

# Energy RTD Framework Programme – “Success Stories”

## Introduction

The policy objectives of research on sustainable energy systems (energy efficiency with new and renewable energy sources) include increasing the security of energy supplies, reducing greenhouse gases and pollutant emissions (Kyoto), as well as enhancing the competitiveness of European industry and improving quality of life both within the EU and globally by improving energy efficiency and increasing the use of renewable energy.

The results from successful short to medium term EU research and demonstration projects contribute to:

- development and implementation of new legislative instruments and other policy measures in the field of energy, and
- thus accelerate the introduction of innovative and cost competitive renewable and energy efficiency technologies into the market.

In particular, results from the energy research and demonstration projects, which have been supported by DG TREN (and earlier by DG ENERGY) over the past ten to fifteen years, have contributed to the adoption of EU Directives<sup>1</sup>, and continue to contribute to their implementation, as well as to the transposition and implementation by the Member States of the policies presented in the Green Paper on the security of energy supplies.

Of course, there is always a period of time between commissioning research actions and achieving an impact from the results and project outcomes in the market. Nevertheless, ex-post impact assessments of actions supported under the Energy RTD FP, in particular for the demonstration actions, concluded that the FP4 programme was successful in strengthening the technological basis of the EU energy industry. Nearly one third of the supported projects had a highly positive impact. Many renewable and energy efficiency projects helped to establish a good basis for the development of community legislation (renewables electricity, biofuels and co-generation) and also national and local legislation.

Budgets allocated under the EC RTD framework programmes for renewable energy and energy efficiency, although increasing over time, have been relatively slow to grow in comparison to market growth rates, but have had a considerable impact, thereby creating value-added at European level and exploiting synergies, which otherwise would not have occurred.

Despite the technological risks inherent to demonstration actions, one can conclude that the energy demonstration actions conducted by DG TREN have been successful in spearheading and accelerating technological innovation in support of EU policy objectives and targets.

## RES electricity

DG TREN has been supporting innovative renewable electricity producing technologies since the beginning of the 1980's. In a first stage, the challenge was to develop reliable renewable

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<sup>1</sup> Electricity from renewable energy sources, Energy performance of buildings, Cogeneration (CHP) and Establishment of regulatory and fiscal measures for the promotion of liquid biofuels

energy systems, demonstrate their operation and disseminate the project results. Emphasis was given to the technical problems which had to be overcome. In a later stage, once most of the technical “teething” problems had been successfully overcome and the technologies had become more mature and reliable, research and demonstration at an EU level concentrated on technological innovation to improve system efficiencies and to achieve economies of scale. This has resulted in reducing the installation and production costs, thus making investments in RES systems more attractive and competitive compared with conventional energy sources. At the same time, EC supported research and demonstration projects in the wind, photovoltaic (PV), bio-electricity, hydro and geothermal sectors have contributed to building the political confidence and commitment which were needed to achieve the adoption of the EU Directive on electricity from renewable energy sources (21% target by 2010). In addition to demonstration projects, other research actions have contributed to the development of renewable energy policy and regulatory instruments, incl. renewable support schemes, which have now been adopted by several Member States.

**Wind technology** is evolving rapidly. Technological advances supported by EU RTD actions in aerodynamics, structural dynamics and micro-meteorology have contributed to a 5 percent annual increase in the energy yield per m<sup>2</sup> or rotor area. The annual energy output per wind turbine has increased 100-fold in 15 years, their weight has halved in 5 years and noise emission levels have halved in 3 years. In 1985, wind turbine prototypes were only 50kW in size whilst, by 2004, EC demonstrations of machines with sizes of up to 5MW<sup>2</sup> have been supported. The costs of wind generated electricity was reduced from 35 €cent/kWh in 1980 to less than 5 €cent/kWh in 2004. Prototype offshore wind power plants<sup>3</sup>, which were demonstrated with EC support, have now become large scale commercial practice. *[The latest EC projections expect that wind power in Europe will reach 70.000 MW by 2010 (incl. 14.000 MW offshore). Looking further ahead, the European Wind Energy Association has adopted a target of 180.000 MW for 2020, of which 70.000 MW will be located offshore.]*<sup>4</sup>

**Solar photovoltaics** is an electricity generating technology, which is highly appreciated by architects for integration into buildings<sup>5</sup>, and indeed EC demonstrations of PV in buildings are reported to have boosted public support for energy saving and for the use of renewable energies. For example, the following EC supported demonstration projects have contributed to building sufficient public support and consequent political confidence to permit Member State governments to establish dedicated national support schemes for PV technologies in line with the RES-E Directive: PV pergola in the King’s garden at La Moncloa in Madrid; PV pergola on the waterfront in Barcelona; PV generators in the roof of the Reichstag, the Berlin Bank, and the Lehrter Bahnhof in Berlin; PV sound barriers along highways and railways in Munich, Switzerland, Netherlands and other Member States<sup>6</sup>. As a result, PV module production capacity has increased from about 100 MW per year to about 1100 MW per year during the last 10 years. In the same period, total PV systems with costs of around 5000

<sup>2</sup> 5MW-OWREC project

<sup>3</sup> VINDEBY and LELLY projects

<sup>4</sup> **Wind energy examples:**

“**COD**” (5<sup>th</sup> FP concerted action, NNE5-633-2001) is speeding up the implementation of off-shore wind energy by providing a harmonised European approach to deployment, environmental impact analysis and permission procedures for off-shore wind farms. It contributed to the **Egmond Declaration** with recommendations for policy measures to be implemented by European institutions, Member State authorities and the wind industry.

“**DOWNVIND**” (6<sup>th</sup> FP demonstration FP6-503202-2003) is developing technologies and techniques which will enable European contractors to lead the global market for installing and operating wind-farms far from the shore, by delivering cost reductions that will make off-shore wind-farms in deep water economically viable. The project coordinator, Talisman oil company, has stated that they will invest in 2GW of offshore wind power if their EC supported demonstration project is a success.

<sup>5</sup> PV LEHRTER STATION project

<sup>6</sup> PV SOUNDLESS project

€/kWp<sup>7</sup> have been demonstrated, compared with nearly double these costs at the beginning of the period.

**Concentrating solar power** has recorded remarkable progress. Three world leading EU supported demonstrations of different system configurations are currently under way<sup>8</sup> in Spain, and these have already led to new national legislation and an effective support scheme.

**Bioenergy** (Biomass and Waste) continues to be the largest source of renewable energy in the EU. Collaborative EU research and demonstration have led to significant increases in overall conversion efficiency from about 25% to 35% for electricity over the last 20 years. EC demonstrations of co-firing with coal<sup>9</sup>, which is an option with major market potential, have shown that there is a significant potential to reduce the environmental impacts of “clean coal” plants by co-firing with biomass. Recently developed and demonstrated innovative biomass Combined Heat and Power (CHP) systems offer cost competitive options to the industrial sector with overall energy efficiencies of up to 90%<sup>10</sup>. Waste to energy demonstration projects have continued to address simultaneously energy production and sustainable waste treatment methods, while at the same time improving conversion efficiencies (incineration from 22% to 28%<sup>11</sup>) and reducing operational costs.

**Geothermal** energy production for heating has been demonstrated with EC support in combination with ground coupled heat pumps, which is the fastest growing sector of geothermal energy use, whilst demonstrations of geothermal electricity production are focused on improving the performance and reducing the costs of using low temperature sources (90°C in 1990’s to 65°C today<sup>12</sup>). **Small Hydro** power demonstrations supported by the EC have been focused on the exploitation of low head sites, where the largest remaining potential exists in Europe<sup>13</sup>.

## Energy Efficiency in Buildings

Buildings are responsible for more than 40% of the energy consumption in EU25. The “Energy Outlook up to 2030” forecasts that this share will stay at the same level for the next 25 years. The EU demonstration projects have provided valuable support to legislative and regulatory measures, in particular to the Directive on the Energy Performance of Buildings. The most recent demonstration projects go clearly beyond the requirements of existing legislation and thus contribute effectively to the future development of regulations in the building sector.

EC demonstration projects have progressed well in the field of integrated design in order to find intelligent solutions to low energy consumption and increased comfort levels in buildings. They integrate different skills and expertise of urban planners, architects, energy suppliers, owners, renters: they take advantage of advanced communication and information tools. The largest potential for energy efficiency lies in the renovation of existing buildings.

In the field of social housing, there are very tight financial constraints on investment. In the New Member States, the majority of the citizens live in buildings of prefabricated concrete-

<sup>7</sup> PV ENLARGEMENT project

<sup>8</sup> PS10, ANDASOL, SOLAR TRES projects

<sup>9</sup> LAHTI project

<sup>10</sup> BIO-ORC project

<sup>11</sup> AMSTERDAM INCINERATOR project

<sup>12</sup> LOWBIN project

<sup>13</sup> SEARCH LHT project

panel construction, which were mostly constructed from the late 1960's to 90's and which consume 2 to 3 times more energy than in EU15. Nevertheless, excellent results are being achieved by demonstration projects addressing the refurbishments of social housing. For example, energy consumption can be reduced by up to 90%, while the loans for the renovation costs can be paid off using the money which is saved on the energy bill within 10 to 15 years. Such results may be replicated at a larger scale in several Member States.

## Energy Efficient Cities - CONCERTO

CONCERTO is the new research and demonstration initiative from DG TREN, which aims to demonstrate radically improved energy efficiency and renewable energy use in community – wide areas in EU cities, at acceptable costs. CONCERTO will support 27 cities ( e.g.Nantes ,Stuttgart, London ,Torino, Barcelona) over the next 5 years (clustered in 9 projects<sup>14</sup>).

The 28 CONCERTO cities are demonstrating the innovative integration of cogeneration, energy management systems and advanced technologies in eco-buildings, together with a high share of renewable energy supply. The projects include analyses of technical and financial risks, and future market potentials, as well as socio-economic research to analyse the local trends in energy costs, prices and savings, the social impacts, and the quality and added values of the energy services provided.

CONCERTO cities will demonstrate the high potential for energy efficiency which can be achieved within realistic market conditions. They will then publish and share “best practice policies” with other cities in order to raise their performance above that required by the latest legislation.

The CONCERTO initiative will mobilise over 3 billion € of investment for sustainable energy related actions, and achieve energy savings with significantly lower investments than would be possible with individual measures only. Successful CONCERTO cities are expected to achieve a pay-back of their initial investments within 10 to 15 years, leading to the stimulation of replication on a much larger scale in the future.

## Biofuels for transport

**Biofuels** can effectively replace fossil fuels for transport and heating applications with significantly improved overall emissions, while at the same time improving the security of energy supplies and increasing the cohesion and interactions with rural sectors of society. Several technology providers now offer commercially available industrial processes which are competitive for the production of the traditional biofuels, biodiesel, bioethanol and biomethane. However, ethanol from lignocellulosics and the production of synthetic biofuels (via gasification and synthesis gas) still need technological development, and can be usefully accelerated towards commercial viability within a timeframe of 5-10 years by collaborative EU research and demonstration. DG TREN (FP6) has therefore recently supported projects for the next generation of biofuels such as biodiesel from sunflower and waste streams<sup>15</sup> and

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<sup>14</sup> Renaissance, Polycity, Eco-city, Ecostiler, Sesac, Tetraener, Crrescendo, Energy in Minds, Act2

<sup>15</sup> Contracts BIODINA NNE5-2001-649 biodiesel from sunflower; & Contract BODIEPRO NNE5-2001-832, biodiesel from animal tallow, used cooking oils

bioethanol from lignocellulosics<sup>16</sup>. In addition, new contracts supported by DG TREN will begin in 2005 on the production of biomethane from wood<sup>17</sup> and on large scale demonstrations of the use of bioethanol and biogas in cities for public transport, captive fleets, company cars etc<sup>18</sup>. These demonstration projects will bring biofuels closer to the European citizen ( target of 5,75 % of biofuels in transport by 2010 ), and further demonstrations of this type, aiming to accelerate the markets for specific new technologies, will be continued in FP7.

## Hydrogen for transport

Hydrogen and fuel cell technologies have made a tremendous progress in the last years. The progress made has placed these technologies in the forefront of the research policy with the establishment of a successful **European Hydrogen and Fuel Cell Technology Platform** in January 2004. Hydrogen and fuel cells are also in the international research forefront with the **International Partnership for the Hydrogen Economy** established in November 2004.

The next step would be the creation of a **Joint Technology Initiative in Europe making use of Article 171** of the Treaty in FP7 (2006-2013). The industry is giving clear signals of its interest, as shown at the Second General Assembly of the hydrogen platform.

**DG TREN has pioneered this vision and effort since 2001 when it was decided to support the CUTE project (52M€)**, which is regarded worldwide as the most important demonstration project on hydrogen. Today the 27 hydrogen fuel cell buses have been operating in regular public transport services for more than one year. 3.000.000 Europeans have been moved in their cities without noise or harmful emissions. The buses have made more than 600.000 km.

By the end of 2005 (after negotiation of the current call) the portfolio of hydrogen demonstration projects of DG TREN will be composed by three large projects developing technologies for **cars (ZERO REGIO – 23 M€)**, **buses (CUTE plus – 51 M€)** and **small transport<sup>19</sup> (HYCHAIN – 52 M€)** as well as exploring **infrastructure solutions** for the supply of hydrogen.

Karl Kellner , D2 , 16/03/05

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<sup>16</sup> BABILAFUENTE NNE5-2001-685, bioethanol from barley straw

<sup>17</sup> Bio SNG Proposal N° 2004-19895

<sup>18</sup> BEST Proposal N° 2004-19854 for bioethanol and BIOGASMAX Proposal N° 19795 for biogas

<sup>19</sup> Mopeds, mini-cars, wheelchairs