

Energy, Environment and Sustainable Development (EESD)

EU-Target Action: Integration

The European citizens are increasingly concerned by how to properly respond to global climate change. In addition, the recent crisis, following oil price instabilities, has demonstrated once more the vulnerability of the European energy supply. The European Commission have recently adopted a Green Paper entitled "Towards a European Strategy for the Security of Energy Supply" discussing what should be done to prepare EU for these long term challenges. Such a debate is critical, as in the EU the demand for energy and, in particular, for electricity will continue to increase in the next 20-30 years and meeting the challenge of security of energy supply will be key for the development of a dynamic and sustainable economy in Europe.

Under the European Union's Research Fifth Framework Programme, the non-nuclear energy (NNE) part of the Thematic Programme "Energy, Environment and Sustainable Development" (EESD) has been revised last year to establish the priorities and road maps that will be the basis for the calls closing in 2001 and 2002. A number of Target Actions were defined aiming at combating the Global warming, increasing energy efficiencies and providing Europe with safe and sustainable energy into the 21st century. This paper presents the actions and priorities of the NNE-Programme, with special emphasis on the Target Action I: Integration of renewable energy sources (RES) and distributed generation (DG).

1. The EESD-Energy Programme and research and development needs

More and more, the world community fears that using fossil fuels could lead in time to devastating climate change. It is progressively being accepted that "something" must urgently be done to reduce emissions of CO₂ and other greenhouse gases. At Kyoto, the European Union has lead the international community in defining limits on the release of greenhouse gases. Nowadays, further instruments, actions and plans are being discussed and launched. More than ever, many of the most important challenges need to be organised in coordination with Member States in order to respond to environmental problems shared by Europe as a whole.

The EU EESD-Energy research programme embraces the entire range of activities, from basic research through to demonstration. It plays a critical role in the medium to long term, by feeding the market with technologies, processes and products which offer the potential to reduce the emission of greenhouse gases. It also provides vital support for the Union's key policy objectives of reducing atmospheric pollution and improving the security of Europe's energy supplies - both of which are critical to the quality of life of its citizens.

In the energy sector, there are three main driving forces for which technical and socio-economic research is needed for the medium to long term.

First, research helps to cut pollution, by providing new technologies which allow our buildings, vehicles, manufacturing industries and electricity generation plants to use fossil fuels more efficiently.

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Second, research makes it possible to use clean, renewable sources of energy – reducing the rate at which our oil reserves are consumed, and equipping us to produce the power we will still need when the oil starts to run out.

Third, the research programme makes a significant contribution to Europe’s industrial competitiveness – for example for renewable and clean coal-technologies.

2. Programme Implementation for 2001-2002

The Fifth Framework Programme for Research and Technological Developments, covering the period 1999-2002, was adopted in December 1998. Its non-nuclear energy programme, which is part of the Thematic Programme “EESD”, was based on past JOULE-THERMIE efforts (figure 1), but it also seeks to create conditions in which research results are likely to be taken up by the market.

The programme has been revised to establish the priorities and road maps that will be the basis for the calls closing in 2001 and 2002. The results of the calls for proposals during 1999 and 2000, together with the perspective for programme evolution in the light of political priorities, have been analysed and discussed in detail recently with the programme’s External Advisory Group, the Programme Committee and independent external experts.

This consultation-process has led to the current “Work Programme Update”, covering the period 2001 - 2002. During this period, the implementation of all programme activities will focus on a new approach based upon three main elements:

1. concentration of a substantial fraction of the programme budget (approximately 60%) around a core set of Target Actions which are designed to facilitate solutions with a measurable impact, high profile and direct relevance to EU policy objectives;

JOULE III. Integration of RES: Hybrid and stand alone

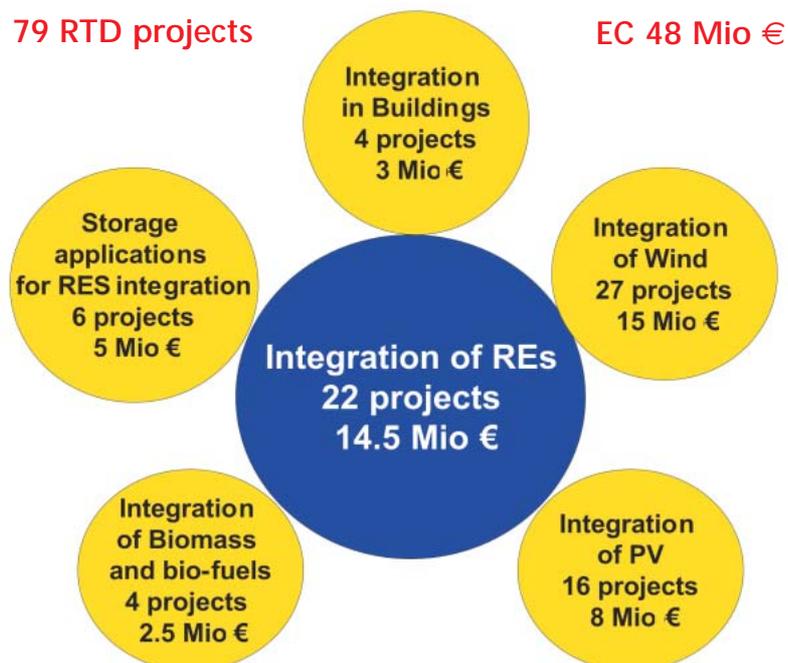


figure 1
Joule III:
Integration of
Renewable Energy
Sources (RES)

Today, centralised generation:
 swifter, higher and stronger

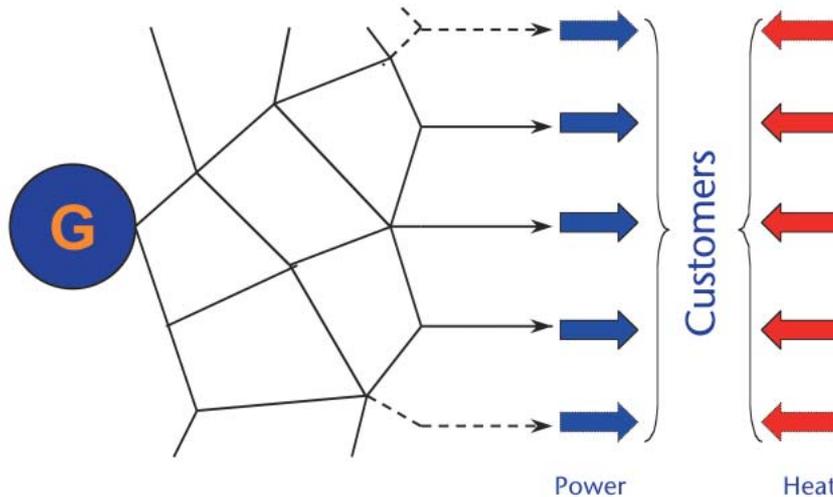


figure 2
 Today, centralized generation

2. identification of priorities with strategic importance to the EU, at least one of which should be addressed by proposals related to any of the topics of the Work-Programme, to which the remaining 40% of the programme budget are allocated;
3. a clear differentiation between proposals addressing problems that can be solved and technologies that can be used within the short time-frame (less than five years), and proposals which address problems and technologies within the medium-to-long time-frames (more than five years).

3. The Target Action INTEGRATION of renewable sources and distributed generation in energy systems

Global and EU energy supply is currently dominated by combustion of fossil fuels, which are the main green house gases (e.g. CO₂) which is considered to be linked to global warming. A shift towards sustainability based on new (e.g. hydrogen and fuel cells) and renewable energy sources (wind, biomass, solar, PV, etc.) is necessary, but needs a substantial and continued Research, Technology and Demonstration (RTD) effort which has to be supported jointly

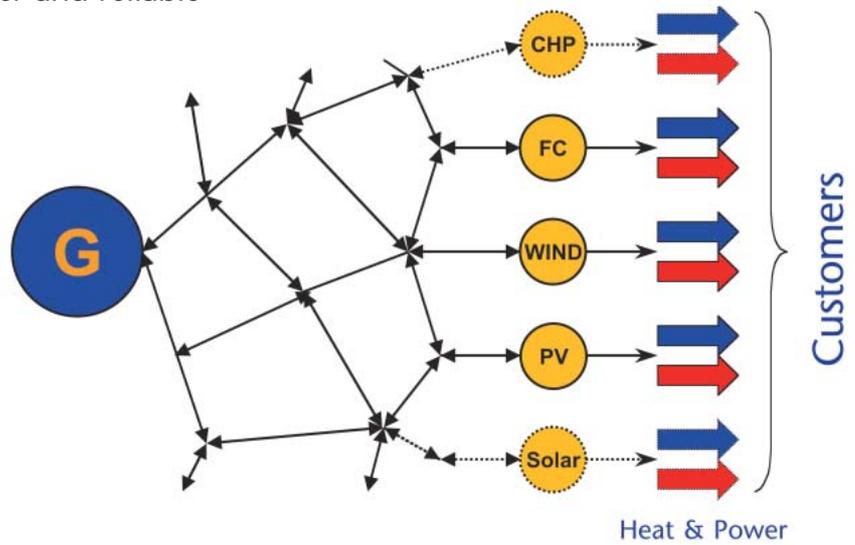
by industry and public sources in the EU. The ongoing liberalisation of the energy- and electricity-market is generating important changes, such as the development of distributed or "embedded" generation, which represent not only challenges, but also opportunities that need to be exploited.

On the other hand, the take-off foreseen by the White Paper on Renewable Energy Sources and the development of distributed generation necessitates the immediate provision of conditions for access, and effective integration, into the existing and evolving energy networks, as well as the preparation of the next generation of energy production and distribution infrastructure. Such an infrastructure will need to manage flexibly and effectively the supply of many thousands of small generators and a few hundred big ones to a huge and highly variable demand.

The joint EU energy- and electricity-markets need to respond rapidly to these challenges in order to gain the full potential of the opportunities offered by new technologies. The obstacles are however not only technological, but include also normative and regulatory issues which require multidisciplinary action involving social and economic, as well as scientific research, to overcome political, legal and administrative barriers.

Vision for tomorrow: Integration of RES+DG cleaner, cheaper and reliable

figure 3
Vision for tomorrow:
Integration of RES
and DG



The establishment of a European Research Area for the integration of renewables and other sources of energy generated in a decentralised manner will help to accelerate the change of the energy supply paradigm and achieve the objectives of sustainability and security of supply for the EU. Joint European efforts stimulating the symbiotic interactions of new and renewable energy technologies, advanced storage and conversion systems, systems engineering, information and communication technologies and advanced electronics are currently under way and will hopefully result in new approaches to manage and operate the energy networks of the future, able to ensure a stable and reliable supply responding to the quality requirements of demanding customers operating in the knowledge society.

The changing energy landscape

The integration of renewable energy sources (RES) and distributed generation (DG) refers to the widespread use of small, modular energy conversion units close to the point of consumption.

Today's energy supply is dominated by the large-scale, centralised combustion of fossil fuels (coal, oil and gas), with energy delivery

over long distances. Maintaining this energy model might be neither desirable nor sustainable, for many reasons, e.g.:

- Fossil fuel resources are finite and non-renewable.
- EU already has a high dependence on imported fossil fuels (50%) and this is projected to grow to 70% over the next 20-30 years if nothing is done.
- Burning fossil fuels releases carbon dioxide (CO₂) into the atmosphere. This greenhouse gas is considered to be largely responsible for global warming.
- Other air pollutants (e.g. sulphur dioxide and nitrogen oxides), affecting people's health on a more local scale, are also released by the combustion of fossil fuels.

RES and DG for heating, cooling and electricity have the potential to become the cornerstone of a future, more sustainable European energy supply.

Their uptake on a sufficiently large scale will transform the energy landscape from one dominated by the centralised combustion of fossil fuels to one in which cleaner and new technologies contribute a substantial share.

To achieve this profound change, leading to thousands of small energy producers being

connected to energy networks, alongside hundreds of large producers, cannot be achieved until fundamental issues relating to the integration of distributed energy resources need to be solved.

Managing the transition – the need for research

The integration of distributed energy resources into existing energy systems represents a major challenge that will require substantial and continued research, technological development and demonstration effort to accompany policy and regulatory measures. This effort needs to be supported jointly by industry and public sources in Europe.

The Commission considers that substantial progress can be made in the field of integration through more focussed collaboration in research and technological development – both within and beyond the European Union. The European Research Area (ERA) will help to deliver this by co-ordinating know-how and resources efficiently and involving all stakeholders in a genuine dialogue.

In a rapidly evolving commercial environment, heavily influenced by the liberalisation of energy markets, a better co-ordination of national and European efforts and a greater co-operation between recognised centres of excellence and industry could create significant rewards and help unlock the huge potential of RES and DG to contribute to sustainable energy production and use.

Overcoming the barriers

The future expansion of RES and other not yet competitive distributed generation units will have to face various ambitious policy targets and support schemes on the one hand and increasing liberalisation of European energy markets on the other.

The barriers to a better and faster integration of RES and other distributed generation systems can be classified into three categories:

Political and Legal Barriers:

- Unconformity between technical interfaces and legal frameworks, as the Distribution System Operator (DSO) is not the owner of the RES or decentralised generation unit.
- Lack of regulatory framework for the interaction between a variety of decentralised generation operators and DSO regarding indemnification and insurance.
- Not clarified European-wide responsibility for quality and reliability of energy supply and legal framework for grid access and power wheeling.

Administrative Barriers:

- Lack of standardised contracts for interconnection of decentralised generation units.
- Variety of contracts with different decentralised generation operators and corresponding account procedures.
- Limited experience with monetary assessment of additional values (e.g. peak shaving, load management) or additional expenditure of decentralised generation and realisation in contracts.
- Tariffs issues for demand shapes, backing services, distribution wheeling, etc.
- Lack of acceptance of emerging regulatory necessities.

Technical Barriers:

- Lack of standardised power interfaces between decentralised generation units and distribution network.
- Lack of standardised communication interfaces for control and supervision of decentralised generation units and of the distribution network.
- Lack of suitable control strategies and procedures for electrical supply systems with high decentralised generation penetration.
- Lack of strategies and procedures for decentralised ancillary services (frequency and voltage control) on different voltage levels.
- Lack of experience with the operation of electrical supply systems with high penetration of RES as an intermittent energy source.

Target Action I: Integration of RES and DG in energy supply systems

The Integration of RES and DG in energy supply systems has been identified as a medium-to-Long-term Target Action (TA) of the Energy RTD Programme in the 5th Framework Programme.

The objectives of this TA are being reinforced today with new policy measures and legislation at national and European level aiming at increasing the deployment and integration of RES and DG in the liberalised markets within next years.

Results of this TA will complement EU Directives on internal electricity markets and the electricity produced from RES, as well as other actions and measures for the liberalisation of energy markets, security of supply, e-trading, etc.

Indicative RTD subjects for this Target Action

- Development of new technologies and concepts for the operation and exploitation of the electricity networks and mini-grids

which are able to cope with the integration of RES and other decentralised electricity systems in a European deregulated market. They include systems for frequency and voltage regulation (this particularly in view of the increase of non-regulated generation), development of intelligent protection systems, two-way real-time communications integrated into the power system targeted at the control of the power supply and consumption and for the collection and processing of information between the supplier and the clients;

- Socio-economic and pre-normative research related to the liberalisation of energy markets and RES integration;
- Address technical and non-technical issues related to large shares of RES and decentralised energy in overall energy supply which are expected in the long term. This includes measurement of RES and other decentralised energy production systems, as well as prediction and planning techniques for their integration and acceptability and also quantification of externalities and benefits;
- Integration of RES and non-RES energy sources and storage systems, in particular hybrid systems (including co-generation) and stand alone systems, to ensure a cost-effective and reliable energy supply able to cope with any demand fluctuation;

Indicative timetable and budget

RTD Target Actions [1] 60% of total budget	
Short-Term 50% of total Target Action budget	Medium-to-Long-Term 50% of total Target Action budget
1 st closing date: 15.03.2001 Budget: ~70 M€ Topics covered: - Sustainable Communities - Clean Urban Transport - Gas Power Generation	1 st closing date: 15.02.2001 Budget: ~70 M€ Topics covered: - Fuel Cells and hydrogen, - Bio Energy, Integration, - Cleaner fuels for transport, - Storage, Photovoltaic
- 2 nd closing date: 14.12.2001 Budget: ~75 M€ Topics covered: - Application Driven Fuel Cells - Bio-electricity - Eco-buildings	2 nd closing date: 14.12.2001 Budget: ~75 M€ Topics covered: - All MLT actions addressed

figure 4
Indicative timetable
an budget in the
5th Framework
Programm

- Critical technologies offering high potential for distributed and decentralised generation, such as micro gas turbines (below the MW range) and small to medium gas turbines (up to 40 MW).

development of decentralised energy technologies. Employment creation, for example in the agricultural biomass sector, will also be stimulated.

figure 5
DISPOWER network
in progress

Expected contribution to major EU policy objectives

The widespread integration of renewable energies and distributed generation will contribute significantly to achieving a wide range of EU policy objectives:

- Sustainable development, combating climate change and reducing air pollution – e.g. a shift from the large-scale combustion of fossil fuels to a more sustainable, decentralised energy supply will help the EU to meet its Kyoto commitments regarding the emission of greenhouse gases (particularly CO₂): 8% reduction by 2008-2012.
- Security and diversity of energy supply – reducing the EU's external energy dependence is crucial for the development of a dynamic and sustainable economy in Europe. If nothing is done, external dependence (on coal, oil and gas) will reach 70% in 20-30 years time, against the current 50%.
- Increasing the penetration of Renewable Energy Sources – doubling their share in the energy supply quota from 6 to 12% and raising their part in electricity production from 14 to 22% is an objective to be attained between now and 2010.
- Energy market liberalisation – increased opportunities for smaller-scale generators will revolutionise the production and supply of energy to the benefit of consumers and to the distribution system itself.
- Industrial competitiveness – developments improving the integration of renewable energies and distributed generation will create new markets and business opportunities, especially for "Small and Medium Enterprises" (SMEs). The export potential for such technologies is particularly high.
- Economic and social cohesion – remote regions and island communities will benefit greatly from the possibilities offered by the

