Federal Ministry
of Education
and Research

Future Megacities
Megastädte von morgen

Energy as a Key Element of an Integrated Climate Protection Concept for the City Region of Gauteng (EnerKey)

Overview and Findings to Date

Megacities of tomorrow have a crucial role to play in the transition towards a global sustainable development. One of the key issues they have to address in order to implement sustainability is solving the energy problem: secure energy supply, equitable access to clean, safe energy resources as well as environmentally responsible energy production and use are fundamental prerequisites for the sustainable development of the world and of megacities in particular. Johannesburg, Ekurhuleni and Tshwane (JET) form part of the Gauteng Global City Region (GCR) in South Africa. Together the population exceeds

10 million. With an average annual population growth rate of approximately 2.4 %, the population is projected to grow to 14.6 million by 2015, ranking it the 14th largest urban region in the world. The Gauteng government has endorsed a strategy to develop this city region into a globally competitive district. The EnerKey project will undertake to assist the region to tackle these energy challenges and develop measures to improve and even optimise the sustainable development of megacities while meeting major economic, social and environmental objectives. The Metropolitan region of Gauteng, comprising the municipalities of Johannesburg, Ekurhuleni and Tshwane, was selected as the study site because of its potential for a successful sustainable transformation.

The project aims will be reached by a simultaneous top-down and bottom-up approach. While the whole energy system of the Gauteng region will be evaluated in the long-term using a top-down energy model approach, individual and smaller scale projects shall be realised in a bottom-up approach in the short term where monitoring will allow regular optimisation.
In the pre-phase the following key results were achieved:

- An excellent research and development (R&D) network was established with relevant institutions in research, local government, NGO and business.
- Significant funding for the work of South African partners was acquired for four projects from NRF and SANERI for a period of up to five years.
- Strong interest and support from SA and German companies for the project has been established and reinforced.
- Scientific and technical results were achieved through several smaller research projects which had been carried out in the course of the pre-phase, e.g. the EnerKey schools project, the solar water heaters project, the driving cycle project and the social housing and energy project.

Objectives of the Project

The main objective of the project is to develop adequate tools and initiate a process for the sustainable transformation of the urban area of Gauteng. This aim will be achieved by developing and demonstrating a pathway for such a process focusing on the energy sector as the key sector of the economic and overall development of the urban society of megacities, as well as for global development. The project will consist of:

1. the exchange of knowledge and experience between German and South African key players in the (municipal) energy sector with particular emphasis on integrated approaches, including technical, economic, environmental and socio-economic aspects. The mutual exchange of knowledge and experience between the German and the South African side is secured by a "mirror structure" of the project team.
2. capacity building and training of key players and a wider group of stakeholders in the energy sector, in order to allow for the development of self-sustaining processes.
3. developing structures in the participating institutions and municipalities which favour active promotion and the enforcement of sustainably sound processes.
4. the networking of involved individuals, groups and institutions in order to establish a long-lasting exchange of experience and a wider range of the sustainability concepts.
5. the education and dissemination of information and experience to a greater number of stakeholders and, particularly, to the public in order to build up the acceptance and inclusion of sustainability measures.

The project will cover all relevant fields of the energy system and integrate sustainable energy planning:

- technical and non-technical aspects of the three main public economic sectors:
    - energy sector (production, conversion, distribution and use),
    - housing sector (houses, buildings and settlements), and
    - mobility sector (private and public transport)
- environmental aspects: emission and air pollution effects from the production and use of energy, greenhouse gase emissions, specific urban and local air pollutants, etc.
- economic aspects: costs and prices; cost-effects of measures for private and public households, macro-economic effects
- social and socio-economic aspects: driving forces for energy consumption, poverty and economic equity, work and employment options, regional development, interrelation of the developed to the developing countries
- decision and participation processes in political power: access to information and distribution of knowledge, participation of the public, communication structures
- education and training: curriculae in schools, higher education institutions and universities, vocational formation and training, etc..

Particular attention will be paid to four aspects of sustainable energy systems:

- the rational use of energy, energy efficiency and energy-saving measures,
- the use of renewable energy resources (solar, biomass, wind, geothermal, etc.),
- emission control, climate protection and global change, options for emission trade,
- the strengthening and development of subsidiary and social structures, e.g. through public participation in the decision process, capacity building, access to information, etc..

Expected Project Results

The results of the project are expected to contribute to the improvement of the energy sector in particular and the sustainability of megacities in general, e.g. by

- direct improvements of the structures for energy supply and the establishment of self-sustaining, subsidiary structures of the energy institutions, structural improvements in the municipal administrations and the decision-making processes,
- a more sustainable fulfilment of the energy demand and of energy efficiency and savings,
- capacity building, training and education in the target region and a democratic participation in the energy sector,
- better information and knowledge transfer by supplying guidelines, information materials, best practice examples to schools, high-schools, other education and training institutions, decision-makers, stakeholders and other interested groups,
- clear targets and definitions of energy-specific and general sustainability indicators and improvements in the relevant target corridors.

Specific results will be obtained in technical, institutional, methodological and socio-economic aspects:

Improvements in Knowledge, Technologies and Environmental Performance

- the development of a modelling tool, TIMES, to evaluate data from various components of the energy system (technology options, energy policy, social and environmental drivers) to determine an optimal integrated energy and climate protection concept,
- a detailed analysis of the energy balance (energy supply and consumption, efficiency, emissions, etc.) of the target municipalities, end-use efficiency and a least-cost expansion plan for the energy sector which will serve as basis for developing pilot projects and giving recommendations,
- a strategic "Energy Action Plan – EAP" with concrete and specific projects to improve the energy supply and sustainability criteria shall be developed with recommendations for adequate tech nologies, promising action areas (e.g. with the use of particular renewable energies or energy efficiency measures),
- a process of continuous improvement by monitoring the effectiveness, success and progress of the energy projects in terms of economic, environmental and social impacts. The lessons learned will allow the optimisation of the energy and economic development of the municipality. This will be the basis for guidelines of "best practice projects" for increased energy efficiency and sustainability,
- evaluation of effective $C0_2$ and emission mitigation strategies in the energy sector; greenhouse gas mitigation initiatives shall yield the development of an outline of promising CDM-projects in order to take advantage from the market incentives provided by the Kyoto Protocol.

Improvements in Capacity Building, Integration and Networking of Institutions

- continuous information and experience exchange between key departments responsible for energy and sustainability questions between the municipalities of Johannesburg, Ekurhuleni, Tshwane and Stuttgart,
- establishment of a project management structure with an independent quality assurance board appointed from scientists and respected persons from the South African and German side,
- information dissemination through materials developed for schools, other education and training institutions; intranet access for project participants to updated and exchange project information; a detailed website.

Improvements in Applicable Instruments, Tools and Methodologies

- a user-friendly software to work with and analyse databases on energy consumption, energy supply chains, energy flows and intensity of the different sectors of economy, characteristics of technologies and environmental impact of energy uses,
- methodological tools for local energy planning and comparative analysis of the different alternatives of energy policy,
- improvements in Socio-Economic, Integrative and Overall Sustainability Aspects.
- Participation models for complex and large (energy) projects, e.g. round table, discussion panels, enquiries, etc.,
- integrative project management and implementation involving economic, environmental and socio-economic aspects and putting together different competences and networks,
- definition and establishment of sustainability concepts for large urban areas and megacities.

The expected results will have great scientific and operative relevance. Implementation of innovative methodologies for energy management on a local or regional scale will promote environmental protection and reduce the consumption of fossil fuels. The collaboration between different developing and industrialised country partners is beneficial for analysing different ways for increasing sustainability, achieving the Kyoto Protocol targets and allowing all partners to establish a long-lasting partnership for mutual support in the future.

German Partners:

- Institute of Energy Economics and the Rational Use of Energy (IER), University of Stuttgart
- TUV Rheinland Group (TIE)
- Institute for Future Studies and Technological Assessment GmbH (IZT)
- Fraunhofer Institute for Building Physics (IBP)
- Institute for Sustainable Energy Management (INEP)
- City of Stuttgart
- German Chamber of Business Southern Africa
- German-African Business Association
- German Technical Cooperation (GTZ)

Cooperation Partners in South Africa:

- University of Johannesburg
- The City of Johannesburg
- Erkurhuleni Metropolitan Municipality
- The City of Tshwane
- Energy Research Centre, University of Cape Town
- University of Pretoria
- Sustainable Energy Africa (SEA)
- Council of Scientific and Industrial Research (CSIR)
- Eskom

Coordinators/Contacts:

Dr. Ludger Eltrop
IER-University of Stuttgart
email: le@ier.uni-stuttgart.de

Prof. Harold J. Annegarn, PhD
University of Johannesburg
email: han@rau.ac.za

Internet: www.enerkey.de; www.enerkey.co.za