

Title: Analyzing the necessity and potential to switch to hydrogen as an energy carrier to achieve a sustainable energy system

Acronym: HYFORSA

Submitted by:

Stefan Szewczuk (sszewczu@csir.co.za)

Tel: 012-841-2345 Mobile: 082-453-1383

Postal Address: M&Mtek CSIR P O Box 395 Pretoria 0001

Theme: Energy

Focus Area: Hydrogen and fuel cells

Type of project: R&D project, including technology demonstration (large scale)

Summary: This project aims at supporting a South African (political and even societal) debate on the necessity and potential of a switch to a hydrogen economy. The results of the project will function as a strategic document that can facilitate the policy choices for or against specific hydrogen related technological options that can be implemented on the short term, taking into account the energy and environmental problems that these options solve and at what economic and societal costs they do so. The final report will highlight the drivers, barriers, required changes and required actors for the implementation of hydrogen related options that can be implemented on the short term and that will go to a next phase of widespread market entry after the demonstration phase in different sectors and for different applications (stationary, mobile or residential) in South Africa.

Expertise offered: Understanding of the South African energy situation in relation to that of Europe. Expertise and experience transferring European know-how and expertise to SA with a view to assisting EU based organisations

Previous FP involvement: Yes

Details of previous FP involvement: Under FP 5's Energies Joule-Thermie: Renewable energy for rural electrification in Eastern Cape. Under FP6's Synergy Programme: Accelerating the market penetration of renewable energy technologies in South Africa and a project entitled CDM for Sustainable Africa

Consortium status: A core consortium has been identified with the lead partner being the Netherlands Energy Research Foundation. The two SA members are CSIR and a BEE - Tatelano Technologies

Expertise sought:

Related projects: FP6 International bilateral cooperation South African national R&D programmes

Title: Sustainable Transfer and Adoption of Biofuel Technologies**Acronym:** STABT**Submitted by:**

Alan Brent (abrent@csir.co.za)

Tel: +27 12 841 4855 Mobile: +27 82 468 5110

Postal Address: RBSD, NRE PO Box 395 Pretoria 0001 South Africa

Theme: Energy**Focus Area:** Renewable fuel production**Type of project:** R&D project, including technology demonstration (large scale)

Summary: Future projections and forecasts indicate the potential of the sub-Saharan African region to participate in the supply of biofuels. To this end, further studies have been undertaken to determine the feasibility of such renewable technologies, and it has subsequently been proposed to implement strategies in regional policies. However, a number of important issues have been raised to ensure the sustainability of biofuel technologies in the sub-Saharan region. For example: awareness and capacity building of all stakeholders in such technological systems, including, but not limited to, relevant government departments, farmers, persons involved in agro-forestry, funding and financial institutions, related industries, NGOs, academic and R&D institutions; a roadmap must be established, whereby detailed stable, long-term, holistic policies can be formulated for such technological systems; and in-depth analyses of the appropriateness of different technologies in a regional context, considering issues such as effective utilization of by-products and effluents, natural resource management in terms of biodiversity, ecology and pollution control, the management of supply and distribution chains, and effective production and applications of biofuels, to name but a few. These issues call for incorporating the concept of sustainable development into the technology management field of knowledge. The research will subsequently focus on the development of technology assessment methods, as they are applied in specific technology management practices that are important in the biofuels context, i.e. Technology Road mapping and Technology Transfer, which integrate the intrinsic modelling that is researched in the emerging field of sustainability science. The final outcomes from the research will be the development and demonstration of effective management models, at sector and organisation levels. The research will address two distinctive challenges: the effective and sustainable transfer and adoption of biofuel-related technologies, and the interaction between multidisciplinary research teams that will be required to reach truly sustainable technology management practices.

Expertise offered: The team of researchers lead by the Council for Scientific and Industrial Research (CSIR) brings together a range of sub-Saharan expertise that is fundamental if sustainable biofuel technology adoption is to be achieved in the region: capacity development at first and second economy levels and in urban and rural areas; R&D engagement with the public and private sectors, and communities, at first and second economy levels and in urban and rural areas; ongoing R&D in technology and knowledge management, and sustainability science, i.e. the complexity of social-ecological interactions; technology assessment, modification and deployment in the African context; and understanding of the resource base of the region. To this end the CSIR has been actively undertaking research projects in Africa since 1993 and is currently working in about 23 African countries.

Previous FP involvement: No**Consortium status:** Potential consortium members have been identified in Europe**Expertise sought:** Biofuel technology developers and technology transfer researchers**Related projects:** FP6 South African national R&D programmes

Title: Demand-side energy management and control systems

Acronym: DSM

Submitted by:

Xiaohua Xia (xxia@postino.up.ac.za)

Theme: Energy

Focus Area: Energy efficiency and savings

Type of project: Networking between organisations in the same area

Summary: DSM problems both from the supply-side and the user-side are formulated in the control system framework. Load modelling, electric components and energy efficiency systems based on new metering and monitoring technologies are casted control engineering structure. Optimal control strategies are generated through developing a software platform.

Expertise offered: energy efficiency, control systems, optimization

Previous FP involvement: No

Consortium status: looking for energy efficiency researchers and practitioners

Expertise sought: strong experience of existing DSM programmes

Related projects: South African national R&D programmes

Title: Integrated power electronic processors

Acronym: IPEP

Submitted by:

Ivan Hofsjager (iwh@ing.rau.ac.za)

Theme: Energy

Focus Area: Energy efficiency and savings

Type of project: R&D project (small scale)

Summary: Power electronics systems offer great potential for power savings, and the exact amount of electrical power can be delivered in the correct form where and when it is needed. The technology to do this has been available for the last several decades, but has not found widespread deployment due to its high cost. Power electronics has not achieved the same cost reduction spiral as communications and information technology electronic systems. This limits its deployment. Part of the problem is the paradigm of discrete construction of the power electronics which has remained the same for the past several decades. Recently work has begun to surface on integrated magnetic components that perform more than one function and ultimately lead to lower cost. In this project the complete integration of the power converter will be investigated. This basically entails a stack of plat materials with differing electromagnetic properties stacked on top of one another in a manner that the desired power electronics function is fulfilled. This project includes the materials technology and the design procedures required. The entire converter no longer consists of lumped parameter components and the mathematical treatment of the "spread out parameters" from a modelling viewpoint is required for both the analysis and design phases. This type of converter can be well utilized in consumer applications as well as a component for use in the automotive and avionics sectors.

Expertise offered: Existing experience in the design and prototyping of integrated power supplies. Rough functional mathematical models of distributed design have already been developed and verified experimental. With these models it is possible to design and develop the structural parameters of the converter. Several studies have also already been carried out into the synthesis of such structures and this experience is useful for new converter designs. Laboratory facilities exist for planar prototyping including magnetic and dielectrics, but not for high level materials handling and bare die processing

Previous FP involvement: No

Consortium status: none

Expertise sought: An industrial partner(s) closer to the actual markets is required to advise on the specific application and to take the technology further after the initial development. Fitting into an existing power electronics program would be ideal.

Related projects: None

Title: Energy generation through the treatment (Anaerobic Digestion) of the organic fraction of the Municipal Solid Waste (OFMSW) with the aim to supply energy for rural townships in Southern Africa

Acronym: BG from OFMSW

Submitted by:

Suzan Oelofse (soelofse@csir.co.za)

Tel: 012 841 4333 Mobile: 0833888023

Postal Address: PO Box 395 Pretoria 0001

Theme: Energy

Focus Area: Renewable electricity generation

Type of project: R&D project (small scale)

Summary: Daily about 8.9 million tonnes of Municipal Solid Waste is collected in the six metro cities of South Africa. Most of this waste locally finds its way to landfills, resulting in the production of methane and leachate. Due to the large environmental impact of the generation of gas and leachate from these landfills, many are due to close in the near future resulting in finding other methods for treating waste. An alternative to the landfill option is the biological treatment of this fraction of waste, especially anaerobic digestion, resulting in a controlled methane production. Anaerobic digestion is cost effective, due to the high energy recovery (CH₄) linked to the process and its limited environmental impact. This technology can maximise recycling and recovery of waste components. In South Africa the general way of generating energy in the rural townships is through burning paraffin, wood, peat moss and other products, which when burned produce high levels of CO₂, which emission has a negative effect on the environment. In case the local OFMSW was collected and treated anaerobically in an aerobic digester, built next to a rural township, the produced methane could be used to create energy for the local population. The burning of CH₄ rather than CO₂ would earn points (money) on carbon trading. Advantages of the proposed technology o Less waste into landfill: less uncontrolled CH₄ production as well as less leachate production and ultimately less need for new landfills o Controlled CH₄ production from waste, to be used as energy o Less CO₂ emission from burning of fossil fuels and wood o Protection of green house effect o Earning carbon trading points o Technology beneficial for the generation of alternative energy o Technology beneficial for cleaner environment o Recycling of waste to energy

Expertise offered: Waste Management, waste minimisation, organic fermentation, biogas generation, and engineering. For South Africa an unexplored field and therefore we are looking for international partners that can add value and expertise. The team would like to develop a prototype as showcase for the South African waste management industry divorced from landfilling.

Previous FP involvement: No

Consortium status: Currently the CSIR is formulating the proposal and identifying consortium members within UCT, UKZN, and interested municipalities

Expertise sought: The South African Team is interested to collaborate with European partners who have already expertise with biogas generation from the OFMSW.

Related projects: None

Title: Continuous reactor for hydrogen production using Fe₂O₃ water-splitting reaction

Acronym: CONREHYP

Submitted by:

Thomas Roos (throos@csir.co.za)

Tel: +27 12 841 2329 Mobile: +27 82 33 27833

Postal Address: CSIR PO Box 395 Pretoria 0001 South Africa

Theme: Energy

Focus Area: Renewable fuel production

Type of project: R&D project, including technology demonstration (large scale)

Summary: DLR has successfully demonstrated a batchwise, intermittent reactor for hydrogen production using Fe₂O₃ on a SiC monolith. This project seeks to develop a continuous rotating reactor for continuous production of hydrogen (and possibly oxygen), with improved energy re-use by means of appropriate heat exchangers. Use will be made of the 25 square metre heliostat at the CSIR.

Expertise offered: Solar: autonomous 25 square metre heliostat at CSIR Heat exchangers: Dr Dietlief Kruger at University of Stellenbosch (more than 30 years experience)

Previous FP involvement: No

Consortium status: Partners sought

Expertise sought: DLR, Cologne, Germany (Christian Saettler and team); Chemical Process Engineering Research Institute, Centre for Research and Technology, Greece (C. Agrafiotis and team)

Related projects: None

Title: Geophysical CO2 Monitoring Technologies

Acronym: GeophCO2MT

Submitted by:

Stephanus du Plessis (sduplessis1@csir.co.za)

Tel: +27 11 635 0068 Mobile: +27 82 653 8910

Postal Address: PO BOX 91230 Auclandpark, 2006 Gauteng South Africa

Theme: Energy

Focus Area: CO2 capture & storage technologies for zero emission power generation

Type of project: R&D project, including technology demonstration (large scale)

Summary: For CO2 sequestration projects, how to monitor the movement of the CO2 in the subsurface is problematic and not completely solved. Geophysical monitoring technologies will be developed and applied to ascertain the applicability of the geophysical techniques to monitor the flow of CO2 in the subsurface at CO2 sequestration sites. It is understood that where CO2 is sequestered in an oilfield that the CO2 may cause an increase in electrical resistivity - that may be detected by appropriate geophysical techniques. The injected CO2 front could also cause micro-seismic events. The CSIR has developed techniques to accurately determine the source locations of microseismic events in 3-D. This technology could be applied successfully for CO2 monitoring. The project would consist of a feasibility study to ascertain the suitability and problems for doing geophysical surveys in this environment. Depending on the results of the feasibility study, field surveys will be carried out.

Expertise offered: Geophysical monitoring technologies: Electrical Resistivity Tomography, Radio Imaging, Borehole radar, micro-seismics. Geophysicists and seismologists with many years of experience and research track records.

Previous FP involvement: Yes

Details of Previous FP involvement: FP6 TOP UP CALL - CO2REMOVE; submitted a proposal that was accepted by the commission. The funds were however cut back, and the CO2REMOVE programme manager (Emile Elewaut, TNO) is to negotiate with the Commission project officer during October.

Consortium status: TNO, La Plata University - Argentina, Donetsk National technical university - Ukraine

Expertise sought: TNO, Emile Elewaut; Sasol, CO2OIL, University of Roma - Prof Lombardi

Related projects: FP6

Title: Optimisation of paper and pulp processes using advanced modelling techniques

Acronym: Pulp Optimisation

Submitted by:

Philip De Vaal (philip.devaal@up.ac.za)

Postal Address: Department of Chemical Engineering University of Pretoria, PRETORIA, 0002, South Africa

Theme: Energy

Focus Area: Knowledge for energy policy making

Type of project: Networking between organisations in same area

Summary: Use of different advanced modelling techniques to improve control of pulp reactors (batch as well as continuous) based on a combination of mechanistic and stochastic techniques, including Monte Carlo methods. The purpose of this research will be to include as many wood properties as possible to formulate an accurate model, which can then be used for optimal control of pulping processes.

Expertise offered: Our group has extensive experience in fundamental modelling of batch and continuous processes and applying those to enable advanced model-based control of the pulping process.

Previous FP involvement: No

Consortium status: New initiative - possible collaborators: Prof Erik Dahlquist Mälardalen University Sweden as well as SAPPi South Africa

Expertise sought: Both mentioned organisations have indicated willingness to participate

Related projects: South African national R&D programmes

Title: A Bio-energy Research Programme to source and create solutions with the aim of setting out parameters for the development of suitable biomass and its by-products to become a replicable and sustainable biofuel industry

Acronym: sbf

Submitted by:

Elsa S. Du Toit (elsa.dutoit@up.ac.za)

Postal Address: Department of Plant Production and Soil Science Faculty of Natural and agricultural Sciences University of Pretoria

Theme: Energy

Focus Area: Renewable fuel production

Type of project: R&D project, including technology demonstration (large scale)

Summary: Present major study "The potential of alleviating poverty in southern Africa's rural areas by the production of a needed product - biofuel - while reducing GHG emissions is a solution to many of Africa's problems. Biodiesel is produced from oil producing tree seeds and nuts from selected drought resistant trees. There are many tracts of land suitable for bio-energy production in Southern Africa - marginal land that is not suitable for agricultural purposes: land along side railway tracks, roads, rehabilitated mines; land that is situated near communities that cannot be farmed due to the threat of theft. Trees as a source of oil are cost-effective versus commercial plants that have to be planted every season. Many tree varieties supply seed for oil for many years and are far cheaper to establish than commercial oil crops. Trees require less input and maintenance while growing than commercial crops. Yields increase annually. Therefore, the main purpose of this study is to investigate phenology, growth and water requirements of these 'non-irrigated' trees in a new established plantation, planted at different densities. Correct spacing is one of the most important considerations in growing biodiesel trees with economic success. The correct spacing for the long term productive life of an orchard/ plantation depends on the expected size of the mature tree which depends on several factors such as climate, soil type and soil depth, plant/ rootstock vigour and the trees natural growth habit.

Expertise offered: All aspects related to propagation and cultivation of potential biofuel trees and crops. Carbon crediting etc.

Previous FP involvement: No

Consortium status: Working together with Department of Trade and Industry, Department of Agriculture, Private and Public (Mafikeng Biodiesel Company) biofuel companies and other Universities

Expertise sought:

Related projects: South African national R&D programmes