



South African NEET Workshop

Energy Technology Collaboration

Sandton Convention Centre
Johannesburg
20 – 22 February 2007

SUMMARY NOTE



s a n e r i
South African National Energy Research Institute



SUMMARY NOTE

South African NEET Workshop
Energy Technology Collaboration

Sandton Convention Centre
Johannesburg
20-22 February 2007

Summary of the NEET Workshop

SANERI, the new South African National Energy Research Institute, and the International Energy Agency (IEA) have concluded their first energy technology collaboration workshop. The workshop was one of the activities initiated by the G8 Gleneagles summit in 2005, also attended by South Africa as well as Brazil, China, India and Mexico.

The G8 (Group of Eight) is the international forum for the leaders of eight countries representing about 65 percent of the world's economy. They have supported the IEA to take action to better link the IEA's technology network with the five rapidly growing economies represented at Gleneagles. For this purpose, the IEA has created an outreach programme called NEET (Networks of Expertise in Energy Technology).

South Africa has taken the lead in organizing a first workshop together with the IEA's NEET Initiative to facilitate a comprehensive exchange about programmes and to explore opportunities for strengthening international ties.

The three-day NEET workshop took place in Johannesburg from 20 to 22 February 2007. Support was also given by the international Renewable Energy and Energy Efficiency Partnership (REEEP), and the South African Fossil Fuel Foundation (FFF).

Mr. M. Mangena, South African Minister of Science and Technology, opened the event on Tuesday, 20th February 2007. More than 100 South African key stakeholders and 20 international experts spent three days exchanging information about their various programmes. Solar, wind, hydropower, cleaner fossil fuel power production, improving energy efficiency, demand side management, information dissemination and energy modelling have been addressed, and possible areas for future joint action have been explored.

IEA's collaborative programmes, the Implementing Agreements and IEA Working Parties have issued invitations to South African stakeholders to mutually share expertise and join forces with the IEA's energy technology network experts from governments, industry and research institutions.

The event was instrumental in reviewing the status and challenges of selected technologies and related policies in South Africa and in the IEA's international energy technology network. It was recognised that in many areas goals and challenges have remarkable similarities. There were other areas where national South African priorities are not covered by other international programmes but which could be addressed in the future.

The workshop was divided into individual sessions where first the international perspective was presented, followed by an overview about the status in South Africa. Finally, there were comments by a representative from industry or other stakeholder in South Africa.

From the sessions the following highlights have been noted by the rapporteurs:

RENEWABLE ENERGY SESSIONS

General remarks:

The IEA Renewable Energy Working Party (REWP) invites SANERI, on behalf of the South African government, to attend the 52nd REWP meeting as an Observer in October 2007 in Germany. In this context, REWP resolves to grant South Africa “observer” status for future REWP meetings. In addition, REWP invites South Africa to participate at future REWP Spring workshops.

REWP proposes to organise a representative event in South Africa together with SANERI, ESKOM and other selected stakeholders in October 2008, back-to-back with its 54th REWP meeting. Such an event would be coordinated as a reference event for Sub-Saharan Africa, with South Africa playing a regional leadership role. In the run-up to this regional conference, REWP - in conjunction with the Implementing Agreements – offers to define specific “case study” projects with SANERI on technology applications and capacity building.

REWP also encourages participation by South Africa in at least two or three renewable energy Implementing Agreements (IAs), possibly Solar Heating and Cooling (SHC) and two others, in addition to those which the country already is a Contracting Party to, namely the SolarPACES and Bioenergy Implementing Agreements.

Renewable Energy IAs will offer SANERI a selection of products, such as reports and analysis, to appreciate the potential added value the IAs can provide to South Africa and neighbouring countries. Such preliminary provision of information will assist SANERI in evaluating and selecting which IAs to join. SANERI experts will be invited as observers to IA Executive Committee (ExCo) meetings.

SolarPACES

South Africa, represented by ESKOM, is already a full member of this Implementing Agreement, reflecting its great potential for concentrated solar power (CSP). The SolarPACES and ESKOM representatives noted that considerations in CSP’s favour include its capability to deliver large scale grid-connected base load power, its complementarity with hydro and wind power, its integrated energy storage capacity, its limited macro-environmental impacts and its potential for cost competitiveness. The value to South Africa of having access to international knowledge and experience through this IA was acknowledged.

Solar Heating and Cooling

Solar water heating and cooling (SHC) were identified as having particular relevance to South Africa to address rural energisation and to moderate the growth of electricity demand. Applications for SHC in South Africa include active space cooling, water heating, space heating, food processing and daylighting. Mechanisms for increased use of SHC technologies were the identification of negative impacts of existing energy service provision; the assessment of opportunities for substitution with SHC systems; investment of R&D and feasibility; and investment in system deployment.

South Africa has been formally invited to join the SHC IA and several South African participants, including universities, expressed interest. South Africa is invited to attend the next ExCo meeting as an Observer. This IA appears to be one of the most promising for South Africa.

Wind Energy Systems

The South African Wind Energy Programme has commenced in January 2007 with a target of 45MW by 2012. Developing a stable and supportive regulatory framework is crucial. Several areas of common interest for international cooperative research in the wind energy field were identified:

The design and operation of a power system with a representative penetration of wind energy, while operating (almost) isolated from the neighbouring countries, as South Africa is, constitutes an extremely relevant case study for the IEA. Wind countries participating in Task 25 (Design and operation of power systems with large amounts of wind power).

The level of development of the South African transmission and distribution network also allows the most recent optimization methodologies to be applied. This relates to the objective of minimisation of grid integration costs while maintaining the overall power quality and high level of the system's performance (Task 25 and follow-up of Task 21 – Wind Park Dynamic Models for Power Systems).

On a different scale approach it seems highly desirable to have a close international D&D cooperation in the isolated hybrid systems using small wind turbines area, and thus contributing to the national objective of wide rural electrification serving the vast majority of the South African population (Task 11 – Base Technology and new R&D task on small isolated systems to be created).

South African participants also expressed their interest in the integration of wind and hydropower task, operated by IEA Wind as Task 24.

As a first step, South Africa was invited to attend the next ExCo meeting to be held in Korea in April 2007.

Hydropower

The most promising area for collaboration seems to be small hydro since South Africa has identified significant potential in this area. The South African government determined in a macroeconomic analysis accompanying its 2003 White Paper on Renewable Energy that hydro can provide a 10% share of least-cost RET deployment to achieve the 2013 target of 10,000 GWh renewable energy contribution to final energy consumption. This technology can also contribute to rural electrification. Enhancing the number of qualified personnel for project development and within regulatory bodies is key. South Africa may benefit from the experiences learned by IEA countries to raise public awareness of the issues related to hydropower and facilitate their acceptance.

South Africa can offer case studies of great interest. South Africa is invited to attend the most relevant upcoming Task (Annex) meetings.

Photovoltaic Power Systems (PVPS)

South Africa is conducting cutting edge research in several areas, including ribbon silicon and thin film technologies. Rural energisation for developing countries (Task 9), hybrid systems and mini-grids (Task 11) and system performance (Task 2) appear the most relevant to South Africa besides the mandatory information dissemination task (Task 1). The possibility exists for new tasks depending on South Africa's specific research interests. The issue of energy storage in specific climates, such as South Africa, could be the focus of a specific PVPS study.

South Africa has been invited to participate as an Observer at the next ExCo meeting in mid April 2007 in Athens. Further discussions were proposed on South African participation. The IEA was invited to participate in the Solar World Congress to be held in Johannesburg in October 2009.

Hydrogen

South Africa has developed a national RD&D strategy for hydrogen and fuel cells, building on their strength as the world's leading supplier of platinum. Particular interest is placed on catalysis expertise, cost-effective hydrogen production and niche application for fuel cells. This allows South Africa to exploit gaps within an incipient hydrogen economy in which the country has a comparative advantage. Participants recommended that South Africa adapt hydrogen technologies developed at the international level for local requirements.

Current fuel cell activities in South Africa were mainly for demonstration purposes in order to convince decision-makers of the significance for the country of the technology. Fuel cell technology could contribute to rural electrification. The IEA offered links to the IA on advanced fuel cells.

The objectives of the proposed RD&D strategy have highlighted the twin challenges of technological and human capacity in South Africa.

The Council for Scientific and Industrial Research (CSIR) expressed interest in further discussion with the HIA. Especially CSIR is very interested in new and high temperature processes for hydrogen production, coupling with high temperature source (nuclear PBMR or solar) and could participate to the new HIA annex on this topic. Contact with Gilles Rodriguez, future operating agent of this new annex has been established to attend as an observer the next meeting and evaluate interest

More generally speaking, South Africa was invited to attend the upcoming HIA ExCo meeting in May 2007 in Switzerland.

Ocean Energy Systems

South Africa has significant ocean current and wave potential. South Africa has done extensive research and design work on wave energy converters. South African knowledge and data is of great interest to the international community, especially the ocean energy industry.

The IEA would welcome South Africa's participation in the IA-OES. Furthermore, the OES proposes to assess potential participation of SA research community in the European Commission funded Coordinated Action project that brings together over 50 partners twice a year for information exchange and collaboration, and if possible, invite their participation. In addition, South Africa was invited to join the European Ocean Energy Association and to participate in the upcoming proposals to the EC on various topics relative to the development of Ocean Energy Systems and markets.

South African universities expressed their interest in the OES IA. As a first step, South Africa was invited to attend the upcoming OES IA ExCo meeting in Mexico City in mid March 2007.

FOSSIL FUELS SESSIONS

General remarks:

For many decades SA was primarily a resource-rich country exporting much of its raw materials. Coal and electricity were cheap. Subsequently, South Africa has developed own technologies to suit conditions, capacities and constraints

South Africa is now a world leader in certain technologies – coal-to-liquids using the Fischer-Tropsch method, pulverised coal combustion of low grade coals, underground gasification and coke-substitutes for the metallurgical industry amongst others.

However the country lags behind in terms of modern clean coal power generation mechanism, the human capacity to run such technologies and the funding to generate R&D and implementation.

It is to be hoped that close collaboration with NEET and the IEA Implementing Agreements will permit the fast-tracking of technological innovation into this country with specific reference to clean coal technologies which will permit SA to join the international trend towards zero emissions, reduce global climate impacts and improve the health, welfare and well-being of this country (and this region's) populations.

Working Party on Fossil Fuels

The presentation highlighted future trends indicating that in the long term, fossil fuels will be phased out and renewables will ultimately take over and fuel and electricity costs will rise as this process takes place. This scenario will have to be addressed internationally. In the interim, fossil fuels are considered the most sustainable sources of energy world wide.

The Stern report and others have projected serious global air quality issues in the near future resulting from fossil fuel-based technologies. This has resulted in the need for the development of zero emission technologies (ZETs), these being the major technological issues for implementation in the period 2000 to 2100. The G8 Gleneagles meeting in 2005 directed that, inter alia, clean coal technologies and carbon capture and storage programmes be encouraged not only in developing countries but also introduced into non-developed countries.

The IEA is now undertaking a "best practice" approach in encouraging the introduction and development of processes in different parts of the world, including activities such developing new technologies, modelling prediction efficiencies in coal-fired plant, sulphur-based capture, carbon capture and storage mechanisms.

South Africa (Eskom) indicated that Fluidized Bed Technologies (FBT) will suit South African coals and that supercritical pf combustion may, in time, be favoured over conventional pf boilers due to lower costs and water-for-cooling requirements. Underground gasification is currently being explored

on a pilot scale basis. So far this process has shown itself to be favourable compared against Integrated Gasification Combined Cycle (IGCC). If successful in up-scaled version, this process is considered to be a quantum leap forward for energy and petrochemical production in South Africa. Other clean coal technologies are also under review in this country. In the long term, much more research and development will be needed for Carbon Capture and Storage (CCS) in South/Southern Africa.

Anglo American indicated that the issues shaping the sustainable fossil fuel debate include coal stewardship and life cycle impacts from production to utilisation and emissions with cost-energy and process-effective operational targets, good supplier relationships with effective coal and carbon policy in the market place and clean coal technologies in the form of company strategies and initiatives.

Policy debates, techno-transfer exchanges, actions and areas for further collaboration and discussion included the following:

- Life cycle impacts – application from production through to energy and emissions with cost implications
- National and global coal reserves – development of credible statistics with respect to sustainable energy supply in the short, medium and long term
- Coal product stewardship – security of supply of specific products (e.g. steam coals and coke) nationally and internationally
- Process stewardship – protection and enhancement of all stakeholder interests, (e.g. in terms of safety, health and environmental issues).
- Policy debates – consideration of complementary affordable, available energy resources, co-utilisation processes and inherent geopolitical risks

Identified gaps:

In addition to the above issues which would need to be addressed within the South African context, further identified gaps in this country included, inter alia,

- Coal to liquid (CTL) processes, i.e. (a) using alternative technologies to Fischer-Tropsch and (b) specific impacts and applications to transport fuels
- Low smoke fuels/coal-burning for rural and low-cost domestic households in cases where electrification is not affordable, has been rejected by the householders or is not possible due to grid limitations.

Recommendations:

It was strongly recommended that SANERI Working Groups participate in all relevant IEA Implementing Agreements and/or Programmes working within the various ambits of Clean Coal Technology.

Clean Coal Centre

Extensive discussions on cleaner and more efficient power generation took place, including specifically carbon capture and storage mechanisms. Much of the discussion overlapped with the following session on the Greenhouse Gas and R&D Implementing Agreement (IA).

Policy debates, techno-transfer exchanges, actions and areas for further collaboration and discussion included the following:

- Regulations and legislative frameworks with respect to emissions, efficient plant processes
- Regulatory incentives for Clean Coal Technologies (CCT) – these need to be advanced in SA
- High-tech developments and advanced CCT processes – including
 - * supercritical power generation,
 - * zero emission technologies (ZETS) such as FutureGen,
 - * coal-to-liquids (CTL) and gas-to-liquid (GTL)

- * underground gasification technology
- * fluidised bed and other new emerging CCT technologies.

- Process efficiency – including choice of the most efficient processes and plant designs suitable for South African coal products in future, their optimal operation and the retrofitting and upgrading of old power plants
- Modelling to predict efficiencies which includes clear understanding of the impact of specific or available coal feed qualities, plant design and process operation
- Carbon credits and trading opportunities
- Carbon Capture and Storage (CCS) in association with the continued utilisation of current coal-fired plants as well as future plants.
- Public awareness mechanisms with specific relevance to the Southern African situations
- Clean coal technology options in general, with respect to keeping coal as prime feed for energy security of supply

Identified gaps:

All the above issues would need to be addressed within the South African context. No further specific gaps were identified.

Recommendations:

Collaboration with IEA Implementing Agreements on any or all of the above topics was strongly recommended.

Greenhouse Gas and R&D

Extensive discussions on cleaner and more efficient power generation took place, including specifically carbon capture and storage mechanisms. The Greenhouse Gas and R&D IA representative presented the main stages of capture, highlighting the current and future technologies. The South African representatives indicated that South Africa differs significantly from Annexure 1 countries as coal provides over 90% of energy requirements in this country. However, an integrated energy plan is underway at present which will phase in alternative energy sources over time, the primary issue being the need to normalise against a country's natural resources. South Africa also has many other major issues to face including technology, finance and regulatory limitations, public acceptance and limited mechanisms.

Policy debates, techno-transfer exchanges and actions and areas for further collaboration and discussion included the following:

- CO2 capture technologies – three or four stages capture mechanisms, oxyfuel systems, capture-ready power plant for future installation
- Storage for CO2 – quantifying and characterising geological storage deposits and researching the mechanisms of storage in those deposits for long term reliability
- Full scale demonstration plant projects - >300 MW required for post-combustion CO2 capture
- Creation of standards for efficiency and permanency of capture in storage
- Risk and insurance aspects of storage with long term liability with respect to storage
- Regulations, legislation and policy frameworks on CCS
- Predictable policy and tax regimes
- International emissions trading schemes
- Public awareness and consultation to allay concerns
- Capacity building in all relevant areas from geology to capture, dispatch and mechanical storage.

- Roadmap strategies to provide optimal options for future developments

Identified gaps:

Limited to non-existent capacity in virtually all the above areas in the South African fossil fuel community was identified, resulting in the proposal for strong participation of SANERI Working Groups in, and collaboration with, IEA Implementing Agreements and Programmes on all carbon capture and storage aspects.

Recommendations:

It was strongly recommended that South African SANERI Working Groups participate in the IEA Greenhouse Gas Implementing Agreement and any relevant related Programmes.

Fluidized Bed Conversion (FBC)

Fluidised bed technology (FBT) was recognised as a key to improved energy security and reduced CO₂ emissions by all. It was agreed by all relevant parties in South Africa and IEA specialists that work on common problems should take place resulting in the sharing of results, with each country paying for own costs.

Focussed discussion included the advantage of FBT for co-conversion when using coal, biomass and other renewable waste materials, the need for suitable fuel characterisation, the stabilisation of feedstock when introduced into FBT plant, fluidisation mechanisms and modelling, the impacts of scale up requirements from current processes and the utilisation of FBT ash. Additional challenges included the requirement for zero emissions in future, the development of new processes including Fischer-Tropsch technology, increasing efficiency, handling higher steam temperatures (now reaching 550°C) and future legislations relative to FBT.

Policy debates, techno-transfer exchanges, actions and areas for further collaboration and discussion included the following:

- Advances in technological, commercial and end-use innovations and applications for fluidised bed technology (e.g. chemical looping and flat bed technologies using high ash coals, biomass and waste materials for energy production, and alternative uses for fluidised bed technology including metallurgical processing)
- Increased developments specifically in gasification-related fluidised bed technology for various advanced process applications
- Characterisation of coals and their technical performance in FBC technologies
- Impacts of fuel mixtures when using coal and various biomass or other animal waste products in fluidised bed processes
- Efficiencies of fluidised bed processes, for both combustion and gasification
- Public awareness and consultation to promote fluidised bed technology, with specific relevance to maximum capacity output per plant in South Africa (Eskom requires outputs comparable to current pf boilers before serious consideration will be given to FBC introduction)
- Capacity building in all relevant areas from geology to capture, dispatch and mechanical storage.
- Roadmap strategies to provide optimal options for future developments

Identified gaps:

Despite diverse use of FBT in South Africa in a variety of different industries (e.g. mineral treatment including gold, zinc and ilmenite roasting, drying and recovery, petrochemical production including catalytic crackers and advanced synthol reactors, gasification and combustion in small scale processing units), specific gaps were identified particularly in the fields of energy (including waste to energy). These included

- Enhanced FB gasification technology relevant for SA

- Coal characterisation and performance in fluidised bed conditions with specific application to South Africa discard coals, low grade coals, chars and alternative feed materials.
- Impact of coal ash (specifically sulphur, not necessarily chlorine) on corrosion of fluidised bed boiler, gasifier, feed equipment and ash removal plant
- Emission control and availability of cost-effective, suitably reactive sulphur absorbents (limestone)

Recommendations:

Participation of SANERI Working Groups in the IEA Fluidised Bed Conversion Implementing Agreement was strongly recommended, and that close associations in particular with relevant specialists in countries including India be maintained. There is significant potential for FBT in South Africa although limited interest in large scale Eskom-sized units.

Conclusions on Fossil Fuel Sessions:

Discussions in all of the Fossil Fuel sessions concluded that the following clear steps needed to be taken:

- Increased international communication must continue
- Strong collaboration with NEET and the IEA needs to be maintained
- Implementing Agreements or Programmes of specific relevance need to be set up
- Capacity building in all technological areas and at all levels needs to be improved
- Expanded Public Awareness programmes need to be implemented

Within South Africa, the following steps need to be taken in order to facilitate further collaboration with the IEA Implementing Agreements:

- Experts and current centres of expertise need to be identified in SA and Working Groups under SANERI need to be formulated
- Avenues for communication require to be identified and initiated
- Topics and tasks of common concern require to be listed in ranking order
- Collaborating mechanisms need to be set up – international IEA meetings, visits to sites, conferences and local working groups
- Funding agencies for R&D will need to identified and brought on board in a number of areas
- Follow-up meetings with NEET and the IEA need to be planned.

END-USE TECHNOLOGY SESSIONS

The broad range of end-use technologies was addressed in two sessions which elicited active participation by delegates.

End-Use Working Party

The following points of information arose from the presentation on the activities of the End-Use Working Party (EUWP).

- South Africa does not currently participate in the activities of the End-Use Working Party
- However, it was acknowledged that there are clearly direct and immediate benefits to SA in support of:

- Implementation of The Energy Efficiency Strategy of South Africa which was approved by Cabinet in March 2005 and which sets the target for improved energy efficiency in South Africa at 12 percent by 2015.
- Learning from IEA (particularly in terms of the Brazilian and Mexican experience as emerging economies which have similarities to the South African situation)
- Developing policies and methods of building more sustainable homes and buildings
- The Department of Minerals and Energy (DME) and the recently-established National Energy Efficiency Agency (NEEA) indicated a real interest in collaboration with the End-Use Working Party.

Demand-Side Management

Based on the three presentations and discussions in this session the following observations became apparent:

- The targets within the Eskom / NEEA DSM programme are 3000 MW of sustained savings by 2012 and 8000 MW of sustained savings by 2025
- These targets have been set within the context of the Energy Efficiency Strategy of South Africa
- Although South Africa is not a member of the DSM Implementing Agreement, Eskom has participated in two meetings with observer status
- Given the current medium-term crisis in electricity generation capacity in the region (and in South Africa specifically) there are immediate benefits to South Africa in engaging actively with the DSM IA. Specific outcomes from this engagement would focus on:
 - Enhancement of the overall energy system performance (including non-electricity systems) for economic, environmental and social development
 - Support for planning and implementation of the DSM programme by Eskom and NEEA
 - Providing access to resources and the extensive experience in the IEA on DSM technologies and initiatives
 - Development of skills and practical experience.
 - Discussions in the session confirmed the interest in active participation by the DME, Eskom and NEEA. In addition, there was interest expressed by others including private sector stakeholders.

CROSS-CUTTING ISSUES

Energy Modelling: ETSAP

The presentations in this session confirmed the benefits of (and need for) energy modelling to provide a basis for interrogating scenarios to guide investment decisions in South Africa's energy economy. The main outcomes of the session were:

- SA does not currently participate in the Implementing Agreement but there are well-established links between South African stakeholders and ETSAP. An ETSAP workshop was convened jointly by the Energy Research Centre and other partners in Cape Town, June 2006.
- There are clear benefits to South Africa including international support to modelling at regional, national and metro/district level.
- One of the questions raised was how to communicate with policy makers in order to ensure that the role, benefits and/or limitations of modelling were understood.

- There was specific interest in collaboration with the IA which was expressed by the Energy Research Centre at the University of Cape Town. In addition, it was suggested that DME, NERSA and Eskom would be interested although they were not represented in session

Energy Technology Data Exchange

The final session covered the issues relating to data management and information exchange. Outcomes of the session included:

- As a consequence of fragmentation in the administration and funding of energy research in South Africa, there is a poorly co-ordinated body of experience in research management and information management.
- South Africa does not currently participate in the ETDE (although Brazil and Mexico do).
- Given the legacy of a period of neglect in this area, the immediate benefits to South Africa of participating in the ETDE include:
 - Support in re-establishing and maintaining information management systems
 - Access to up-to-date peer-reviewed and other reference documents
 - Stimulation of information sharing
 - Interface with international experience
 - Learning from successes (and failures)
 - Jumpstarting and avoiding duplication

Arising from the clearly articulated need for support, the ETDE offered an invitation to SANERI to join the EDTE. This invitation included trial access to ETDEWEB and participation in the ETDE 20th anniversary conference in Lisbon, July 2007.

Summary and Conclusions from the End-Use and Cross-Cutting Issues Sessions

The overall impressions of these sessions confirmed that the IEA IA's and WP have expressed a sincere interest in collaboration with South African stakeholders through membership or sponsor participation in the IA's or WP. Furthermore, there was a correspondingly high level of interest from South African stakeholders to participate subject to resource constraints.

Arising from this promising expression of interest, questions were raised regarding the protocols for participation and the costs for task-sharing and cost-sharing. These aspects of the participation were identified as being important and needing to be clarified and confirmed. These questions were then addressed at the final wrap-up session of the workshop.

Overall, it was emphasized that the end-use and cross-cutting issues have a high impact in assisting SA with the immediate (and) long-term energy demands. Consequently, they have a high priority in terms of future collaboration between SA and the IEA.

IEA Working Parties, Implementing Agreements, IEA Secretariat, South African government representatives, SANERI and other stakeholders have agreed to follow up on identified possible action items. Detailed notes of each session will be circulated. Also, each IEA Working Party and Implementing Agreement will provide details of their follow-up proposals. It is expected that relations between South Africa and the IEA network will be broadened and deepened and that in several additional cases, South Africa will become a full Implementing Agreement member.

Johannesburg, 22 February 2007