ac.za and talfstad@ebe.uct.ac.za

Electrifying issues: Mark Howells of UCT's Energy Research Centre (ERC) talks Doriccah Lefawane, of the Department of Minerals and Energy in Pretoria, through some of the complications of energy-modelling software.

What's driving the growing carbon credit market?

THE CARBON MARKET

The trade in carbon credits is growing, and growing fast. Last years carbon market was estimated to be 360 million, and this grew from 96 million the year before. That is a growth of over 300%, and if countries are going to meet their commitments under the Kyoto Protocol, it will have to grow faster, much faster.

But what is driving this growing carbon credit market? Can South African companies cash in, and if so, how?

THE GLOBAL CARBON MARKET – WHAT'S DRIVING IT?

There is growing concern about the impact that increased emissions of certain gases, known as greenhouse gases , are having on the global climate. Carbon dioxide emissions are the most important, and the burning fossil fuels (coal, oil and gas) are the biggest emitter of carbon dioxide.

Because of this, an international agreement, the Kyoto Protocol, was established to limit emissions of greenhouse gases. Under the Kyoto Protocol, industrialised countries (the so-called Annex I countries) have agreed to limit or reduce their emissions of these greenhouse gases.

Many Annex I economies are more efficient than developing economies. It costs less to reduce greenhouse gas emissions in developing economies, such as in South Africa. As a result, a Clean Development Mechanism (CDM) was set up. Annex 1 countries could purchase `certified emissions reductions' (CERs), a form of `carbon credit', from developing counties. These credits are then used to off-set their own emissions. Many Annex 1 countries are struggling to meet their targets from internal actions, so the demand for carbon credits is rising.

The CDM scheme is simple. If a project in a developing country would reduce emissions, help (sustainable) development in that country, and meet a list of pre-defined criteria, it may qualify. The project owner in the developing country then sells the reductions (CERs) in emissions to an Annex I country to gain extra revenue.

At present, CER's are trading between $5 and $9 per ton of CO_2. South Africa could quite easily reduce more than 50 million tons of CO_2 (representing about 15% of energy related GHG emissions) at a cost lower than that, annually. The new market is potentially huge.

HOW CAN SOUTH AFRICAN COMPANIES CASH IN?

By developing CDM projects. The main criteria are that projects have to be `additional'. That is: that they should not be viable without the extra revenue from CDM. If the project is additional and the reductions in emissions that result can be certified (CERs), then they can be sold.

A local example is a recent application by SAPPI. Extra CER revenues have turned a marginal project into one with a 20% return on investment. The project involved altering their boiler stock so that some of the coal being burnt to raise steam could be replaced by waste bark. Under normal circumstances the coal would be burned which releases CO_2 emissions, while wood is re-grown and re-captures CO_2 as it does. Also, the bark would have normally decomposed to methane, which is several times more potent than CO_2, per ton released.

While this example may sound exotic, there are a myriad of potential opportunities, from simply using less energy to produce goods to housing schemes, which include better insulation. South African industry notoriously uses more energy than it could – for instance, none of the thousands of Reconstruction and Development Programme (RDP) houses have ceilings, which would increase their thermal efficiency considerably.

Developing CDM projects however, requires several steps, can be costly and slow to develop and their approval is not guaranteed. The steps are summarized and simplified below and each follow particular rules:

1. The project should be identified and detailed;
2. A baseline for the project must be established. This means that the carbon emissions that would have occurred if the project did not go ahead must be determined;
3. It then requires approval by the South African [Designated] National Authority (DNA) and to do this, needs to meet several criteria, including an additionality test;
4. The project then needs to be validated, and this must be carried out by a shortlist of approved bodies, known as Designated Operational Entities (DOE's);
5. After this, it is registered with an international body called the CDM Executive Board;
6. The full financing (possibly including agreements to purchase the emissions reductions to be certified (CERs)), implementation and operation of the project can then ensue;
7. The project requires monitoring to show that the claimed emissions are being saved;
8. The savings need to be verified by another DOE; and
9. Finally, having jumped through these hoops, the emissions reductions are certified by the DOE, and a CER is issued by the CDM Board and cash can begin to flow.

Recognizing that the process can be laborious, various aspects have been simplified especially for smaller scale projects, which generate renewable energy (less than 15MW), energy efficiency (saving less than 15GWhrs per year) or will save less than 15 000 tons of CO_2 per year. The longer the project runs, the more CER's will be available, and the project developer

has a choice to register the project for seven years with an option of two further renewals of seven years each, or for ten years with no option for renewal.

The CDM essentially represents an additional and potentially significant revenue stream for otherwise marginal projects. The most difficult test is whether or not the project is additional. If investigations show that it is not, and it should go ahead anyway, at the very least, a sensible investment opportunity has been identified.

For more details, please contact the National Designated Authority (DNA) that approves all local applications for and promotes CDM projects. www. dme. gov.za/cdm/portfolio_promotion.htm.

Useful guidebooks can also be downloaded from the following website addresses:
www.cdmguide. com/
www. eri.uct. ac.za/brown%20 haze.htm
www.3e.uct.ac.za/cdm/ main.htm.

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Contact: Mark Howells
Energy Research Centre (ERC)
University of Cape Town
Tel: +27 21 650 3898
Fax: +27 21 650 2830
E-mail: markh@eng.uct.ac.za

BP moving beyond petrol

BP has launched a new corporate advertising campaign developed by Ogilvy Cape, which attempts to demonstrate the company's approach to business.

The campaign takes a two pronged approach: visuals of what it means to go beyond the obvious, supported by a series of short statements of how BP attempts to go beyond just petroleum.

Rams Ramashia, BP's Chairperson, says: 'The BP brand is well known and loved by South African consumers, which is why for the past four years, we have enjoyed the top spot in the petroleum sector in the independent South African Brands and Branding survey.

'In developing a new campaign, our intention was to build on the existing positive reputation we have in the market place. In particular, we wanted to articulate our concept of going beyond, and how this approach brings to life our brand values of progression, innovation, performance and green'.

The TV campaign sets the scene, which is carried through using billboards, magazines and newspapers.

Greg Burke, Ogilvy Cape Creative Director, says: 'BP's global slogan 'beyond petroleum' is all about its unshakeable commitment to human progress.

'It is a brand which is striving to be better. Everything BP does from cleaner fuels to solar power on its forecourts, from community initiatives to corporate sponsorships, from coffee at its Wild Bean Cafe's to fresh bread and good value at its BP Express convenience shops, it is all about being better.'

Contact: Louise Marsland
Editor – Bizcommunity.com
E-mail: editor@biz-community.com

The price of crude oil

There is much gnashing of teeth about the current and likely future of the crude oil price. Motorists reel at every monthly increase. Economists bewail the dire effect upon their growth predictions. Is it a disaster for us all? I think not.

Let's recall what happened in the 1970's. The oil price shot up about 20-fold almost without warning. Suddenly South A on the open road, and the speed limit was enforced rigidly. Government took a very sensible decision, to invest what was a huge sum in those days, R7.3 billion, to build Sasol 2 and 3 at Secunda. (Sasol 1 at Sasolburg was small, essentially a demonstration plant). Sasol 2 and 3 provided us with nearly half our petrol needs and about 15% of our diesel needs, and gave us a measure of independence.

Then in the mid-80's gas was found off Mossel Bay, and Mossgas (now PetroSA) was the response. It too is only a demonstration plant, producing about 25 000 barrels per day of product from gas and the balance, about 10 000 barrels per day, from condensate. Unfortunately, the condensate reserves offshore were less than had been hoped. Today we have to import condensate to keep the plant going. Nevertheless, Mossgas gave Sasol the opportunity to design the first commercial oil-from-gas plant in the world. Moreover, Sasol had not previously been responsible for design, and learned a lot about the process while building Mossgas. Further offshore exploration identified some small oil resources, and they contribute about 5% of our crude oil supply.

Today the synthetic fuel pla frica discovered that we were very vulnerable. Motorists were restricted to 80km/hnts save us huge sums in foreign exchange – annually they contribute more than their original cost to our balance of trade, and their contribution to our balance of trade helps strengthen the Rand, which in turn reduces the local price of fuel. The Secunda plants are profitable above about $15/barrel and PetroSA at above about $20, so they are making very good money. Their taxes help to balance the national budget.

Thus we now have proven synthetic fuels technology that is very saleable. Sasol is looking to export its know-how to Qatar, Nigeria, and China among others. That should bring in lots of lovely royalties.

If we have some insulation from world oil prices, why does the motorist not feel it more? Part of the problem is that Government, like governments everywhere, has seen the cash cow. In 1990, we paid R0.47 taxes on every litre; today we pay R1.42. With 21 billion litres sold, the Minister of Finance is happy. Worse, Government is determined to keep the cash cow happy, and sets a basic fuel price about R0.25/l above the real import parity price.

Another part of the problem is the oil industry itself. Not for nothing have they been among the top of the world's companies for the best part of a century. Production costs, including paying for exploration, are still less than $10/barrel. Who can forget how one company offloaded a carrier full of crude at Durban, and then sailed on to the mid-Atlantic to scuttle the ship in the hopes of hiding their support for the apartheid government? That tells you just a bit about the profits. The oil industry is global in its reach, and global in its influence.

Its influence extends to being cosy with Government about the returns they expect for marketing. The fuel price is set so the industry is guaranteed a 15% return on their assets. Guaranteed? With a commodity for which the demand is almost insatiable? And how, pray, do you calculate the assets of the industry? It requires running together the reported assets of at least five separate companies. One year the total shot up by over R10 billion. Sasol had joined the cartel, so their assets (for which we had paid in the first place) were added to the total. Enron should have been so lucky!

But a world price is still a world price, and we cannot be completely insulated. Some of the present pricing is the result of supply problems. Iraq was one of the bigger suppliers, so in one sense we are all paying for an illicit Yankee adventure. Production is another bottleneck – the oil companies have not invested in new oil refineries. South Africa is not alone in having a collection of refineries, nearly 50 years old.

When all is said and done, why are the economists so gloomy? We survived a 20-fold price increase in the late 1970's. We should survive a mere threefold increase a generation later.

(With acknowledgements to Cape Argus, 8 September 2005)

Contact: Dr Philip Lloyd
Energy Research Centre
University of Cape Town
E-mail: plloyd@ebe.uct.ac.za

SAEE banquet and awards ceremony

The Southern African Association for Energy Efficiency (SAEE) will be holding their Annual Banquet and Awards Ceremony in Krugersdorp on 19 October 2005. This event presents an opportunity meet new SAEE members, and rebuild relationships with existing SAEE members.

SAEE annually recognizes the outstanding accomplishments of individuals and companies in the energy field through the SAEE Awards Program. The Awards are a token to recognise the commitment to their profession, desire to further the association's mission, and participation in civic and community affairs. The Awards will be presented at the SAEE Banquet.

The latest Certified Energy Managers (CEMs), who have successfully passed their exams and received approval by both the CEM Board and the American Association for Energy Engineers (AEE), will also be presented with their certificates.

Award Categories

Award 1: Energy Company of the year
This award is given to a company which has demonstrated outstanding achievements in the energy industry in Southern Africa during the year.

Award 2: Best Certified Energy Student of the year
This award is given to a student who obtained the highest score in an exam during the year as part of being certified as an energy manager.

Award 3: Energy Newcomer of the year
This award is given to recognise a newcomer who has demonstrated outstanding achievements in the energy industry in Southern Africa.

Who may nominate?
Nominations can be made by anybody for the awards that are listed, and the person being nominated does not have to be a member of the SAEE. However, current members of the SAEE Committee are excluded as nominators and / or as candidates for any award.

How do you nominate?
In general, all award nominations must include a nomination form, a seconded person's signature that is supporting the nomination being made, and a supporting rationale for the nomination.

Rationale for nomination
A motivational letter is required, explaining the basis upon which the candidate is being nominated for the award. This should exceed 150 words, giving the main accomplishments for why the candidate is being nominated for the award. This will be used at the awards ceremony if the nominee is the winner.

Award nomination deadline
All award nominations must be received at the SAEE Offices by close of business on 30 September 2005. All nominations will be evaluated by an award panel of judges.

Contact: Nikki Nel
The Southern African Association for Energy Efficiency (SAEE)
10 van Riebeeck Street, Potchefstroom, North-West 2531
Cell: +27 (0) 82 828 8546
Fax: +27 (0)18 293 1499
E-mail: Nikki@saee.org.za

Energy events 2005/2006

NOVEMBER 2005
10 - 11

WEST AFRICAN POWER INDUSTRY CONVENTION 2005
Dakar, Senegal

Contact: Zelda Weitz - Spintelligent
Tel: +27 21 700 3500
Fax +27 21 700 3501
E-mail: zelda@spintelligent.com
Website: www.spintelligent.com/events

JANUARY 2006
16 - 18

5TH SOUTH AFRICAN CONFERENCE ON APPLIED MECHANICS
Cape Town, South Africa

Contact: Nawaz Mahomed
E-mail: Nawaz.Mahomed@dst.gov.za
Website:
www.samechanics.co.za/sacam.html

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22 - 24

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Website: www.saplanners.org.za

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3 - 7

PAN AFRICAN POWER CONGRESS & EXPO 2006
Johannesburg, South Africa

Contact: Terrapinn
Website: www.terrapinn.com

10 - 12

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Contact: Jan Simpson, Conference Manager
Tel: +1 918 831 9736
Fax: +1 713 963 6280
E-mail:
pgreconference@pennwell.com
Michael T. Eckhart, President, American Council on Renewable Energy (ACORE)
Tel: +1 202 429 2030
Fax: +1 202 429 5532
E-mail: meckhart@acore.org
Website: www.power-gengreen.com

18 - 21

7TH EUROPEAN CONFERENCE ON INDUSTRIAL FURNACES AND BOILERS
Porto, Portugal

Contact: INFUB
Tel: +351 229 73 4624/ 229 73 0747
Fax: +351 229 73 0746
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Website: www.cenertec.pt/infub

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Sonya.xia@windpowerasia.com
Website: www.windpowerasia.com

Visit www.erc.uct.ac.za for further events and details

Energy Management News

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Enquiries, comments, articles, and information on energy events are welcome, and should be sent to:

Richard Drummond
Energy Research Centre
University of Cape Town
Private Bag
Rondebosch 7701
South Africa.
Tel: (021) 650 3894
Fax: (021) 650 3230
E-mail: rdrummond@ebe.uct.ac.za