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IN THIS ISSUE

ERC determines Cape Town's energy future

A recently completed study by the Energy Research Centre (ERC) developed some scenarios for Cape Town's energy future. Long range Energy Alternatives Planning (LEAP) has been used to simulate how energy might develop in Cape Town over the next twenty years. Cape Town had already developed a State of Energy report earlier, and adopted a City Energy Strategy including a 10% renewable energy target. The new ERC report looks forward at how energy patterns might change in the future.

The report finds that policy interventions indeed can make a difference. Major energy savings can be made from modal shifts in the transport sector and with efficient lighting. Efficiency measures save money, and can help poor households in particular, reduce their energy bills substantially. Implementing the city's renewable energy target will have significant costs, which can be partly offset by selling carbon credits. Targeted interventions can reduce local air pollution, and Cape Town has the opportunity to become a leader in addressing greenhouse gas emissions. The report identifies policies that are sustainable – viable in terms of costs, social benefits and the environment.

The ERC report builds on previous work done on the 'State of Energy' for Cape Town. That report was useful in capturing the current status of energy in the city, informed the City Energy Strategy conference and Cape Town's own strategy and provided the starting data for this study. This report takes the work further in developing a tool that simulates what might happen to energy *in the future*, in a business-as-usual case and with policy interventions.

A range of policy interventions is selected, and how these would change energy development in the city is examined, compared to a reference case. Interventions were selected based on various criteria, including implementation cost and technical feasibility, environmental priority and political will. Different policies can be grouped for their sectors – industrial, residential, commercial, government and transport – and also combined to form multiple-policy scenarios. These scenarios should be understood as a series of 'what if' questions, e.g. what if the City of Cape Town increased efficiency in its own buildings? The scenarios are *not* any prediction of the future, nor are any of these scenarios considered more likely than others.

Instead, the ERC reports the implications of different policies and scenarios. The implications for energy, environment (both local pollutants and global greenhouse gases) and development are of particular interest. This study reports the cost implications of different scenarios only to a limited extent, as to do this adequately for many of the scenarios is beyond the scope of the project. Areas where further work is required, including around costing, are also identified.

The following are the main conclusions of the ERC's work:

- **Policies can make a difference to energy consumption in Cape Town**

The energy scenarios examined in this study generally show energy consumption rising as economic activity (GGP) and population increase. However, significant energy savings are possible *relative to business-as-usual*. Unsurprisingly, since transport currently accounts for 54% of energy consumption, the biggest energy savings potential lies in this sector.

- **Major energy savings can be made from modal shifts in the transport sector and with efficient lighting**

Amongst all interventions considered, by far the largest savings can be gained by a shift from private to public transport modes. Savings are of 1200 TJ / year, equivalent to 36 million litres of petrol and diesel in the first year. However, electricity use increases 50 TJ, with the modal shift due to increased use of electric trains. Switching to more efficient lighting can result in substantial savings in several sectors, amounting to 38 million kWh in 2001. Energy savings are important to the City, since it depends on imports of both electricity and liquid fuels.

- **Energy efficiency saves money over the life of the intervention**

Efficient lighting in the commercial sector, can save R144 million over the projection period. More efficient heating and air conditioning could save R32 million in the commercial sector, and R1.3 million in government buildings over the projection period.

- **Energy saving in poor households can reduce their energy bills substantially**

The significance of savings in the residential sector is that low-income households can save on their energy bills. Each household could save R75 per year just by installing two CFLs (at capital cost of about R30). The payback periods for ceilings and solar water heaters (SWHs) is expected to be longer. Local government should consider subsidising the capital costs of these interventions for poor households. The potential for SWHs is largest in medium- to high-income households, where electric geysers constitute the largest single use of electricity. These households should be able to afford the upfront costs of SWHs.

ERC staff involved in Cape Town's energy future (from left to right): Harald Winkler, Alison Hughes, Glen Heinrich and Eugene Visagie. Absent was Mark Borchers of Sustainable Energy Africa (SEA).

- **Implementing the city's renewable energy target will have significant costs, which can be partly off-set by selling carbon credits**

The estimated *total* capital costs of implementing the renewable energy target is R4 370 million. These are total costs, and should in future be compared to the costs of the alternative, e.g. building a coal-fired power station. The reduction of GHG emissions could earn the city revenues of R700 million over 20 years – about 17% of the total capital costs.

- **Targeted interventions can reduce local air pollution**

Cape Town has long suffered from the problem of 'brown haze'. Policy interventions can address this problem of local air pollution, which is largely vehicle-generated. Improved public transport infrastructure will be the key in reducing transport energy and emissions by making a modal shift possible. In 2020, a shift to public transport can save 1021 tons of particulates. Total reductions of SO_2 are 1400 tSO2 by

Household electrification

2020, most of which comes from industry.

- **Cape Town can become a leader in addressing greenhouse gas emissions**

Cape Town has already set a forward-looking target for renewable energy. The scenario modelling shows that this policy could save 49 ktCO_2-equivalent in 2001 already. A surprising result is that transport policy can result in even larger savings in the same year, of 72 ktCO_2-eq. While these interventions require substantial investment in energy and transport infrastructure, they would enable Cape Town to become a leader in addressing a critical global environmental problem – in line with its goals as a member of the Solar City Initiative.

- **Some policies are viable in terms of costs, social benefits and the environment**

CFLs in residential, commercial and government sectors and HVAC in commerce and government sectors stand out as policies that have benefits from every angle, and should be implemented at scale immediately.

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Meeting South African renewable energy targets

This article gives an overview of a study on renewable targets for the electricity sector in South Africa. The study used the Long range Energy Alternatives Planning (LEAP) model to provide estimates for the financial costs of reaching specified levels of renewable generation.

BACKGROUND

The Department of Minerals and Energy (DME) has finalised its White Paper on Renewable Energy. In this document, a target of 10 TWh is set for renewable energy contribution to final energy consumption by 2013. This is to be produced mainly from biomass, wind, solar and small-scale hydro resources. In addition, it has been suggested that at least 4 TWh of this target should come from the electricity sector.

With the targets in place the question now becomes how these are to be achieved. A strategy is needed to pave the way forward and develop an appropriate plan. This article presents a study that examines the issues involved and seeks to identify alternative plans and provide estimates of their financial costs.

METHODOLOGY

The objective for this study was to give a preliminary estimate of what the financial costs of meeting various renewable targets for the electricity sector would be. This was done by comparing the costs of a non-renewable reference scenario with the costs of scenarios with renewable targets.

Scenarios were designed with four main criteria in mind. Firstly, it was a requirement for each scenario that the specified target for contribution from renewable energy sources was met. Secondly, the contribution from each renewable technology was not allowed to exceed the potential estimated by the DME1. Thirdly, each scenario was designed to have diversity in the renewable electricity generation expansion. Finally, an attempt was made to keep costs low.

Technical and economic data for generation technologies was taken from three main sources; the National Integrated Resource Plan (NIRP)[2], the DME[1] and the International Energy Agency (IEA)[3]. Costs were evaluated by producing levelised cost curves for all options and thereby allowing for the comparison of generation costs from various technologies at different load factors. The curves were produced for three time periods – 2003, 2010 and 2020, as some technologies were assumed to show significant cost reduction over time. These curves were then used in a screening process where the most expensive options were eliminated and the cheaper ones ranked based on their levelised cost of generation.

A reference case and four scenarios were created. The reference case was taken from the NIRP[3] and is a least cost expansion plan with no renewable targets, developed by the National Electricity Regulator. This reference case was used as the base for the four other scenarios, which represented different levels of renewable generation. These levels ranged from the case where only the minimum requirement of 4 TWh of renewable generation from the electricity sector is met, to one where the entire 10 TWh is met by the electricity sector.

The two other scenarios represent intermediate levels of renewable contri-

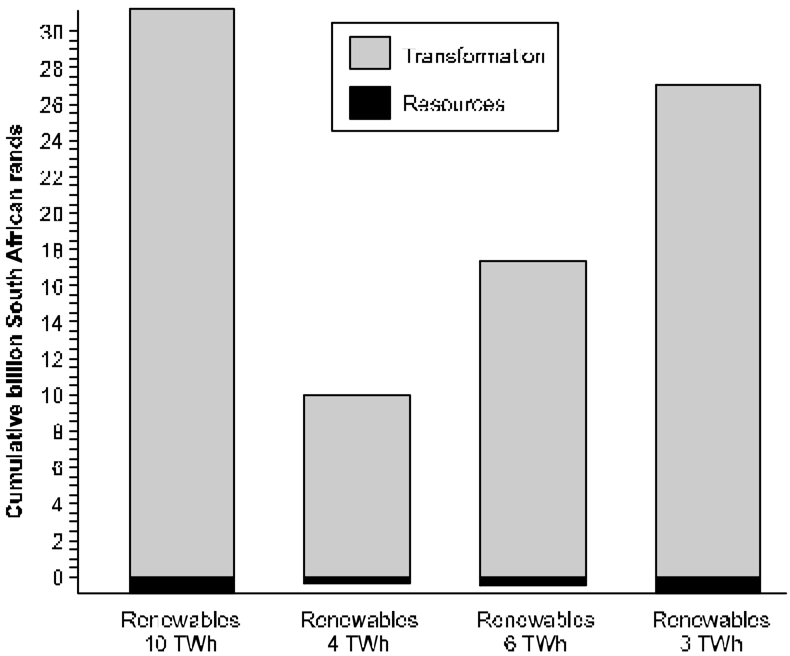

Figure 1: PAMS Costs – Year 2013: Cost all Costs

butions at 6 and 8 TWh. Renewables were assumed to replace baseload coal fired generation and were also assumed to be first on the power station merit order. The scenarios were also required to maintain the reserve margin at the same level as the reference case.

The LEAP software was used to develop a model of the South African electricity supply industry. All power stations (existing and future) were represented individually in the database. Scenarios were entered through exogenous specification of expansion plans.

Only costs relating to electricity generation were included in the analysis. These costs were broken down into investment costs, fixed operation and maintenance costs, variable operation and maintenance costs and fuel costs. The power stations were dispatched according to a specified merit order, with renewable generation assigned to come online first. Electricity demands were modelled in aggregate and were the same in all scenarios.

RESULTS

The main purpose of this exercise was to determine the financial cost of different renewable targets.

Figure 1 shows the added cumulative cost of each scenario in 2013 over the reference case. The values are thus the total added cost incurred due to the enforcement of a specified renewable contribution to total generation. We see from the chart that to reach the minimum requirement of 4 TWh, an additional 10 billion Rands will have to be spent over the next 9 years. This is equivalent to an increase of 8% over the reference case. The added cost is not only a reflection of the higher levelised costs of renewable technologies compared to those they are replacing, but also of the fact, that more total capacity is needed to maintain the reserve margin due to the intermittent nature of some renewable resources.

Figure 2 shows the difference in electricity generation by technology between the reference case and the different scenarios. Positive values indicate additional generation while negative values indicate less generation. Thus, the introduction of renewable technologies reduces the load factor of existing coal fired stations and delays the construction of new pulverised coal fired and fluidised bed combustion stations.

CONCLUSIONS

It is clear that the renewable targets will involve significant financial costs. The scenarios developed here indicate that the cumulative cost of meeting a target in the 4-10 TWh range is roughly 2.5 to 3 billion Rands per TWh.

The introduction of renewable electricity sources, mainly displaced gener-

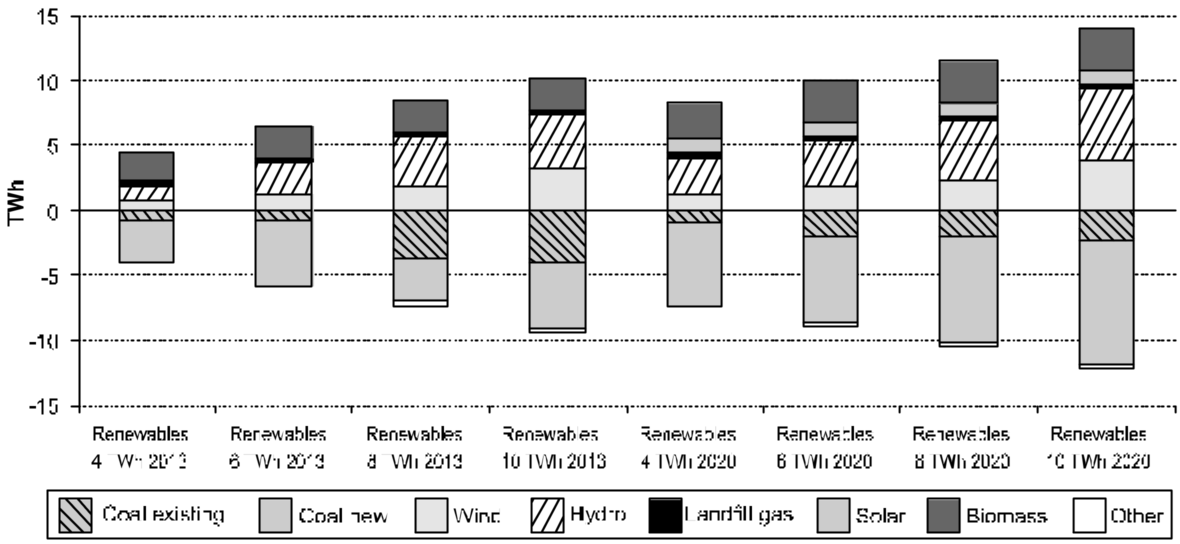

Figure 3: Difference in electricity generation by technology between reference case and different scenarios

ation from coal fired stations. Although not quantified here, this should lead to substantial reductions in green house gas emissions and other pollutants.

Wind generation has the largest potential, but is not among the cheapest alternatives, even at a 35% load factor. Co-generation from biomass is competitive, although the economics of this form of electricity production have been simplified in this analysis as related operations have been ignored. The costs of hydro installations vary widely, but there should be substantial potential for generation at a reasonably low cost. Currently, solar thermal generation has very high costs, but with the cost reductions estimated by the IEA, they become price competitive towards the end of the period. The IEA projections must, however, be seen as highly uncertain and very optimistic.

It should be possible to meet the targets at lower costs than those derived here. The scenarios have not been optimised and there is little reason to believe that the suggested expansion plans are the most cost effective, even when the diversification criteria introduced earlier is taken into account. It is therefore suggested that further studies into the matter include some form of optimisation routine.

The targets apply to energy consumption rather than production, and an issue that warrants further examination is that of system losses. In this study, all generation options have been charged with the same transmission and distribution losses, while in reality that the decentralised nature of renewable generation suggests that the incurred losses may be smaller than the system average. By differentiating losses from different generation options, the estimated costs of meeting the targets might be brought down further.

Renewable energy has a vital role to play if the world is going to tackle the long-term challenge of global climate change. South Africa has recognized this challenge and is committed to promoting greater use of renewable energy in its electricity sector. However, this study highlights some of the difficulties of introducing renewables in a country where fossil fuels (in this case coal) are available in large quantities and at very low cost. Indeed, the electricity produced in South Africa (primarily from coal) is among the cheapest in the World. In part, the low cost reflects the fact that significant environmental costs have not been included. Fully accounting for the greenhouse gas and air pollution impacts of coal, will undoubtedly make renewables look more attractive.

The LEAP data set described in this article is available for download from the COMMEND website.

Notes

1. Economic and Financial Calculations and Modelling for the Renewable Energy Strategy Formulation, Department of Minerals and Energy – Government of South Africa, February 2004.
2. National Integrated Resource Plan 2003/2004 – The National Electricity Regulator, 2004.
3. Renewables for Electricity Generation – Status and Prospects – International Energy Agency 2003.

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Energy modelling activities at the Energy Research Centre

Together with the US EPA, the ERC held a series of workshops to investigate development paths that would serve the dual purpose of reducing greenhouse emissions and increasing economic growth. A full set of proceedings and background material can be found on the ERC website. The EPA provided funding and technical guidance. This work forms part of a joint USA-SA bilateral agreement.

Recommended for perusal are proceedings from a recent conference held by Stanford University's Program on Energy and Sustainable Development (PESD): 'Electricity and the human prospect'. A draft paper investigating pro-poor energy policy, jointly written by UCT and Stanford's PESD can now be downloaded from the ERC website. In particular, we investigate the complementary roles of LPG and electricity.

Two new modelling studies are available from the Energy Research Centre. The first is an energy model that has been compiled using the LEAP (Long range Energy Alternatives Planning) software for the City of Cape Town. The work was undertaken as part of the Dutch Ministry of Foreign Affairs funded COMMEND program. The report can be downloaded from the ERC website and looks forward at how energy patterns might change in the city's future. The model database can be downloaded from the COMMEND website. Other ERC models that can currently be downloaded from this site include a renewable electricity supply model for South Africa.

The second study is an initial twelve-country optimisation energy supply model for the Southern African region. This work forms part of an M Sc thesis undertaken by ERC staff member, Thomas Alfstad. It considers scenarios of regional trade and was developed using the TIMES model generator. The thesis may also be downloaded from the ERC website.

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2nd Industrial and Commercial Use of Energy Conference

25 – 27 May 2005, Cape Town

OBJECTIVES

The first international conference on the Industrial & Commercial Use of Energy (ICUE) was held in Cape Town during the National Energy Month in May 2004, and because of the success of this first Conference, it was decided to have a follow up Conference in May 2005, coinciding once again with the National Energy Efficiency month.

ICUE (pronounced IQ) offers a forum for professionals and practitioners in all fields of commercial and industrial energy, to discuss developments in the effective use of all forms of energy.

ICUE will provide cutting-edge "real world" solutions to reduce energy related costs and improve overall performance in industrial plants, commercial, institutional and government facilities, with a full line-up of intensive seminars on a variety of current topics. Participants will learn about the latest regulatory and market trends, which have an impact on their decisions, and hear firsthand reports on successful projects and technology applications. They will explore the complete spectrum of resources now offered by energy service providers to help reduce energy costs, analyse energy data, develop demand side management strategies, upgrade equipment, electricity tariffs, obtain project financing and more.

There's no better way to find the immediate answers you need, and to assess the full scope of potential energy solutions available to you, than by attending the 2005 Industrial and Commercial Use of Energy Conference in Cape Town.

ICUE focuses on promoting sustainable development particularly in Southern African countries, through the effective use of energy. Developing as well as developed countries jointly face many challenges of a global nature, as was highlighted at the Johannesburg World Summit on Sustainable Development. Technical, economic, social and environmental issues will find a place in the envisaged energy-related plenary and theme sessions. Managing the rising cost of energy in all sectors has recently become an important field of study and expertise. It has therefore become important to address effective energy management in commerce and industry, with the aim of reducing operational costs and educating decision-makers about energy efficiency and how to implement effective energy saving measures and strategies.

Papers and networking events will establish opportunities for energy stakeholders, who include end-users, equipment suppliers, energy service suppliers, utilities, policy makers and academics. This may also lead to the formation of new business partnerships, especially during the Exhibitors forum.

CONFERENCE THEMES – ICUE

- Demand-side management and implementation strategies in the industrial and commercial sectors
- National Energy Efficiency Strategy
- Heating verification and air-conditioning optimisation
- Tariffs and metering and cost of electricity
- Industrial and commercial lighting
- Measurement and verification of energy projects
- Sustainable Energy Services and performance contracting
- Facility management, maintenance and commissioning
- Industrial energy system optimisation
- Self and co-generation
- Market rules for renewable energy power producers
- Climate change and Clean Development Mechanism
- Boilers, furnaces and steam distribution systems
- Energy management systems
- Africampus: Energy management on Campus

EXHIBITORS

Companies interested in exhibiting at the conference are invited to contact the Conference Secretariat. Early registration will secure a good exhibition site.

Contact: The Industrial & Commercial Use of Energy Secretariat
Fax: +27 21 460 3701
E-mail: icue@ctech.ac.za
Website: www.ctech.ac.za/users/visitors.html

May is Energy Efficiency Month

With more and more energy users, South Africa's energy reserves are becoming increasingly stretched. The Department of Minerals and Energy, the National Electricity Regulator and Eskom have got together to promote Energy Efficiency for May 2005. The aim is to encourage all South Africans to do their bit to save energy and save money as a result. Find out more on the Energy Efficiency website: www.enerficiency.org. za.

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UCT invitation to a lecture by Richard Heinberg

The South African New Economics Network (SANE) invites you to a lecture and discussion by Richard Heinberg.

Richard Heinberg is a futures analyst and author. He holds the view that the world is entering an era of rapidly declining petroleum production, with a fall in natural gas production following soon after. He argues that this decline in available energy must have severe effects upon the human race.

SANE has taken the initiative of inviting Richard Heinberg to South Africa for a series of talks, private meetings and seminars. His current focus is on the challenge of 'Peak Oil', a subject he has researched deeply and which he believes carries far-reaching economic, political and social implications world wide, most of them inadequately understood. He is coming to South Africa in order to help raise the level of public discourse around what actions are most appropriate, if we are to avoid the worst consequences of the imminent slow-down in global oil production.

Richard Heinberg is the author of six books including:

- *The Party's Over: Oil, War and the Fate of Industrial Societies* (2003), and
- *Powerdown: Options and Actions for a Post-Carbon World* (2004)

He is a core member of the Faculty at the New College of California in Santa Rosa, where he teaches a programme of *Culture, Ecology and Sustainable Community*. He writes an award-winning monthly *MuseLetter* (now in its 14th year, at *www.museletter.com*) and his essays and articles have appeared in many journals. His books have been translated into eight languages. He travels internationally to speak on the subject of Peak Oil, and has given over 100 presentations on the subject to academic and general audiences.

Heinberg writes: 'The world is about to plunge into a new era of dwindling fossil fuels, and no one is prepared. If the leadership of the US (and other countries) continues with current policies, the next decades will be filled with oil wars, economic collapse, and environmental catastrophe. The political elites find it difficult to understand or deal with the depletion of the resources that fuel the modern world. As a result, our global industrial civilization is likely to collapse as others have in the past, but this time the scale will be global.'

Heinberg will discuss the evidence for a near-term global peak in oil production, as well as the likely consequences for the economy, transport, agriculture, and geopolitics. These consequences include an inability to feed the present inflated global population. His presentation will be a starkly frank look at our prospects as the industrial period winds toward its inevitable conclusion. He will indicate the direction in which business, governments, academia and economists need to work to prepare a basis for survival.

The lecture details are:

When: 5 May 2005

Time: 1 pm

Venue: Menzies 10
Upper Campus
University of Cape Town

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Beyond BEST

An alternative for pro-poor energy pricing

The Basic Electricity Support Tariff (BEST) was designed to advance the welfare of poor households (UCT, 2002). Specifically, the South African government chose to supply 50 kWh Free Basic Electricity (FBE) per month per household. We illustrate an alternative that would cost less, with larger benefits for the poor. By offering electricity for free, FBE distorts the energy choices of poor households – encouraging them, for example, to cook with electricity when alternatives such as LPG can deliver a similar cooking service at a much lower cost to society.

INTRODUCTION

For a decade, the South African government has steadfastly supported energy policies that advance the welfare of the poor. These have included the world's most effective *policy* for electrifying low-income areas in urban and rural regions alike (Gaunt, 2004). In this tradition, the government has introduced a 'Free Basic Electricity (FBE)' scheme that will offer 50-kilowatt hours per month for free to most households that have access to electricity.

We suggest some caution and offer an alternative strategy that would cost government no more, yet deliver larger – possibly much larger – benefits for the poorest households while also lightening the stress on South Africa's increasingly strained power grid.

The offer of 50 kWh for free is likely to have a substantial effect on the energy choices of poor households. Detailed surveys of energy budgets in extremely poor electrified households – such as impoverished shacks in townships – show that when the household must purchase its electricity, usage varies, but is typically about 20 kWh. Electricity is more expensive than traditional alternatives such as coal or firewood for cooking and heating (Williams et. al., 1996); households use electricity sparingly. Typically, purchased electricity is used for television, lighting, electric irons, and a few other applications for which fuel substitutes are inferior or absent. For the most energy-hungry applications, however, traditional fuels continue to dominate (Afrane-Okese, 1998). Free electricity may change this.

In a trial run in 2002, government offered 50 kWh of free electricity to households for a one-year period. The response, documented in detail through Eskom's Load Research Programme, was a rapid rise in average monthly consumption of tens of kWh per household. There is reason to expect that the surge in demand will be even higher when households have confidence that free electricity is here to stay. As free electricity was offered in Khayelitsha, Cape Town, a survey by the University of Cape Town in January (Cowan and Mohlankoana, 2004) revealed that households are responding as expected. In ever-larger numbers, households are purchasing and using electric cookers, and there is some evidence that households are also using electricity for the bulk heating of water.

There is little doubt that free electricity has improved the livelihoods of poor households. FBE has reduced household expenditures and also expanded the use of a clean fuel at the expense of mainly dirty alternatives. Our question is whether it is possible to do better at the same cost.

METHODOLOGY

We focus on the most striking and possibly costly shift to free electricity – the use of electricity for cooking. This shift is worrisome because there are rivals for clean cooking – notably LPG stoves that will find it difficult to survive in the marketplace when electricity is free. Moreover, most cooking (with electricity) occurs during periods when electricity is already in peak demand. At the margin, this electricity is particularly costly for society since electricity is difficult to store and thus the entire electric power system must be sized for adequate supply during peak periods. We illustrate our point quantitatively by comparing electric cookers with LPG stoves, and we focus on the incidence of cooking during peak electric periods.

The South African electric power system is already close to peak capacity during winter months. New demand will require the construction of new power plants. Plants (and transmission and distribution lines) are needed not only to supply the quantity of power consumed, but also to preserve the buffer of about 15% (NER, 2004) extra capacity – known as the 'reserve margin,' which sits on call ready for dispatch should another generator or power line in the system fail. Incidentally, even without FBE, South Africa will require new power plants; the extra power consumed under FBE accelerates that need. The details of the calculations rely mainly on the same assumptions and models deployed in the National Electricity Regulator's (NER) most recent National Integrated Resource Plan (NER, 2004).

We assume that the hot plates introduced in response to FBE will operate 45 minutes per day (Cowan, 2004), with a 70% chance that this takes place during peak periods. Further, we assume that on average they are operating at 50% of their power level. Consider boiling food in water. When heating water, hot plates will be consuming close to maximum power. However, once brought to a boil the power will be reduced, and the average power consumed will be less than maximum power. During operation, these plates use electricity from, amongst others, baseload coal plants, which is extremely inexpensive: about R0.08 /kWh (NER, 2004), including the cost of maintenance, fuel and losses (including theft) that are typical of an electric service in low-income areas. We consider the cost of connection to the grid as largely 'sunk' and do not include the costs of transmission and distribution. These simplifications will act to underestimate the cost savings that would accrue from switching fuel use away from electricity.

For electricity supply, we assume that this new demand (often termed the 'marginal demand' by economists) for electricity will be served by an average blend of two types of plants: large coal-fired power plants typical of South Africa's present power system (which are 'on the margin' 80% of the time) and pumped storage facilities such as the Braamhoek Scheme (which are 'on the margin' 20% of the time). These assumptions are extremely conservative, as most cooking will take place when the system is near peak (e.g. late afternoon) and maybe the role for pumped storage (which is costly) may be even larger than we assume[1]. With our conservative assumption, the average marginal price of electricity generation is about R0.09 /kWh consumed.

Using a more realistic blend of plant (including an Open Cycle Gas Turbine OCGT plant) and marginal operating time, we would derive a marginal generation cost of about R0.17/kWh consumed. The table shows the operating, maintenance and fuel costs for these options.

The results are particularly sensitive to the assumptions about the relative roles for pumped storage and OCGT. As a general rule, pumped storage schemes are costly to build and require long lead times, but have low operating costs compared to OCGT. Thus, South Africa has built a few – and has begun the process to build one more. Once these facilities exist, there are strong incentives to use them. OCGT, by contrast, is relatively inexpensive to build but extremely expensive to operate. If the plant burns oil-based fuels, then during periods of high oil prices, power generation is especially costly. These units are much smaller in size and require less lead-time for construction; thus OCGT investments are easier to scale to the exact demand. In most of the world – where demand for peak power is rising sharply – these properties help to explain why such gas turbines are occupying an increasing role in the power system.

To illustrate what is at stake, we assume that power is dispatched on South Africa's power system at minimum cost. Thus, coal plants are constantly in operation; during non-peak periods extra electricity from these plants is used to pump water in pumped storage facilities. During peak periods, the pumped storage is used to the maximum extent possible, and any residual need for power supply is satisfied with OCGT. Using such a method, and looking over the next decade, we expect that OCGT plants will be needed to supply only a very small fraction of the extra demand for cooking power that FBE creates. However, during most peak periods, the OCGT plants are still essential – they maintain the reserve margin, which means that they incur the cost of construction and maintenance but not the actual cost of operation. All told, for every kilowatt of capacity required by low-income consumers at peak times, there is a once-off cost of R5 949 required. This is the per kilowatt cost of an OCGT plant inflated by the losses associated with transmitting and distributing it to the customers concerned. Again, we neglect the cost of having to increase the capacity of the transmission and distribution system. This again reflects a very conservative assumption.

To summarize, using our simplified and conservative assumptions, we may approximate the minimum cost of supplying electricity for cooking. We distinguish between, and account for, the cost of supplying electrical energy and the cost of maintaining the reserve margin. The cost of supplying electrical energy is a function of what plants are running 'on the margin'[2] while cooking is taking place. The cost of the reserve margin is the cost required to install the cheapest capacity on the grid, namely OCGT plant[3].

Suppose that electricity was not free. What alternative sources of heat energy might households select? We focus on LPG because it offers service that is comparable to electricity: quick heating with essentially zero indoor air pollution (Williams, 1994)[4]. Already many low-income households select LPG for cooking where it is available. From those markets, which are served mainly by private enterprise, we derive estimates of the actual costs for LPG services.

Compared with electric stoves, LPG systems[5] (stove, valve and tank) are about R50 more costly and have twice the lifetime: 10 years, rather than 5. The valve systems have a short lifetime of about 3 years. The retail price to fill a six-kilogram LPG cylinder is R36[6] (Tatham, 2004). We expect that these costs would decline with experience as the LPG business is still struggling to secure a foothold in these new markets and probably incurs higher costs than would prevail at a larger scale. However, for this analysis, we use these values.

RESULTS

The LPG option is less costly than electricity. Let us consider the cost of maintaining 1.5 kW of electric cooking capacity and the cost of 1.3kW LPG hotplates over a twenty-year period, which is the economic lifetime of the new OCGT plant. According to our assumptions, 1.5 kW of electric hotplate on average will consume 0.75 kW, and only 70% of these hotplates will be consuming electricity during peak periods. This implies that 0.525 kW, or R3 123 of reserve margin will not be needed for the LPG option. Over the period, the household would have invested in four electric hotplates, and these would have consumed on average 205 kWh per year, not all at peak

Table 1: Operating and Maintenance (O & M) and Fuel Costs for the three main options for generating peak power (NER, 2004)

Plant type	*Pumped storage gas turbine*	*Open cycle*	*Coal fired*
Units	R/kWh	R/kWh	R/kWh
Operating & maintenance	0.05	0.14	0.02
Fuel costs	0.06	0.81	0.04
Losses (T&D)	0.03	0.24	0.02
Total	**0.13**	**1.18**	**0.08**

times.

The total cost of the hotplates, reserve margin requirements and electricity (with our conservative assumptions and a 10% discount rate) is R3 522. The total cost of supplying the same cooking requirement using LPG systems, with two LPG stove/cylinder systems, seven valve systems, and similar quantities of fuel consumed, is R1 109. This means there is a (net present value) difference of R2 413 over the twenty-year period. This represents an average annual levelized (taking into account that money could be earned if it was left in the bank) saving of R258 per year, if households were to use LPG instead of electric hotplates. Again, we emphasize that this figure relies on conservative assumptions; higher savings are likely.

CONCLUSIONS

That amount (R258 /year) is approaching ten percent[7] of annual income for a typical poor household (poorest 10%). In other words, the distortion created by offering free electricity -which results in households cooking with electricity rather than gas – is a waste that could otherwise be used for other pressing needs. The amount is equivalent to removing the total cost of the LPG stoves and giving every household 3.3 free kilograms of LPG per month. This is more than sufficient to the very basic cooking requirements considered in this experiment. Such resources are substantial for the very poor; they also indicate the savings that government could capture with a better-designed energy policy for the poor.

Of course, the savings (of R258/year/household) we describe would accrue to society as a whole. Thus, the benefits to the target households will not change, but the cost of supply will be reduced[8].

Before turning to implementation, we note that these calculations are very sensitive to several assumptions. It depends on the peak coincidence factor—that is, the assumption that 70% of cooking occurs during peak periods. Our sense is that assumption is robust, and without real time pricing of electricity, it will be difficult to shift cooking behaviour away from peak periods. The crucial assumptions concern the technologies that will be used to supply peak power and maintain reserve margin.

As South Africa has already committed to building new pumped storage, we have assumed that the actual power generated by OCGT plant(s) is 0% of the total marginal power consumed by these hot plates. OCGT is used *only* to preserve the peak reserve margin.

However, there are three reasons to be sceptical of that assumption, and all three underscore that our calculations may be extremely conservative. One is that as households gain confidence that FBE is, indeed, a permanent policy they will optimise their investment in electric appliances (including stoves) to make fullest use of the free power. A second reason is that 50 kWh is not set in stone, and already there are agitations to raise the number – additional load would require additional operation of OCGT unless a substantial commitment was made to pumped storage facilities. Third, with time the rest of the economy is likely to shift as well, to a more peaky load profile; as that happens, the marginal kWh consumed through FBE increasingly require dispatch of OCGT.

Other assumptions to which the results are sensitive include the price of LPG[9] and the price of the appliance. We show in Table 2 below, annualised savings as a function of peak co-incidence factor, LPG[10] increases and increased appliance[11] costs.

Interestingly, with the high appliance and LPG cost assumptions, there is still a net saving to be had by moving to LPG of R147 per system for a twenty-year period.

DISCUSSION AND IMPLEMENTATION

These calculations illustrate the potential for substantial savings. They also suggest urgency for reform since expectations (and capital investments such as electric stoves) are solidifying around the promise of free electricity. Once those promises are cemented in place, it may be politically difficult to change course.

We focus on two options. For both, we assume that government will keep the social cost of pro-poor energy policy fixed. Our aim is to illustrate how deployment of the same level of public resources could yield much larger benefits for poor households.

The first option reflects what many governments in other countries have done. Namely, government could simply extend the policy of free (or cheap) energy services to a wider array of fuels, so as to re-level the playing field. It could cut prices on LPG, for example, so as to encourage its use. But such policies have two severe and, in our view, fatal problems. First, it is politically very difficult to contain costs through a policy that multiplies price distortions in an already distorted market. Government will find it very difficult to roll back the 50 kWh of free electricity already on offer; instead, it will probably find the need to add new cut price services on top of the existing subsidies. Second, managing behaviour and technological choices through distorted markets is extremely difficult and prone to failure. For example, although LPG appears to be superior for cooking, should government also offer subsidies for solar hot water heaters that, like LPG, are more cost effective than electricity for supplying the service of water heating in some settings? How will government

Table 2: Key assumptions and their effect on the annualised saving to society

Peak co-incidence factor	*Annualised saving in 2005 Rand*	*Appliance costs 2005R per system (% increase in costs)*	*Annualised saving in 2005 Rand (% increase in costs)*	*LPG costs in 2005 R/kg*	*Annualised saving in 2005 Rand*
100%	401				
90%	353	375 (140%)	225	11 (83%)	180
80%	305	175 (12%)	255	9 (50%)	211
70%	258	156	258	6	258
60%	210				
50%	162				

anticipate the rise of new technologies – will it offer to subsidize all newcomers, and will innovators of new technologies believe that such a promise is credible? Already LPG is at a disadvantage relative to paraffin as the latter enjoys special tax treatment. With time, such an approach to pro-poor energy policy is likely to become both expensive and highly market distorting.

A second option would make use of the market. We envision a simple but profoundly important change to the free electricity policy: offer free energy *equivalent* to 50 kWh per month. Allow households to choose the clean energy source that best meets their needs, rather than specifying (through an electricity-only subsidy) that the choice must be electric. The best way to implement such an approach will probably vary by region and type of household. For households that use pre-paid codes on their electric meters, the subsidy can be delivered by household, allowing the user to choose a mix of energy options adding up to be totally consistent with the subsidy. Such a system could be administered by means of distributing to consumers, vouchers or an 'energy card' akin to a bankcard. Approved vendors, whether LPG sellers or installers of solar hot water heaters, could debit the cost of their services directly from the cards or use the vouchers as a cash equivalent. This option[12] offers the opportunity to rectify a distortion that is already arising in electric services, with negative consequences for innovation and fairness in the provision of electric services: rural homes served by solar power have limited electricity supply. The approach proposed here, which would make free basic energy fungible for non-grid electric services as well as non-electric services, would level the playing field.

For households that have traditional meters (rather than pre-paid cards), implementation may prove more difficult. Such households presently receive FBE directly on their electric bills; for non-electric services to have easy access to the same subsidy, it may be necessary to create a scheme that would allow households to transfer some (or all) of their subsidy from the electric distributors to non-electric vendors. Such an approach may be cumbersome and could allow incumbent electric distributors to frustrate the policy by raising barriers and complications; those problems, however, are not appreciably different from those that arise with many types of regulation of electric distributors worldwide and can be overcome with relative ease and the focused attention of the NER.

We offer these calculations and thoughts on FBE reform in the spirit of directing a powerful locomotive before it travels too far down a track that could prove costly and much less effective than plausible alternatives. We accept the importance of pro-poor energy policies and propose reforms that could be surprisingly simple to implement yet profoundly important in multiplying the benefits to the poorest households from the offer of free energy. We also suggest that this reform will make it politically easier for government to contain the cost of these programs, and that a focus on performance will encourage innovators to devise a wider array of pro-poor energy services than would occur through an electricity-only approach. Indeed, this approach may alleviate pending power shortages on the national power grid due to current peak reserve limits and help serve at least two urgent national imperatives.

Notes

1. According to available Eskom statistics, historically, pumped storage plants have run at an annual load factor of 20% (Eskom, 1997). If pumped storage stations operate only at maximum power, these stations will be on the margin for 20% of the time for steady consumption through a 24-hour period. Cooking tends to take place closer to peak than off peak periods, and pumped storage stations need not operate at full power. This implies the assumption that pumped storage stations are on the margin for 20% of the time that energy is required, which is conservative.
2. In order to be conservative, we do not consider the capital cost component of new plants required to produce electricity.
3. In the NIRP analysis carried out by the national regulator, OCGT plants are built at various intervals during the twenty year planning horizon considered, and OCGT plants built during times of capacity requirements are not decommissioned. It is therefore reasonable, according to the NIRP activity, to assume that the minimum cost incurred to maintain the reserve margin is the capital cost of OCGT's.
4. We do not consider kerosene as an option due to health effects associated with the way in which it is commonly used. Several thousand die annually in South Africa due to poisoning and burns (compared to last year's ten using LPG). Further, compared to the popular kerosene wick stove, to supply the same quantity of useful heat for cooking, the running costs using kerosene are generally higher – often about 20%.
5. We obtain data from the Afrox-Wild Orchard pilot project (Tatham, 2004), with the cost of an LPG system, R156 and the equivalent single plate electric hotplate is taken as per local supermarket costs of about R110.
6. This is for a crude price of $50 per barrel. We assume that the Rand – Dollar exchange rate of six and the oil price remain constant during the period. We do, however, report the effect of increasing the LPG price used in this study by 80% in the sensitivity analysis in Table 2. The savings are still significant. Worthy of note is that the LPG costs are a function of crude price and not of new capital required for refinery investment.
7. This figure is approximately 6% considering that the poorest 10% of the population earn approximately R4 200 per annum.
8. It should be noted that a similar analysis should be carried out to establish the viability of LPG as a cost cutting measure more broadly than simply low-income consumers.
9. We assume that the changes in a crude price result in direct proportional changes in the LPG price.
10. We assume a delivered cost of 9 and 11R/kg, a 50% and 83% increase over the case study costs are used for this calculation. The increase could be taken to represent an increase in distribution costs or a similarly proportioned increase in crude prices.
11. We assume the costs of standard, but more expensive appliances available on the market, namely a CADAC and Easygas cylinder combinations, available at R375 and R175 respectively. We reiterate that the costs assumed for our primary calculations are based on field, rather than on hypothetical data and the costs assumed for this sensitivity are high.
12. It should be noted that this option requires further study to determine the practicality of such an administration.

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Darling wind farm's EIA approved

The Director-General for Environmental Affairs and Tourism, Dr C Olver, has decided to approve the proposed wind farm on the farm Windhoek in the Darling district of the Western Cape.

This facility will consist of four Danish designed wind turbines that will produce 1.3 MW of electricity each, bringing the total output of the wind farm to 5.2 MW.

This is the first renewable energy power generating facility to be developed by a private company, which will feed into the national power network. It will also be the first commercial wind farm in South Africa. The three turbines installed by Eskom last year is a research project.

It is of great significance that this country is now actively on the road to utilizing renewable sources of energy generation. This is a very important first step in our endeavours towards cleaner production and is of special importance so soon after the ratification of the Kyoto Protocol.

The project will be developed with the financial assistance from the Danish Government through Danida, their funding agency. It is being referred to as the National Demonstration Project, because it will be used as an example for future public-private partnerships in the establishment of electricity generation, which was historically largely the sole domain of Eskom.

The installation is to be erected below Moedmaag Hill, approximately 12 kilometres from Darling, along the way to Yserfontein on the West Coast. The structures will be 50 metres high and the blades will have a span of 31 metres.

This approval was granted after evaluation of the environmental impact assessment in terms of the environmental impact regulations as prescribed by the Environment Conservation Act. This study evaluated the possible negative and positive environmental impacts, and the Department of Environmental Affairs and Tourism came to the conclusion that the positive impacts will far outweigh any possible negative environmental impacts.

DME 2nd invitation to provide non-grid electricity and energy services concession

The Department of Minerals and Energy (DME) recently advertised a second invitation to pre-qualify for the provision of non-grid electricity and energy services concession in the North West Province and the Eastern Cape.

The 2nd invitation is due to an increase in the finance available from the German government through KfW to the South African government, making a total of approximately €20 m available to subsidise the investment costs of photovoltaic equipment.

The overall objective of the project is the 'improvement of living conditions by way of environmentally friendly and cost-efficient energy supply to poorer segments of the South African population in the project area(s). The objective shall be achieved through the installation, operation and maintenance of solar homes systems (SHS) for basic lighting and power and modern thermal fuels (MTF) for thermal requirements in homes, and by the installation of photovoltaic (PV) systems in schools and clinics within the service areas, by a non-grid energy service provider.'

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What was really behind the repeated power failures in Johannesburg?

Johannesburg has experienced continued electricity problems, even on Christmas Day. According to City Power, there has never been enough money allocated to municipalities to maintain networks. In Johannesburg, networks were installed from 1939 to 1949. Hurst Hill, the station responsible for keeping huge areas of Johannesburg in the dark for several days recently, was commissioned in 1959.

When City Power took over in 2001, before embarking on electricity network maintenance programmes, audits were carried out and a master plan was drawn up. City Power is in the third year of their five-year plan. So in two and a half years from now, the network should be at an acceptable level.

They say that they need about R2 billion to sort out the problem and it cannot be done all in one year, otherwise the whole city would have to be switched off! They have 'progress rolling plans' – with dates and designs as to what has to happen in what area! Among some of the delays is the acquisition of long-lead items such as transformers, which take about 12 months to manufacture. All their original equipment manufacturers, ABB, Alstom and Siemens – are in discussion with City Power every day. The Eskom Enterprises subsidiary company, Rotek, has done an audit of all transformers. ABB has done an audit of all protection systems.

The National Electricity Regulator (NER) has been conducting compliance audits for the various municipalities around the country. The NER view is that the main issues include the lack of funding and skills in the municipalities, and a lack of priority given to electricity delivery by local government. This does not necessarily apply to all municipalities, but where there are problems, this is usually the case. City Power has put plans into place to correct the problems. The NER acknowledges that City Power is channelling resources, skills and effort towards this correction. Some municipalities do not make any effort towards rectifying the problems – in some cases, there has been a total collapse of service delivery, not only for electricity.

Is the infrastructure able to cope with demand? Dr Steve Lennon of Eskom says that if we look at the larger scale transmission infrastructure in the country, which is reaching the middle of its life, it is extremely important that this is kept in good condition and as demand for electricity grows, we need to expand the infrastructure. Eskom has been looking at this for years, and Eskom's performance has been exceptional. Dr Lennon went on to say that last winter, the national infrastructure exhibited levels of reliability that has never before been experienced in South Africa. That infrastructure is continually being enhanced, constraints are continually being relieved and new infrastructure is being developed on an ongoing basis. Eskom has a capital expansion programme which will be financed through electricity tariffs – for this to be successful, the correct procedures must be in place in order to develop an infrastructure that can best service the needs of the economy.

Asked to comment on the lack of skills in the municipalities, City Power said there are no development programmes for young graduates as was the case in the past. They said that now they are working with the original equipment manufacturers, and have appointed many 'new and old' people and with the help of consultants, in some cases, retired municipality employees – either well qualified or well experienced – to transfer the skills necessary.

Following the incident at Hurst Hill Station, the NER issued a statement that it was concerned about the severity and large number of power interruptions in Johannesburg, and it would be conducting an audit this year. This audit will be aimed at assessing the situation at City Power on the ground – many interactions have taken place with City Power management who have explained plans, and who have provided performance information for two years, which has been analysed by the NER. The NER will now assess if infrastructure is well maintained and how the plans are put into practice. This is not unusual, as it has been scheduled for all the metropolitan areas for 2005.

The age of stations, such as Hurst Hill, is a countrywide concern. A number of municipalities are struggling with aged stations, Johannesburg has the worst problem.

The capital budget has been increased from R246 million to R469 million. Is that sufficient? There are other things that the City of Johannesburg has to do – management of waste, water, cleaning, roads etc. – moving from R200 million to R400 million for a mix of refurbishment, electrification, new service connections, public lighting which is being installed in the whole of Johannesburg! More than 50% of the total budget will go on refurbishment, upgrades and replacements. In some cases, it would be a waste of time to upgrade networks, as they have to be replaced.

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Climate change negotiations: Time for a change

By the time the international negotiations on climate change in Buenos Aires ended on Saturday, 18 December 2004, workers had already started dismantling the conference facilities. Yet after two weeks of negotiations, the best that the more than 6 000 participants could achieve was to reach an agreement on holding another meeting.

The Buenos Aires meeting was supposed to discuss what the world should do about climate change after 2012, when the Kyoto Protocol runs out. 'Quite frankly, we don't believe it's time to address the post-2012 time frame', said Harlan L. Watson, the USA's lead climate negotiator, on the second day of the meeting.

The USA has not signed the Kyoto Protocol, and has no intention of doing so. But as Michael Zammit Cutajar, the ex-Executive Secretary of the UNFCCC Secretariat, explained recently: 'The Kyoto Protocol['s] . . . market orientation was largely inspired by the USA [and] largely instigated by the negotiating positions of the USA.'

This 'market orientation' creates a new commodity - carbon cycling capacity. Carbon trading 'turns the earth's carbon-cycling capacity into property to be bought or sold in a global market,' states the Durban Declaration on Carbon Trading, which has been signed by more than 100 organisations.

On the afternoon of 14 December 2004, I sat at the back of the meeting room in Buenos Aires and listened to some of the issues being debated. Sure enough, the USA negotiators were rarely silent.

When I arrived, the item under discussion was L.21, which concerned the level of emissions for the base year of Croatia. The item read as follows: 'The Subsidiary Body for Implementation did not complete its consideration of this agenda item. It agreed to continue its consideration of this item at a future session.' Not much controversy there, I thought.

But the USA team felt they could not consider this item without seeing it in black and white. Negotiations stopped while hundreds of photocopies were run off, one for everyone in the room. The USA suggested that the Subsidiary Body for Implementation should consider Croatia's emissions for the base year at 'its next session, on the grounds that a future session may be SBI 63'.

Saudi Arabia promptly opposed the USA's amendment, without giving any reason. The Netherlands supported the amendment and asked why Saudi Arabia opposed it. The USA suggested that because it did not agree with the text of the informal consultations, which had taken place about Croatia's base year emissions and because Saudi Arabia disagreed with the USA's proposed amendment that 'we should set up a contact group' to discuss the matter further. After a pause, Saudi Arabia decided that it did, after all, agree with the USA's proposed amendment.

Next up was item L.21. This looked much more complicated, which was the report of The Global Environment Facility to the Conference of Parties. Agreeing to a two- sentence statement about Croatia, had taken 10 minutes. I imagined it could take several days to agree to a 12 paragraph global statement. Surprisingly however, the statement was accepted, apart from paragraph 11, which mentioned 'methodologies, indicators and data'. Argentina and China suggested amending the text. The USA and Japan disagreed with the suggested amendments. The discussion ran aground.

Daniela Stoycheva of Bulgaria had the unenviable job of chairing the meeting. She asked representatives from several countries, including the USA, the Netherlands, South Africa, Saudi Arabia, Argentina and Brazil to join her on the podium. They huddled together at the front of the meeting room. After around 15 minutes of private discussion, Ms. Stoycheca announced that 'the parties were able to agree'. The words 'methodologies, indicators and data' were removed from the report. Presumably the Global Environment Facility is to continue its operations without the drawback of having to consider anything as awkward as methodologies, indicators or data.

When the meeting closed, I headed out of the conference centre, past the little Ark that Greenpeace had built under a giant billboard advertising Coca Cola. Looking back at the entrance to the conference area, I read the sign announcing the Climate Change Convention meeting: 'To prevent the climate change, we have to change'. From the discussions that I'd listened to, I could only agree. A good start might be to change the way governments negotiate what they plan to do (or not to do) about climate change.

The participants at the next international climate change meeting, which is to be held in Germany in May, will not be allowed to discuss anything, which might lead to new commitments. The USA had refused to agree to a meeting focussing on compulsory reduction of emissions. Harlan Watson, the USA's lead climate negotiator, told the BBC, 'It is a give-and-take exercise and I think on balance, we are very pleased with the outcome.'

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Worldwide wind energy capacity added by 8 321 MW in 2004

The world market for electricity generation from wind energy once again developed very dynamically in 2004. Some 8 321 MW of new capacity was added, making a new record (in 2003, 8 129 MW was added) now totalling 47 616 MW worldwide (see Figures 1 and 2).

The new leader of new installation is Spain with 2061 MW, thus for the first time taking over the number one position from Germany (2020 MW). Germany, however, remains the leading country in terms of overall capacity representing one third of the global wind energy installations. India has established itself as the third biggest wind energy market worldwide in terms of new installations (875 MW). The Asian country is expected soon to get ahead of the former pioneer country Denmark – with an increase of only 7 MW – and become number four also in terms of total capacity. The Australian-Pacific region showed the highest growth rates of all continents: the installed capacity reached 547 MW compared with 233 MW in 2003, equalling a growth rate of 135%.

However, the global rate of growth fell from 26% in 2003, down to 21%. This is due to the fact that the wind industry has lost momentum especially in the former traditional core markets of Denmark, USA and, to a lesser extent, Germany.

GEOGRAPHICAL DIVERSIFICATION STRENGTHENS THE WIND INDUSTRY

In 2004, a clear diversification process can be observed concerning the distribution of the new market shares. Whilst in 2003, only ten countries had new installations of more than 100 MW, in 2004, 19 countries added more than 100 MW. It can still be stated that the five leading markets – Germany, Spain, USA, Denmark and India – are dominating the overall market with current installations of 37.7 GW. However, their share dropped in 2004 from 82% to 79%. In terms of additional capacity, the share of the top five markets (5 337 MW) reached 64% of the world market, after 79% in 2003 (see Table 1).

This diversification process will broaden the international basis of the wind industry and strengthen the domestic capacities in many parts of the world. Thus, an even stronger and more dynamic development of the worldwide wind energy utilisation can be expected in the near future.

EUROPE

Europe remains by far the leading continent in terms of installed capacity with 34.6 GW (72.7 % of the world's capacity). Germany lost its number one position in Europe and worldwide for the first time since more than a decade ago when it took the lead from Denmark. Spain, after the introduction of improved legislation in 2004, has become the leading wind market in terms of additional capacity and represents now one sixth of the worldwide wind capacity (8 263 MW). Many medium-sized markets bigger than 100 MW emerged in Europe in the past year. The highest growth rates (bigger than 50%) amongst these medium European markets could be seen in Norway, Ireland, Portugal and France (see Table 2).

AMERICA

The American continent represented 7 336 MW or 15.4% of the global wind capacity. In North America, the US market, after a record year in 2003, slowed down in 2004 due to the delay in the prolongation of the production tax credit with an additional capacity of only 370 MW (growth rate of only 5.8%) after 1 685 MW in 2003; thus, the US have lost the number two position in overall capacity to Spain and has even been topped by Japan in terms of new capacity. Canada has kept its position well and had a growth rate of 38% (122 MW added). However, the US market after the prolongation of the production tax credit (for two years) is expected to show significant growth rates in 2005.

No single Latin American country is represented any more amongst the top 20 wind markets. Brazil, however, is expected to start a dynamic development and make a substantial increase in the years 2006-2007, with the Proinfa programme to be implemented.

ASIA

Asia represented 4 726 MW or 9.9 % of the global wind energy market in 2004 (in 2003, the share was at 8.2 %). India once again is the leading wind energy market on the Asian continent, with additional capacity of 875 MW and a growth rate of 42%. Amongst the leading countries in Asia, there is Japan (896 MW), which had the highest growth rate in Asia (77.1 %) amongst the major Asian markets, and China (764 MW), which after the World Wind

Table 1: Worldwide wind energy installation figures per continent as at 31 December 2004
Source: WWEA member survey and own research

	Installed capacity 2004 (MW)	*Installed capacity 2003 (MW)*	*World market share in 2004 [%]*	*World market share in 2003 [%]*
Africa	391.7	271.5	0.8	0.7
America	7 335.5	6 842.6	15.4	17.4
Asia	4 726.0	3 217.6	9.9	8.2
Australia-Pacific	546.9	233.5	1.1	0.6
Europe	34 616.4	28 730.2	72.7	73.1
World	**47 616.4**	**39 295.3**	**100.0**	**100.0**

Energy Conference 2004 and the recent approval of the renewable energy legislation, is expected to have substantial growth in the near future. It is interesting to mention that Japan with an additional capacity of 390 MW has topped the United States and represented the fourth largest wind energy market worldwide in terms of new installations. Another interesting market in the coming years is going to be Pakistan, where the government has approved an ambitious wind energy programme.

AUSTRALIA-PACIFIC

The Australian-Pacific region has been the most dynamical region worldwide in 2004. Australia and New Zealand were the markets with the highest global growth rates with Australia almost doubling (from 197 MW up to 379 MW) and New Zealand more than quadrupling (from 36 MW up to 168 MW) their installed capacity. Together, both countries had installed 547 MW compared with 233 MW in 2003 – equalling a growth rate of 135%. The World Wind Energy Conference 2005 in Melbourne will discuss how to continue and extend this dynamic development of the wind industry in the region and beyond.

AFRICA

In Africa, 392 MW was installed by the end of 2004. Egypt was able to keep its position as the number one wind country on the African continent, with current total installations of 300 MW. Only little progress was made in the rest of the African countries, however, new installations are expected in the near future in Morocco, Egypt, Tunisia and South Africa.

Considering the huge need for a sustainable energy supply in many African countries, development strategies including stand-alone applications have to be developed and implemented as soon as possible in order to harvest the enormous wind potentials for the benefit of the African people of which a minor share have access to a public grid.

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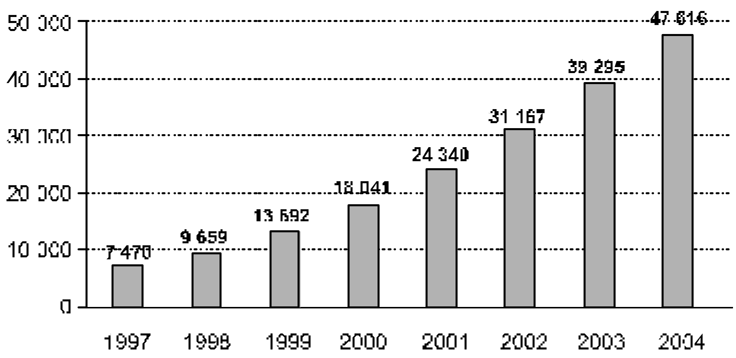

Figure 1: World wind energy – installed capacity (MW)

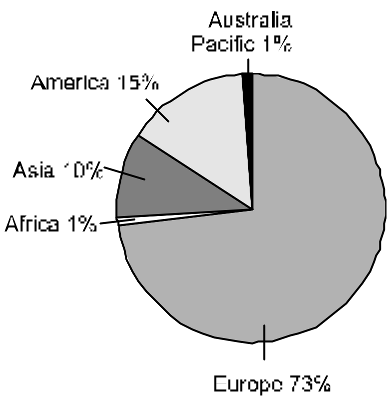

Figure 2: Wind energy – installed capacity by continent 2004 (Total 47.6 GW)

Table 2: Worldwide wind energy installation figures per country as at 31 December 2004
Source: WWEA member survey and own research

Country	*Additional capacity in 2004 [MW]*	*Rate of growth in 2004 [%]*	*Total capacity installed end 2004 [MW]*
Germany	2019.7	13.8	16.628.8
Spain	2061.0	33.2	8.263.0
USA	370.0	5.8	6.740.0
Denmark	7.0	0.2	3.117.0
India	875.0	41.5	2.985.0
Italy	221.0	24.4	1.125.0
The Netherlands	170.0	18.7	1.078.0
Japan	390.2	77.1	896.2
United Kingdom	240.0	37.0	888.0
China	197.0	34.7	764.0
Austria	191.0	46.0	606.0
Portugal	223.0	74.6	522.0
Greece	124.0	34.0	489.0
Canada	122.0	37.9	444.0
Sweden	43.0	10.8	442.0
France	138.0	55.6	386.0
Australia	181.8	92.2	379.0
Ireland	152.9	82.2	338.9
Egypt	120.0	66.7	300.0
Norway	176.0	176.0	276.0
New Zealand	131.6	362.5	167.9
Belgium	27.0	39.7	95.0
Finland	29.5	57.8	80.5
Costa Rica	0.0	0.0	79.0
Ukraine	12.2	21.6	68.6
Korea	48.3	209.3	68.4
Poland	6.0	10.5	63.0
Morocco	0.0	0.0	53.9
Luxembourg	13.0	59.1	35.0
Argentina	0.9	3.5	26.6
Latvia	2.0	8.3	26.0
Brazil	0.0	0.0	23.8
Turkey	0.0	0.0	20.6
Colombia	0.0	0.0	19.5
Tunisia	0.0	0.0	19.0
Czech Republic	7.0	70.0	17.0
South Africa	0.2	1.2	16.6
Iran	0.0	0.0	11.0
Russia	0.0	0. 0	10.8
Switzerland	3.7	69.8	9.0
Lithuania	5.0	250.0	7.0
Croatia	6.0	–	6.0
Estonia	3.0	100.0	6.0
Slovakia	3.0	150.0	5.0
Hungary	1.2	60.5	3.3
Nigeria	0.0	0.0	2.2
Cyprus	0.0	0.0	2.0
Chile	0.0	0.0	2.0
Syria	0.0	0.0	1.45
Romania	0.0	0.0	1.0
Bulgaria	1.0	–	1.0
Cuba	0.0	0.0	0.45
Uruguay	0.0	0.0	0.15
World	**8.321**	**21.2**	**47.616.4**

A light bulb moment for Cape Town advertising agency

Young & Rubicam (Y & R) Cape Town, has recently launched the new Eurolux energy saving light bulbs campaign, consisting of TV, outdoor and print elements illustrating the difference between waste and saving in humorous ways - who doesn't go 'ag shame' at the little dog, Brutus, when it is confronted by a huge bowl of food?

Clever comparisons in the print campaign between the two types of light bulbs (Edison and Einstein) clearly illustrate that Eurolux is the intelligent choice, with the tag line 'Uses 80% less electricity. Lasts 6 times longer' boldly branded at the bottom of the page.

The TV campaign reveals these benefits by making consumers consider how much they waste every day. One ad features an old granny throwing away most of a perfectly good chicken roast to the dismay of her guests, and the other ad shows a man feeding his miniscule dog a massive heap of dog pellets. These images are followed by a clever line reading, 'imagine wasting 80% of everything you use'. The point comes across - why should you waste 80% of your electricity, when you can save 80% with Eurolux?

The billboard is clear and simple, yet eye-catching, tying in with the other campaign elements. It features an eye-catching cut-out of the Eurolux globe along with the tag line, "Uses 80% less electricity" displayed boldly alongside.

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A final word on carbon capture and storage

With reference to Richard Worthington's article ('Avoidance is better than capture' EMN, December 2004), I have thought about it and have realised that I had not expressed myself well enough for someone who maybe less informed. Perhaps with a second bite at the issues, and with the aid of a few graphs, I might manage to improve Mr Worthington's understanding.

He claims that avoidance (Kyoto style) is better than capture. The trouble is that Kyoto avoids very little – he says, 'The Kyoto targets are certainly no more than a faltering first step,' and I entirely concur. When Russia became a signatory to the Protocol, developed countries responsible for about 55% of the 1990 emissions agreed to reduce them to a small percentage below the 1990 level. Those responsible for the other 45% included the USA and Australia. Developing nations were left entirely out of the equation.

We can model the impact of Kyoto. In 2000, the Intergovernmental Panel on Climate Change produced a Special Report on Emission Scenarios (SRES). The scenarios varied enormously, covering a whole range of options from wildly optimistic to wildly pessimistic. However, an average scenario showed business largely as usual, and developing countries not becoming too fossil-fuel-consuming. Under this scenario, emissions grew from about 6Gt carbon equivalent in 1990 to 17.5Gt in 2100. The CO_2 in the atmosphere, which was about 355ppm in 1990 and 376ppm in 2003, would have grown to about 700ppm.

If one then models the impact of Kyoto under this scenario, you find that it will cause a small reduction by 2100, to about 680ppm. This is shown in Figure 1. In other words, Kyoto, which was proposed in 1997 and came into effect eight years later, will cut the growth in CO_2 by about 6 years. By doing nothing, in 2094 we will reach the levels we might have reached under Kyoto in 2100. Eight years of hopes have gained us only six years of grace. Mr Worthington's belief notwithstanding, it does not appear that we should place great faith in multilateral conventions.

If Kyoto is ineffectual, one has to ask what the next step might be? Of course, we could all ride bicycles and hope that the wind would blow strongly enough to allow us to cook our suppers, but would the developing world, deprived of the energy the developed world has enjoyed, be able to develop fast enough to relieve the burden of poverty?

As a first step, let us try to reach an atmospheric CO_2 level that does not continue growing unsustainably, as Figure 1 indicates would be the case. There has been a lot of debate around this topic, and a measure of consensus is approaching. This level is a target of 550ppm CO_2 in the atmosphere. Of course, this is higher than some would have it, but it is a level that allows for the phasing out of many existing sources and their replacement by sources that emit far less – in a nutshell, it is a realistic level.

Figure 2 shows the energy sources for one of the many scenarios in the SRES, adapted to take account of carbon capture and storage (CCS) possibilities. Thermal coal uses rise slowly to 2020 and fall off throughout the rest of the century. It is replaced by coal carbon capture and storage from about 2025 onwards, and also by natural gas, which is a far cleaner fuel. The use of natural gas also rises, from about 100 Exajoules today to about 300 EJ by

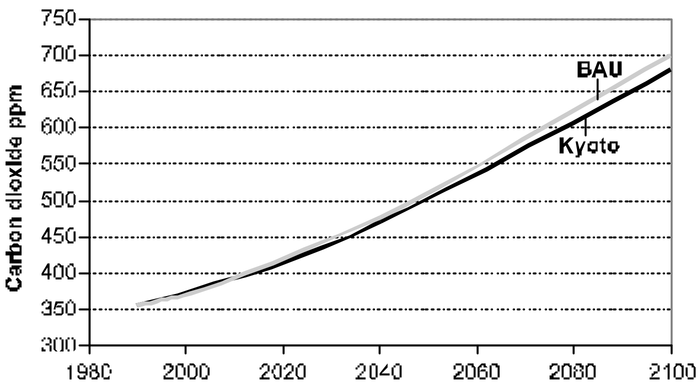

Figure 1: Comparison of business-as-usual (BAU) and Kyoto scenarios

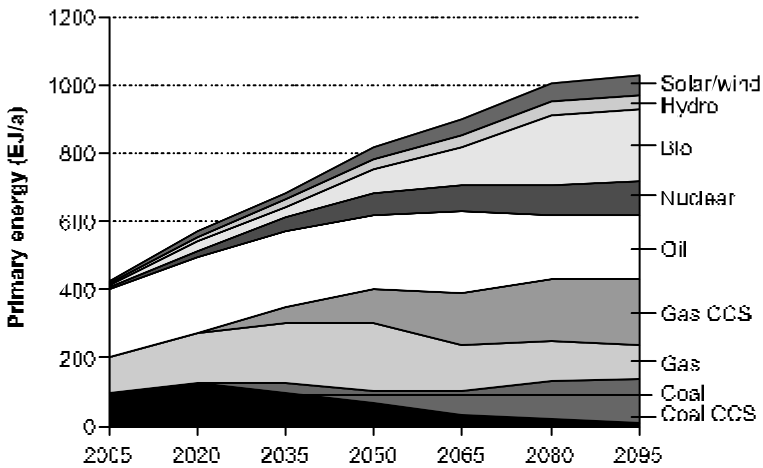

Figure 2: An energy scenario for the 21st century

2095, but from about 2020 onwards, its use is increasingly the subject of capture and storage (it is easier to apply CCS to natural gas than to coal operations).

In this scenario, the use of oil would rise until about 2065, after which oil shortages would increase the price and alternative fuels would take its place. Nuclear's role would increase slowly throughout the century, contributing perhaps 90EJ towards the close. Biofuels would increase dramatically from mid-century onwards, as the role of oil declined. The contribution from hydro energy and solar/wind energy would also increase slowly, and by similar amounts.

This scenario is one of the less conservative ones, and would see some 22MtC emitted by 2095. Nevertheless, it is possible to drive the atmospheric concentration to 550ppm equilibrium even with this scenario, largely because of the adoption of capture and storage. This is shown in Figure 3.

To achieve 550ppm, the allowable carbon emissions would rise to nearly 10GtC/year by 2035, and then drop to about 6.5GtC by 2095.

The savings in carbon emission compared to a business-as-usual baseline would be:

1. A growing contribution from CCS, particularly from 2035 onwards, and reaching about 5GtC by the end of the century.
2. A somewhat lesser contribution from the replacement of coal-derived energy by natural gas, which levels out at about 3.5GtC towards the end of the century as natural gas reserves are depleted.
3. A contribution of about 1.2GtC/year by 2095 from the use of nuclear power.
4. A larger contribution of 1.8GtC/year by 2095 from renewable energy (which is nevertheless smaller than might be expected from the data shown in Figure 2, because the widespread use of renewables incurs significant emissions, and Figure 3 shows the *net* savings), and
5. A rapid increase in savings due to energy efficiency, reaching as much as 3.5GtC/year by 2095, brought about by the rising price of oil and other energy sources from mid-century onwards.

This is just one example of the way in which CCS could play a role in helping to stabilize carbon dioxide concentrations in the atmosphere at reasonable levels. Of course, its role can vary depending on the scenario chosen – one could be very optimistic, and hope that the USA might drop its oil consumption from 2.5t/capita/anum to more like 0.4t/capita/annum averaged the rest of the world over, but the chances of that happening in the foreseeable future seem slender. Alternatively, one could be very pessimistic, and see China growing to be as dominant economically as the USA is today, and with a similar level of emissions. However, we have found that, almost irrespective of the scenario, achieving a low equilibrium level of CO_2 in the atmosphere demands the inclusion of capture and storage technologies in the suite of technologies adopted to control emissions.

This basically was the message of my original piece (Carbon capture and storage, EMN, September 2004). I have read that original piece again, and now recognize that it suffered from a dearth of hard data. I hope what I have written above gives enough data for the less informed to understand why CCS has a significant role to play, and why multilateral agreements are likely to mislead if you don't understand the numbers. Hope is a wonderful emotion, but it always needs to be tempered by reality.

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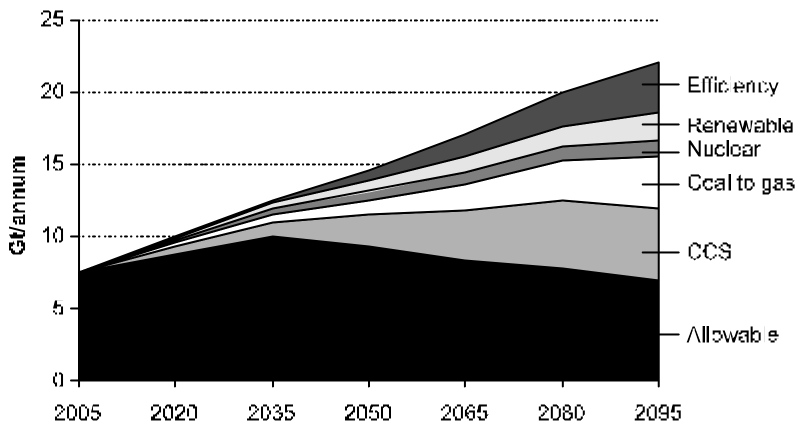

Figure 3: Energy contributions and carbon savings under the scenario shown in Figure 2

Energy events 2005

APRIL 2005

18 – 22

7TH PAN AFRICAN POWER CONGRESS
Johannesburg, South Africa

Contact: Terrapinn
Tel: +27 11 463 6001
Fax: +27 11 463 6000
E-mail: enquiry.za@terrapinn.com
Website: www.powergenerationworld.com

19 – 20

WESTERN STATES COAL MINE METHANE RECOVERY AND USE WORKSHOP
Grand Junction, Colorado, USA

Contact: Jim Marshall
Tel: +1 970 245 4088
Website: www.ravenridge.com/methane_workshop_2005.htm

21 – 22

ENABLING ENERGY EFFICIENCY THROUGH THE IMPLEMENTATION OF RENEWABLE ENERGY
Cabanga Conference Centre, Northriding, Johannesburg, South Africa

Contact: Trade Conferences International, P.O. Box 655, Fourways, 2055, South Africa
Tel: +27 11 803 0009 or 086 304 027
Fax: +27 11 803 5500
E-mail: info@tci-sa.co.za

24 – 29

WORLD GEOTHERMAL CONFERENCE 2005
Antalya, Turkey

Contact: ISEV Consortium
Tel: +90 212 244 7171
Fax: +90 212 244 7181
E-mail: admin-wgc@wgc2005.org
Website: www.wgc2005.org

25 – 27

POWER PLANTS IN COMPETITION 2005 REGULATORY FRAMEWORK, MARKET AND ENVIRONMENT PROTECTION
Potsdam, Germany

Contact: VGB
Tel: +49 201 81 28 251
Fax: +49 201 81 28 321
E-mail: marlies.mix@vgb.org
Website: www.vgb.org

MAY 2005

5 – 7

CLEAN ENERGY TECHNOLOGY AND INVESTMENT SHOW
London, United Kingdom

Contact: Nial Barker, LPB Events, 18 King Edward Buildings, 629 Fulham Rd, London, SW6 5UH, United Kingdom
Tel: 0944 (0) 207 751 9998
Fax: 0944 (0) 207 751 9996
Mobile: +0944 (0) 7973 224 764
E-mail: nb@clean-energy-expo.com
Website: www.clean-energy-expo.com

11 – 12

GASTURBINEN UND GASTURBINENBETRIEB 2005
Dresden, Germany

Contact: VGB
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Fax: +49 201 81 28 321
E-mail: diana.grabowitz@vgb.org
Website: www.vgb.org

15 – 18

WINDPOWER 2005 – CONFERENCE AND EXHIBITION
Denver, USA

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Tel: +1 202 383 2500
Fax: +1 202 383 2505
E-mail: sminer@awea.org
Website: www.awea.org/wp05.html

19 – 21

PALENC 2005 – PASSIVE AND LOW ENERGY COOLING FOR THE BUILT ENVIRONMENT
Santorini, Greece

Contact: Heliotopos Conferences
Tel: +30 210 973 0697
Fax: +30 210 976 7208
E-mail: palenc2005@heliotopos.net
Website: http://palenc2005.conferences.gr

SOLAREXPO – DELIVERING A SUSTAINABLE FUTURE
Vicenza, Italy

Contact: Expoenergie
Tel: +39 0439 84 7652
Fax: +39 0439 84 9854
E-mail: expoenergie@expoenergie.it
Website: www.solarexpo.com

23 – 25

RISO INTERNATIONAL ENERGY CONFERENCE 2005 – TECHNOLOGIES FOR SUSTAINABLE ENERGY DEVELOPMENT IN THE LONG TERM
Roskilde, Denmark

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Fax: +45 4677 5199
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Website: www.risoe.dk/conferences/energy-conf05

25 – 26

ALL-ENERGY OPPORTUNITIES 2005
Aberdeen, UK

Contact: All Energy Opportunities
Tel: +44 20 8241 1912
Fax: +44 20 8940 6211
E-mail: info@all-energy.co.uk
Website: www.all-energy.co.uk

25 – 27

NORTH SUN 2005 – 10TH ANNUAL CONFERENCE ON SOLAR ENERGY AT HIGH LATITUDES
Vilnius, Lithuania

Contact: Edita Milutiene
Tel: +370 5 235 5103
E-mail: ateik@centras.lt
Website: www.northsun.org

25 – 28

4TH INTERNATIONAL CONFERENCE FOR RENEWABLE ENERGY, ENERGY SAVING AND ENERGY EDUCATION
Havana, Cuba

Contact: Dr Conrado Moreno
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Fax: +537 267 1644
E-mail: cier2005@ceter.cujae.edu.cu
Website: www.cujae.cu/eventos/cier

JUNE 2005

1 – 2

VGB WORKSHOP – 'FLUE GAS CLEANING 2005'
Brussels, Belgium

Contact: VGB PowerTech eV.
Tel: +49 201 812 8274
Fax: +49 201 812 8364
E-mail: inse.moors@vgb.org
Website: www.vgb.org

21 – 22

ESTEC2005
Freiburg, Germany

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Tel: +32 2 54 6 1938

Fax: +32 2 54 6 1944

E-mail: info@estif.org

Website: www.estif.org

21 – 23

ENERGY TRANSFORMATION IN SADC 2005
Hilton Hotel, Sandton, Johannesburg, South Africa

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Fax: 086 676 6245

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E-mail: samuel@lbi.co.za

Website: www.lbi.co.za

22 – 24

AFRICA ENERGY FORUM
Barcelona, Spain

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E-mail: bruno@energynet.co.uk
Website: www.energynet.co.uk

ENABLING FRAMEWORKS FOR SUSTAINABILITY – WORKING TOWARDS TRIPPLE BOTTOM OUTCOMES: LEGAL, SOCIAL AND PROFESSIONAL DEVELOPMENT
University of Pretoria, Pretoria, South Africa

Contact: The Conference Secretariat, Kruger & Associates, P.O. Box 78, Victoria West, 7070, South Africa

Tel: +27 53 621 1174

Fax: +27 53 621 1175

E-mail: kruger@kruger-associates.com

JULY 2005
11 – 15

A NEW CONTRIBUTION AGAINST GLOBAL WARMING – INTRODUCING AFRICA'S ELECTRIC POWER ENGINEERING RENAISSANCE
Durban, South Africa

Contact: IEEE

E-mail: pes-africa@ieee.org

Website: www.ieee.org/pes

12 – 15

NUCLEAR POWER ASIA PACIFIC 2005
Hong Kong, China

Contact: Terrapinn

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E-mail: brendan.gow@terrapinn.com

Website: www.terrapinn.com/2005/nps_AU

13 – 15

INTERNATIONAL HYDROGEN ENERGY CONFERENCE AND EXHIBITION, ISTANBUL, TURKEY

Contact: Congress Secretariat

Tel: +90 212 347 6300

Fax: +90 212 347 6363

E-mail: dekon@dekon.com.tr

Website: www.dekon.com.tr

AUGUST 2005
8 – 12

ISES 2005 SOLAR WORLD CONGRESS – BRINGING WATER TO THE WORLD
Orlando, USA

Contact: American Solar Energy Society

Tel: +1 303 443 3130

Fax: +1 303 443 3212

E-mail: ases@ases.org

Website: www.swc2005.org

SEPTEMBER 2005
12 – 15

BIOENERGY 2005 – INTERNATIONAL BIOENERGY AND WOOD EXHIBITION
Jyvaskyla, Finland

Contact: Petteri Rasanen

Tel: +358 14 334 0022

Fax: +358 14 445 1199

E-mail: bioenergy2005@jsp.fi

Website: www.finbioenergy.fi/bioenergy2005

14 – 17

18TH WORLD LP GAS FORUM AND GAS EXPO 2005

Shanghai, China

Contact: 18th World LP Gas Forum Organising Secretariat
Tel: + 33 (0) 1 53 85 8265
Fax: + 33 (0) 1 53 85 8283

E-mail: wlpgas2005@mci-group.com
Website: www.wlpgasforum2005.com

20 – 24

HUSUM WIND
Husum, Germany

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Tel: +49 4841 9020

Fax: +49 4841 90 2266

E-mail: info@messehusum.de

Website: www.messehusum.de

22 – 25

IHE – WOOD ENERGY 2005 – INTERNATIONAL TRADE FAIR AND

CONFERENCE FOR WOOD ENERGY, Augsburg, Germany

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Fax: +49 71 213 0 1610

E-mail: redaktion@energie-server.de

Website: www.ihe-woodenergy.com

25 – 29

18TH WORLD PETROLEUM CONGRESS
Johannesburg, South Africa

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Tel: +44 207 596 5080

Fax: +44 207 596 5106

E-mail: info@18wpc.com

Website: www.18wpc.com

OCTOBER 2005
13 – 15

PVSEC-15 – 15TH INTERNATIONAL PHOTOVOLTAIC SCIENCE AND ENGINEERING CONFERENCE AND EXHIBITION
Shanghai, China

Contact: Worldwide Exhibition Services

Tel: +86 21 523 40653

Fax: +86 21 523 40649

E-mail: srexpo@sh-wes.com

Website: www.sh-wes.com

26 – 28

BIOENERGY 2005 – INTERNATIONAL NORDIC BIOENERGY CONFERENCE
Trondheim, Norway

Contact: NOBIO

Tel: +47 23 36 5870

Fax: +47 22 60 4189

E-mail: post@nobio.no

Website: www.nobio.no

NOVEMBER 2005
2 – 5

4TH WORLD WIND ENERGY CONFERENCE AND RENEWABLE ENERGY EXHIBITION
Melbourne, Australia

Contact: www.wwec2005.com

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

Energy Management News

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