EUROPEAN COMMISSION

Community Research

EUROPEAN ENERGY RESEARCH

Enabling a sustainable, competitive energy system for Europe

Sustainable development and world-class economic competitiveness are central objectives of the European Union. These motivate the European Commission's research priorities to strengthen the scientific and technological capabilities in Europe needed to implement sustainable development, with energy as a key aspect.

Key strategic objectives are to reduce greenhouse gas and pollutant emissions, to secure a future sustainable and diversified energy supply through the increased use of new and renewable energy sources and enable a competitive European industry.

To achieve an impact in the medium to long term, considerable research effort, both technological and socio-economic, will be needed to implement a truly sustainable energy system with clean energy sources, carriers and conversion technologies that are economically attractive and technically robust. It is essential to minimise any potential barriers to adopting renewable energy sources, new energy carriers and technologies, such as photovoltaics, hydrogen and fuel cells, that are intrinsically clean and offer a bridge towards a long term, secure energy supply.

Low-cost PEM fuel cell stack (Courtesy of Siemens, ECN, PSI).

Medium- and long-term research for sustainable energy systems

Working towards a sustainable and secure energy supply for Europe, based on renewable energy sources and clean energy carriers and technologies.

SIXTH FRAMEWORK PROGRAMME

Collection of forest residuals (Courtesy of Timberjack).

What is a sustainable energy system?

Europe's energy system demonstrates unsustainable patterns of development characterised by growing dependence on imported fossil fuels, rising energy demand, transport system congestion and growing CO_2 emissions. The challenge is to alleviate and reverse these adverse trends to achieve a truly sustainable energy system, while preserving the equilibrium of ecosystems and encouraging economic development.

The future sustainable energy mix is likely to be supplied by at least eight different sources (coal, oil, gas, nuclear, hydro, biomass, wind and solar), with electricity and hydrogen as the dominant energy carriers.

The state of the art

Europe has already undertaken considerable research into sustainable energy systems and technologies. Many renewable technologies, such as hydroelectric and wind power, are in daily use, while others, such as fuel cells and photovoltaic systems, have become considerably more cost effective and reliable to the point where they can be commercially developed. Europe's world leadership in installed capacity for wind energy is an example for other technologies to follow.

A further result of significant research efforts is that energy is used more rationally in all sectors and fossil fuel systems are now more energy efficient and have less environmental impact.

Rationale and objectives for future research and development

The medium- to long-term objective is to develop new and renewable energy sources and energy carriers, such as hydrogen and electricity, which are affordable, clean and can be easily integrated into a long term sustainable energy supply and demand structure.

The future large-scale development of such technologies calls for significant improvements in their cost effectiveness, performance, reliability and other aspects of competitiveness against conventional fuels.

As fossil fuels will continue to be used for the foreseeable future, cost-effective solutions for disposing of CO_2 will be required to bring about further reductions in greenhouse gas emissions beyond the 2008-2012 horizon of the Kyoto Protocol.

Research and development priorities for the Sixth Framework

Simplified design of the Piaggio X9 fuel cell scooter to be developed in the FRESCO project (Courtesy of ECN and Piaggio).

Future research will concentrate on four main, interrelated technology priority areas.

- **Fuel cells and their applications** – an emerging, highly efficient, clean technology that is expected to replace a large part of current combustion systems in industry, buildings and transport in the longer term. Fuel cells can use hydrogen to generate electricity with no harmful emissions; they can be used in mobile and stationary applications with power outputs from a few watts to several megawatts.

- **New technologies for energy carriers/ transport and storage, in particular hydrogen** – a future energy system, where hydrogen and electricity are the major energy carriers, will be developed. Integration of distributed energy resources will be studied and technologies for managing, controlling and monitoring interactive energy distribution networks proposed. The technologies for storage, transmission and distribution will improve the quality, efficiency, reliability, safety and security of energy supply.

- **New and advanced concepts in renewable energy technologies** – renewable energy sources (RES) tap naturally occurring energy flows and will make a large contribution to future energy supply. Research will focus on technologies that have significant energy potential. In particular biomass, where opportunities to develop new liquid biofuels exist, and photovoltaic technologies, with their ability to integrate with buildings and their inherent scalability, can benefit from long-term integrated research. RTD in other RES areas, primarily wind, concentrated solar thermal, geothermal and ocean energy, can bring such technologies to a level competitive with conventional technologies.

Molten carbonate fuel cell fuelled by biogas (Courtesy of MTU).

Programme (FP6)

- **Capture and sequestration of CO_2, associated with cleaner fossil fuel plants** – an essential factor if fossil fuels are to be part of a sustainable energy scenario. A holistic approach to near zero emission fossil fuel systems will be developed. The approach will include both cost-effective, safe and environmentally compatible disposal options for CO_2 and the technology to enable cleaner and more efficient fossil fuel plants.

Synergies, cross-cutting and energy strategy related research (external costs, social implementation of new technologies and quantitative and qualitative forecasting methods) will complement these research activities in a horizontal way.

European added- value

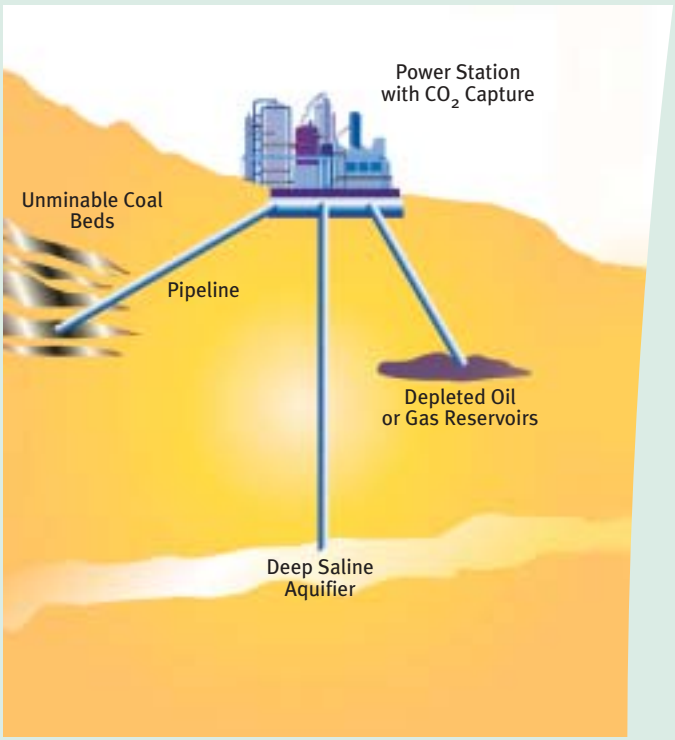
European Union energy research focuses on the actions that can provide the greatest European added value. These include: actions in areas of common concern to Member States; projects that are too large for any single Member State; or areas where high-grade research capability is dispersed around Europe.

The creation of the European Research Area will address issues of fragmentation and duplication of research efforts across Europe to increase cooperation, critical mass and effectiveness in order to achieve ambitious and challenging targets. This will further enhance the European added value in energy research.

This parabolic dish, from the Eurodish project, with a reflective inner surface can produce up to 10kWe with a Stirling engine located at its focal point (Courtesy of Ph. Schild).

Research: the way forward

Initiatives in energy research will be implemented by new support mechanisms that will result in the mobilisation of a critical mass of resource and give a genuine structuring effect to European actions. Within the framework of the European Research Area, "stakeholder partnerships", covering the whole energy value chain in the form of Integrated Projects (IP) and Networks of Excellence (NoE) integrating research teams in key domains, will accelerate the cost-effective development and deployment of sustainable technologies. IPs can lead to technological breakthroughs by applying critical mass to significant problems. NoEs enable knowledge to be developed and disseminated efficiently. Both mechanisms help to eliminate duplication of effort and further integrate European research activities.



A scheme for capturing CO_2 by absorption from exhaust gas after combustion (Courtesy of IEA GHG).

KI-46-02-557-EN-D

Fuel cell bus (Courtesy of SCANIA).

Sleipner West natural gas field where separated CO_2 is being injected into a deep salt-water reservoir (Courtesy of Statoil).

Overview of current EU research and development actions

Research into sustainable energy systems has been significant in recent Framework Programmes.

Some examples of sustainable energy projects

FUERO

This cluster coordinates nine individual projects setting system and component requirements as well as testing procedures for fuel cell vehicles. Fuel choice is a major issue and different fuels and reforming technologies – gasoline, bio-ethanol, methanol and ammonia – are investigated to deliver performance data and fuel path analyses. A new Proton Exchange Membrane (PEMFC) fuel cell stack will also be developed and tested.

FUCHSIA, HYMOSSES, HYSTORY

Cluster of three projects on novel concepts for hydrogen storage for stationary and transport applications. A broad spectrum of materials and production processes will be investigated, particularly on metal hydrides (e.g. Mg alloys, Zr-alloys, alanates), carbon nanofibers (CNF) and carbon nanotubes (CNT). All the projects are expected to deliver hydrogen storage prototypes.

DISPOWER

This project is intended to support the transition of today's energy supply towards a more decentralised and market oriented supply structure. New concepts, strategies and tools will be developed and implemented in order to improve the production and distribution of electricity and heat and support the opening of new opportunities in a growing e-electricity market.

SUBARO

This project aims at sharply reducing costs and the amount of silicon needed for the production of thin film crystalline silicon solar cells by developing a thermally assisted vapour deposition process for manufacturing.

TIME

This project provides solutions for the development of a new and cost-effective ethanol production technology based on lignocellulosic residues and dedicated crops. The project resulted in an improved technology, which could be expected to reduce the production costs of ethanol by 10-20% in the medium- to long-term.

SACS and SACS2

Supporting European teams monitoring the behaviour of the 1 million tonnes per year of CO_2 being injected into the Sleipner field in the Norwegian North Sea. Useful data on transport rates, geophysical properties and potential leakage and sealing mechanisms have been obtained.

NEWEXT

This project will improve the assessment of externalities, i.e. the socio-environmental damages arising from energy production and consumption. It will provide empirical data on the monetary valuation of mortality effects, analyse impacts on ecosystems due to acidification and eutrofication and assess the consequences of accidents in energy chains.

FOR FURTHER INFORMATION

Go to: http://europa.eu.int/comm/research/energy/nn/nn_en.html
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