JRC Scientific and Technical Reports

Analysis of the barriers to the uptake of R&D results in the power sector

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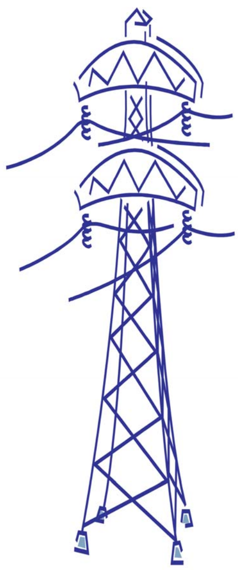

GRID
A coordination action on ICT vulnerabilities of power systems and the relevant defence methodologies

EUR 23267 EN - 2008

JRC
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http://ipsc.jrc.ec.europa.eu/
http://www.jrc.ec.europa.eu/

EUR 23267 EN
ISSN 1018-5593

Luxembourg: Office for Official Publications of the European Communities

Printed in Italy

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Final Report
on

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Proposal/contract no.: 26923 GRID

Date of preparation: 11 January 2008

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Executive Summary

GRID is a Coordination Action on ICT vulnerabilities of power systems and the relevant defence methodologies. The European power system has been developed in the past 50 years independently by every single country, therefore it is basically a set of interconnected national subsystems. Growing integration of the European electricity market with high level of cross-border exchanges was out of the scope of the original system design. This has led Transmission System Operators to operate the system close to its security limits. Control and protection of the power grid is more and more dependant on distributed and interconnected computer systems. Security challenges for the power grid partly arise from this increasing complexity, autonomy and interoperability. Recent blackouts can be seen in this general context.

Power grid vulnerabilities are European wide problems, they cannot be solved individually but require a coordinated European effort. GRID aims at establishing a roadmap for collaborative R&D on power grid security, also based on exchange of information about national, regional and European research projects. Collaborative research programmes might benefit from a mutual exchange of approaches, experiences, and results. However, cross fertilisation may be hampered by existing barriers of an institutional, socio-economic and technical nature. This report investigates barriers to exploitation of national research results in a European context. It provides an overview of current national R&D programmes in the energy sector. Key European economies are investigated, including Germany, UK, France, Italy, Sweden and Norway. Relevant case studies are pointed out concerning:

- Fraunhofer Gesellschaft and the Julich research institute in Germany;
- Public energy research in the UK, especially on Distributed Power generation;
- Italy’s Ricerca di Sistema;
- STEM, the Swedish energy research agency;
- research on power system vulnerabilities funded by the Nordic Council of Ministers in Norway.

Such case studies point out that national research studies concerning power system security have produced a great deal of results whose exploitation out of a national or regional context would be beneficial. However this may be hampered by a number of barriers. These include language (results are often fully documented in the originating country's language only), legislation (e.g. technology requires adaptation of countries energy regulations), background (huge costs of adaptation of specific methodologies out of a national context), restricted access (technology cannot be licensed to third parties; high fees for license are required, etc.).

ACKNOWLEDGMENT

The authors gratefully acknowledge the substantial insight and the advice given by Nils Flataboe and Andrei Z. Morch (Sintef) by commenting on an early draft of this paper.

1 LIST OF ABBREVIATIONS

1.1 General abbreviations

£	Pound (UK currency)
ADEME	French Environment and Energy Management Agency
BMBF	Federal Ministry of Education and Research (Germany)
BMU	Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (Germany)
BMWA	Federal Ministry of Economics and Labour (Germany)
CA	Consortium Agreement
CAT	Carbon Abatement Technology (UK)
CESI	Italian Electrotechnical Centre of Experiences Giacinto Motta S.p.A
CHP	Combined Heat & Power
CIEMAT	Research Centre for Energy Environment and Technology (Spain),
CNEAI	National Commission for the Evaluation of Research Activities (Spain),
CNR	National Research Council (Italy)
CNRS	National Research Centres (France)
CSIC	Spanish National Research Council
DEFRA	Department of Food and Rural Affairs (UK)
DER	Distributed Energy Resources
DFG	German Research Association (DFG),
DG	Directorate General
DKK	Danish krone (Danish currency)
DSO	Distribution System Operator
DTI	Department of Trade and Industry (UK)
EC	European Community
EDF	Electricité de France
EEA	European Economic Area
ENEA	Agency for New technologies, Energy and Environment (Italy)
ENEL	Ente Nazionale per l'Energia eLettrica – National Electricity Company (Italy)
EPIC	Public Establishment with Industrial and Commercial Character (France)
EPSRC	Engineering and Physical Sciences Research Council (UK)
ERA	European Research Area
ERA-NET	Networking of national or regional programmes in the European Research Area
ERC	European Research Council
ESRC	Economic and Social Research Council (UK)
ETDEWEB	ETDE World Energy Base
ETI	Energy Technology Institute (UK)
EU	European Union
EZ	Ministry of Economic Affairs (Netherlands)
FFI	Norwegian Defence Research Establishment
FHG	Fraunhofer Society (Germany)
FhG-SIT	Fraunhofer Institute for Secure Information Technology (Germany)
FP6	6^{th} Framework Programme, 2002-2006

FP7	7th Framework Programme, 2007-2013
IEA	International Energy Agency
GDP	Gross Domestic Product
GERD	national R&D expenditure on Civil R&D
HFG	Centres of the Helmholtz Association (Germany)
HSE	Health & Safety Executive's (UK)
ICT	Information and Communication Technology
IEA	International Energy Agency
IEM	Integrated Energy Market
IMEC	Interuniversity MicroElectronics Centre (Belgium)
IMF	International Monetary Fund
INFN	National Institute of Nuclear Physics (Italy)
IST	Information Society Technologies
ISTAT	National Institute of Statistic (Italy)
KTM	Ministry of Trade and Industry (Finland)
LNV	Ministry of Agriculture, Nature and Food Quality (Netherlands)
LTI	Energy research Centre of the Netherlands (Netherlands)
M€	Million of Euro (EC currency)
MEC	Ministry of Education and Science (Spain)
MIRES	Mission Recherche et Enseignement Supérieur (France)
MiTYC	Ministry of Industry, Tourism and Trade (Spain)
MIUR	Ministry of University and Research (Italy)
MNCT	National Museum of Science and Technology (Spain).
MPG	Max Planck Society (Germany),
MW	Mega Watt (Electric unit measure)
NERC	Natural Environment Research Council (UK)
NOK	Norwegian Krone (Norwegian currency)
NTH	Norwegian Institute of Technology
NTNU	Norwegian University of Science and Technology
NWO	The Netherlands Organisation for Scientific Research (Netherlands)
OA	Operating Agent
OCW	Ministry of Education, Culture and Science (Netherlands)
OEPM	Spanish Patent and Trademark Office
OFGEM	UK 's gas and electricity regulator
OST-OSI	Office of Science and Technology and the Innovation Group (UK)
PTJ	Project Management Jülich (Germany)
R&D	Research and Development
R&D&I	Research, Developing and Innovation
RC	Research Councils (UK)
RDD&D	Research and Development through to Demonstration and commercial Deployment
RdS	Italian System Research (Italy)
REE	Red Eléctrica d'Espana (Spain)
SEK	Swedish Krona (Swedish currency)
SMEs	Small and Medium-sized Enterprises
SPI	Department Secure Processes and Infrastructures (Germany)
STEM	The Swedish Energy Agency
STUK	Radiation and Nuclear Safety Authority (Finland)
STW	Technology Foundation (Netherlands)
TEKES	Finnish Funding Agency for Technology and Innovation
TERNA	National Transmission Operator (Italy)
TNO	Netherlands Organisation for Applied Scientific Research (Netherlands)
TP	Technology Platform

TSO	Transmission System Operators
TVO	Power companies Teollisuuden Voima Oy (Finland)
UK	United Kingdom
UKERK	UK Energy Research Centre
V&W	Ministry of Transport, Public Works and Water Management (Netherlands)
VITO	Flemish Institute for Technological Research (Belgium)
VTT	Technical Research Centre of Finland

1.2 Project acronyms

BAS	"Beskyttelse Av Samfunnet", Protection of the Society (Norway)
CORDIS	Community Research & Development Information Service
DENSY	Distributed Energy Systems (Finland)
ETDE	Energy Technology Data Exchange
EU-DEEP	European Distributed EnErgy Partnership
GRID	Coordination Action on power systems vulnerabilities
PETROMAKS	Research Council program to optimize management of petroleum resources (Norway)
RELIANCE	CooRdination perspectives of the European transmission network research activities to optimise the reLIAbility of power supply, usiNg a systemiC approach, involving growing distributed generation and renewable energy markEts
RENERGI	Research Council program for clean energy for the future (Norway)
SAFIR	Nuclear Power Plant Safety (Finland)

1.3 Glossary of terms

In the following, some key words used in the report are defined.

- *Dissemination:* literally 'to scatter or spread widely, as though sowing seed; promulgate extensively; broadcast'. When applied to research results this means publication of the research results through various ways (and media). In view of taking up, dissemination can be proactive: in that case, the originator – or a delegated third party – contacts potential industrial and business customers, so as to assess their interest and the eventual barriers to take up (e.g., immaturity of R&D results etc.), and then provide services to overcome these barriers. Circulation of the research outcomes, e.g. by demonstrations during events like fairs or via web sites may also be instrumental;

- *Fundamental research*: experimental or theoretical work undertaken primarily to acquire new knowledge of the underlying foundations of phenomena and observable facts, without any direct practical application or use in view;

- *Experimental development*: acquiring, combining, shaping and using of existing scientific, technological, business and other relevant knowledge and skills for the purpose of producing plans and arrangements or designs for new, altered or improved products, processes or services. These may also include, for example, other activities aiming at the conceptual definition, planning and documentation of new products, processes and services. The activities may comprise producing drafts, drawings, plans and other documentation, provided that they are not intended for commercial use;

- *(Commercial/Industrial) Exploitation*: use or utilization, esp. for profit. Basically a synonym of take-up, yet it implies something more. In fact, it is possible to utilise research results as they stand, if they are mature enough for direct application. Seldom is this the case, hence to grant exploitation the third party must have the right to exploit the technology, so as to be able to adapt it to a specific product or process of its interest. These exploitation rights are often granted by the owner subject to limitations, e.g. exploitation limited to a specific field or market sector; see also 2.7 d).

- *Industrial research:* planned research or critical investigation aimed at the acquisition of new knowledge and skills for developing new products, processes or services or for bringing about a significant improvement in existing products, processes or services. It comprises the creation of components of complex systems, which is necessary for the industrial research, notably for generic technology validation, to the exclusion of prototypes as covered by point;

- *Innovation:* a process connecting knowledge and technology with the exploitation of market opportunities for new or improved products, services and business processes compared to those already available on the common market, and encompassing a certain degree of risk. It is possible to differentiate between product, process and behavioural innovation. A product innovation can be a new goods or services put on sale; a process innovation changes the way a given good is produced within the firm or across a supply chain and a behavioural innovation is when an organizational routine is replaced with new ones. Quite often, the innovation turns out to be a mix of all three "pure" categories, as with the case of the introduction of a new product that require new productive competences and changes in the organization.

- *Process innovation*: implementation of a new or significantly improved production or delivery method (including significant changes in techniques, equipment and/or software). Minor changes or improvements, an increase in production or service capabilities through the addition of manufacturing or logistical systems which are very similar to those already in use, ceasing to use a process, simple capital replacement or extension, changes resulting purely from changes in factor prices, customisation, regular seasonal and other cyclical changes, trading of new or significantly improved products are not considered innovation [1];

- *Research organisation*: an entity, such as a university or research institute, irrespective of its legal status (organised under public or private law) or way of financing, whose primary goal is to conduct fundamental research, industrial research or experimental development and to disseminate their results by way of teaching, publication or technology transfer; all profits are reinvested in these activities, the dissemination of their results or teaching; undertakings that can exert influence upon such an entity, in the quality of, for example, shareholders or members, shall enjoy no preferential access to the research capacities of such an entity or to the research results generated by it;

- *Take up*: utilisation of research results by a third party, different from the originator and the funding source.

2 INTRODUCTION

2.1 Scope of the study

The present work provides an analysis of the barriers to the uptake of R&D results in the power sector. It was developed as a specific action of GRID, a Coordination Action on ICT vulnerabilities of power systems and the relevant defence methodologies, whose aim is to establish a Roadmap for collaborative research in the 7^{th} EU Framework Programme. To face such vulnerabilities, a coordinated European effort is needed. Exchange of information and results about past and current national, regional and European research projects is substantial. This cross fertilisation may be hampered by existing barriers of an institutional, socio-economic and technical nature. These barriers may in turn hamper cross fertilisation by direct take up of research results from third parties.

The objective of this survey is to assess whether such barriers still remain in the current research support frameworks EU wide. Particular attention has been devoted to state aids to research in the Energy sector in a set of EC member states and into an associate state, Norway. This analysis is especially interested in fully funded public research, because power system security is considered a public interest matter in most countries – so that relevant research is often fully funded by the state. In such cases, barriers to information exchange are not justified, and there is also little justification to barriers to take-up. Section 2 of this report provides an overview of research funding on the target set of countries and a repartition between fully funded and partly funded research is given. A survey of existing dissemination mechanisms provided by funding agencies and the originators and the relevant barriers is given in section 4.

2.2 Research, Development and Innovation: a process description

Promoting Research, Development and Innovation (R&D&I) is an important objective of common interest worldwide and in Europe especially. During the meeting in Barcelona in March 2002, the European Council adopted a clear goal for the future development of research spending. It agreed that overall spending on Research and Development (R&D) in the Community should be increased with the aim of approaching 3 % of gross domestic product by 2010. It further clarified that two-thirds of this new investment should come from the private sector. To reach this objective, research investment should grow at an average rate of 8 % every year, shared between a 6 % growth rate for public expenditure and a 9 % yearly growth rate for private investment [2].
The Commission considers that the existing rules for State aid to R&D have to be modernised and enhanced to meet this challenge [3]. First, the Commission, wanted to expand R&D support to innovation.
The Commission underlines that competitive markets should in principle, on their own, lead to the most efficient outcome in terms of R&D&I. However, as this is not always be the case, government intervention might improve the outcome. Undertakings will invest more in research only to the extent that they can draw concrete commercial benefits from the results and are aware of the possibilities to do so. There are many reasons for low levels of R&D&I, partly due to structural barriers, and partly to the presence of market failures. A ‘market failure’ is said to exist when the market, if left to its own devices, does not lead to an economically efficient outcome. It is in those circumstances that state intervention, including state aid, has the potential to improve the market outcome in terms of prices, output and use of resources.

Structural barriers should preferably be handled by structural measures, whereas State aid may play a role in counter-weighing inefficiencies due to market failures. Furthermore, empirical evidence indicates that for State aid to be efficient it must be accompanied by favourable framework conditions, such as adequate intellectual property right systems, a competitive environment with research and innovation-friendly regulations and supportive financial markets. However, State aid may distort competition, and strong competition is at the same time a crucial factor for the market-driven stimulation of investment in R&D&I. For this reason, state aid measures must be carefully designed in order to limit the distortions.

State aids to research are the subject of art. 87 of the EC treaty and the related regulations. These were recently revised and summed up by the EC in a unique framework [4]. In this document thresholds for state aid to research are defined. In addition, the document states that research organisations or other not-for-profit innovation intermediaries performing economic activities (such as renting out infrastructures, supplying services to business undertakings or performing contract research), have to respect the normal market conditions and the regular competition. Public funding aid to these economic activities may distort the market, hence an appropriate regulation has been introduced.
The basic rules state that aid intensity, as calculated on the basis of the eligible costs of the project, shall not exceed:

- 100 % for fundamental research;
- 50 % for industrial research;
- 25 % for experimental development.

(Refer to the Glossary 1.3 for a definition of the terms above).

However, the aid intensity must be established for each beneficiary. Non profit research organisations and academia may be funded up to 100%, and Small and Medium-sized Enterprises (SMEs) also are guaranteed higher aid intensity. Current national frameworks comply with these rules, see section 3.

2.3 The GRID Context

GRID is a Coordination Action on Information and Communication Technology (ICT) vulnerabilities of power systems and the relevant defence methodologies. In view of the transformation of the European power infrastructure GRID wants to establish a Roadmap for collaborative research within the current framework programme. Partners in GRID are mostly European research institutes and organizations from the energy and ICT communities.

The advent of new societal needs increases the electricity consumption and the dependency from electricity. Any discontinuance in the energy supply can have a considerable impact on the European citizens' welfare and well being. The European electrical transmission system has been developed in the past 50 years independently by every single country, as a collection of national subsystems. In recent years, an integration of the European electricity market has been carried on, nowadays there is a high level of cross-border exchanges that was out of the scope of the original system design. The huge amount of transactions processed daily in the liberalized market among the various actors, considering also the imports from other country to face the growing demand, can produce saturation of the interconnections. This has led the Transmission System Operators (TSOs) to operate the system close to its security limits. Recent blackouts must be seen in this general context. Protection and control of the power grid is important and is more and more dependant of ICT, which is based on distributed and interconnected computer systems. Security challenges for the power grid partly arise from this increasing complexity, autonomy and interoperability [5]. Although recent blackouts do not seem to have been influenced by malicious acts, existing vulnerabilities could be exploited by malicious threats in the future.

GRID has been designed with the main purpose to develop and to disseminate knowledge at the European and national level on the key issues on ICT vulnerabilities of the electrical power systems. Power grid vulnerabilities are European wide problems, which cannot be solved individually but require a coordinated European effort. Better cross fertilisation across EU stakeholders on existing vulnerabilities and the ways to overcome them is substantial. GRID aims at establishing a roadmap for collaborative R&D on innovative and/or advanced technologies, also based on exchange of information about past and current research projects on the subject – having both a national and a EU-wide scope. Collaborative research programmes having mostly a national or regional scope would clearly benefit from a mutual exchange of approaches, experiences, and results. Concerning European collaborative research programmes the European Community has proposed a set of rules for the use and the dissemination of knowledge, usually defined in the Consortium Agreement (CA) which binds the consortium members. Usually those rules ensure cross-fertilization of foreground results in a European context, but there are not any rules to coordinate the exchange of background results that have been obtained in single national initiatives: experience shows that there may be outstanding barriers against sharing of national research result in a European context.

One specific work package of GRID concerns “Strategies and dissemination” (WP4). This WP4 also includes the analysis of the institutional, socio-economic and technical barriers to reduce the vulnerability of the European power system and market and the integrated ICT systems. Such barriers can be caused by the existence of non-uniformed law regulations, or different cultural backgrounds, as language or method. The aim of this document is to analyse some of these barriers by investigating practical cases where background results exchange among EU stakeholders would undoubtedly be helpful to reduce power grid ICT vulnerabilities.

2.4 Data sources

A huge documentation was consulted to write this document - sections 3 and 4 especially. It is difficult to obtain clear and up-to-date information in such a wide sector as “research funding”. Web consultation was fundamental and in that CORDIS (http://cordis.europa.eu/search), the official portal of the Community R&D Information Service, played a key role: its useful search engine permitted to accede to accurate information about every EC member research system. Most countries have dedicated funding to research institutes within their relevant Ministries for Research, Trade & Industry, Economic Affairs etc.These include:

- VITO (Belgium)
- Danish Energy Authority (Denmark)
- Energinet.dk (Denmark)
- VTT (Finland)
- Academy of Finland
- EDF (France)
- CESI Ricerca (Italy)
- LTI (Netherlands)
- Enova SF (Norway)
- SINTEF (Norway)
- REE (Spain)
- STEM (Sweden)
- OST-OSI (UK)
- Ofgem (UK)

The tables presented in most of the subsections of section 3 contain data collected from the CORDIS search engine. The more interesting national realities have been deepened trough consultation of the specific organisation homepages, see the relevant country subsections in 3. Scientific reports and publications have been also considered. They provide information on national Research policy, e.g. current research policy goals and the relevant main instruments. The above institutes either provide by themselves the necessary budget, or take it from a public/private partnership. Subsections of 3 provide information about every national Research funding systems, and the way research funding is split between public and private contribution. The role of the European and international funding is also indicated. The main public webpages providing such information are indicated at the end of each country subsection.

In addition to CORDIS, the following search engines were used:

Nordic Energy	http://nordicenergy.net/
Google	http://www.google.com
ETDE	https://www.etde.org

Concerning GRID documentation, important information was drawn especially from ref. [5] and [6]. Concerning section 4, several data were collected by interviewing representatives of the mentioned Institutes and other members of the GRID Consortium.

2.5 Mechanisms for research results sharing

In the European context, a Regulation that defines the Rules for Participation to research programmes and Dissemination of results under the Framework programme is established. This was initially set up in the early '70 when the framework programme was launched. EU funded projects are a notorious example of transnational collaboration, in which participants from different cultural backgrounds, with different working methods, communication tools, etc, work towards the same goal. All the members of a common project have to do an effort towards mutual understanding and cooperation in order to solve difficulties related to the differences in languages, methods, and specific goals expectations. To face and to go beyond these barriers an instrument called "Consortium Agreement" (CA) has been defined.

Under the Sixth Research Framework Programme (FP6) the European Commission granted consortia greater flexibility in project management issues. This trend continues with the Seventh Research Framework Programme (FP7). A particularly difficult challenge for the project management is the harmonisation of the diverse interests and objectives of the participating individuals and institutions.

As a contract, the consortium agreement decisively limits the conflicts amongst the project partners. In FP6, the conclusion of consortium agreements was mandatory for big projects only. However, in FP7, consortium agreements are compulsory for all the funding schemes unless otherwise provided in the call for proposals.

The consortium agreement only governs the relations between the participants themselves and it should be noted that the European Commission is not a contracting party in this agreement. The legal provisions which regulate the consortium and the Commission relations are laid down in the grant agreement. In any case, the grant agreement's regulations take priority over those of the consortium agreement. Such an agreement is signed by the participants in a project to fix the binding rules among consortium members. These also include clauses relevant to knowledge dissemination, transfer and protection of Intellectual Property Right (IPR) with respect to the ownership of results and the mutual granting of Access Rights.

Reference: http://www.kowi.de/en/desktopdefault.aspx/tabid-73/

2.6 Guidelines for a Consortium Agreement

A consortium agreement is required for all projects financed, except those exempted from this obligation by the specific call for proposals to which they have applied. The EC is not a party to these agreements and plays no active role in the choices made by the parties of the clauses they deem appropriate to the nature and purpose of their collaboration and interests. The Consortium Agreement must comply with the Rules and the EC contract. However the EC provides a checklist to assist contractors in an EC-funded project in order to identify issues that may arise during the implementation of a research project and which may be facilitated or governed by means of the Consortium Agreement [7]. Participants have greater autonomy to manage the project and to regulate amongst themselves a number of issues, as well as issues relating to intellectual property. This is one of the reasons why the consortium agreement is mandatory, except in those cases where specifically excluded by the call for proposals [8].

The provisions in the Rules that should be addressed include:

a) Provisions for ensuring the technical implementation of the project;
b) ‘Collective responsibility’ is applicable to most actions except SME specific actions, some specific support actions to promote and develop human resources and mobility;
c) The EU contribution is to be paid to the co-ordinator designated by the Consortium and identified in the Contract, who administers the Community financial contribution according to decisions taken by the ‘consortium’ regarding its allocation to ‘participants’ and activities;
d) A single legal entity can participate in the contract, acting as a sole contractor when it is composed of the minimum number of eligible participants as required by the Rules;
e) “Changes in ‘consortium’ membership”, including its modification or extension to include further legal entities contributing to the implementation of the project;
f) Setting out a plan for the ‘use’ or ‘dissemination’ of knowledge submitted by the contractors. This may include:
    - allocation and exercise of joint ownership;
    - setting out the terms of ‘use’ in a detailed and verifiable manner, who will exploit what, when and how and any potential access rights which may be necessary;
    - granting additional or more favourable access rights, including access rights to third parties, or specifying the requirements applicable to access rights. This could identify preferences, potential limits, and potential access rights, which may be necessary.
g) Other issues relating to the intellectual property rights either generated during the project or existing prior to or acquired in parallel with the project as specific pre-existing know-how. Every one of these topics should be carefully considered by the participants and, where appropriate, dealt with in a precise and detailed manner in the consortium agreement.

2.7 Rules for dissemination and use of research results

These provisions define the use, the dissemination, the allocation of ownership and the exploitation rights on the results of collaborative projects. The basic principle of the CA rules is to stress the capacities and role played by each party in order to encourage maximum use of the results either by means of commercial exploitation or by further research applications.

a) Confidentiality: The confidentiality clause comprehends the restrictions to the information availability, the rules to permit the publicly availability through publications. Generally, the period during which the undertaking must be respected exceeds the EC Contract's duration or the consortium agreement’s expiry date (e.g. a 10-year term).

b) Ownership of results: The joint ownership of knowledge should be avoided where possible. Where it is not possible to distinguish the contribution of two or more participants or the result cannot be separated into distinctive parts, joint ownership will be necessary, in this case the participants concerned must conclude a specific agreement. In the event of an invention being the work of a single party to the Contract and solely the result of its intrinsic skills rather than shared knowledge, this party will be the exclusive owner of the results. The conditions for granting of rights, limitations and remuneration, if applicable, should be included in the consortium agreement in as much detail as possible.

c) *Legal protection of results (patent rights):* It may be useful to stipulate an option clause in the event that the designated owner of the result waives its option to start registration proceedings within the period stipulated in the Contract.

d) *Commercial exploitation of results:* The results of EC-funded projects are generally owned by the contractor generating them. However, the nature of the work carried out may result in joint ownership of results. In this case, the parties must determine the terms and conditions for ownership and exploitation. It is necessary to take care in drafting these clauses, to ensure that they do not conflict with the principle of free trade of goods and competition rules within the EC.

e) *Obligation to use:* The EC Model Contract, requires that the results of the project be used (commercial exploitation or further research applications) and that the plan for use and dissemination be clearly identified in the activity reports. It also requires that where dissemination would not adversely affect use, the participants must disseminate the results within two years of the end of the project.

f) *Dissemination of knowledge:* The process of dissemination of results is the responsibility of the owner and must respect the IPR provisions in the EC Model Contract. However, dissemination cannot start until either the knowledge is protected or there is an assurance that dissemination will not affect the protection of the results.

g) *Publication:* According to the EC Model Contract, a participant shall give prior notice of any planned publication of its knowledge to the EC and the other participants.

h) *Background Patents, know-how and information:* The implementation of a research or innovation project may require the use of pre-existing know-how, owned by one of the parties, resulting from work carried out prior to, or independently of, the agreement. In this case, the EC Model Contract provides that the party owning the knowledge must disclose it to the other participants, unless specifically excluded by means of a written agreement before the signature of the Contract. It is important to distinguish pre-existing know-how held prior to the conclusion of the EC contract from that acquired in parallel with it (side-ground).

i) *Sub-licences:* Generally speaking access rights are granted without the right to sub-licence. However, the licensor can authorise the licensee to grant sub-licences to third parties within clearly defined limits. In this case, it is necessary to indicate:

- [special clause for sublicensing of data];
- the conditions under which such sublicenses are granted;
- the need to obtain the licensor's prior consent in accordance with duly explained grounds;
- the need to maintain any access rights as required under the EC contract.

References: ftp://ftp.cordis.europa.eu/pub/fp7/docs/checklist_en.pdf
http://ec.europa.eu/research/fp6/model-contract/pdf/checklist_en.pdf

3 AN OVERVIEW ON THE EUROPEAN RESEARCH IN THE ENERGY SECTOR

3.1 Importance of R&D funding

The theme of funding of R&D is critical to ensure development of energy technologies to solve mid- and longer term energy policy challenges. Energy security, environmental protection and economic growth depend on the energy technology adopted. The role of government energy R&D budgets is becoming more critical given that R&D activities in the private energy sector may be reduced as a result of competitive pressure under energy market liberalisation. R&D statistics seem to be valuable indicators of national energy policy and of technological Change [9].

Despite these critical roles, government energy R&D budgets in many countries were reduced between the early 1980s and the 1990s. This decline represents a continuation, albeit less dramatic, of the trend already established in the 1980s and is largely associated with the difficulties of the nuclear industry and, since 1985, with the decrease in oil prices. From 1998 the government expenditures have slightly recovered. A comparison of energy R&D budgets as percentage of GDP for a set of EC countries is illustrated in section 3.15.

As general comment, Government expenditure for fossil fuel is huge, while the budgets for renewable energy and energy conservation are growing. It is increasingly important to involve the private sector in R&D activities to accelerate technology development. Little information is publicly available on private industry R&D budgets for energy technologies. Data on energy R&D funding reveals current national priorities; it also offers information on experiences with different approaches in energy R&D funding (*i.e.* general funds versus targeted R&D programmes).

3.2 Guideline of the overview

In this section, an overview of the European research in the energy sector is presented. This refers to a set of European countries made of the leading actors in terms of economic capacity and quality of scientific results. Two types of funding have been taken into account:

- Fully public;
- Public-private partnership.

The first type concerns research fully funded by one National or Regional Government. Usually, these funds are provided by the Ministry of Trade and Industry, the Ministry of Economic Affair or the Ministry of Education and Research.

The second type concerns partnership among National Government and other sources, usually private or European Community funding. The repartition of the contributions in this partnership is different in every country, these data are underlined in the text and a comparison among the countries being investigated is further proposed. For each member State chosen, the main institutions providing funding in the Research & Development (R&D) field are shown and the main subjects (i.e. research institutes, universities, private companies) involved in such funding programs are listed.

The following European countries are analysed: Belgium, Denmark, Finland, France, Germany, Italy, Netherlands, Norway, Spain, Sweden and the United Kingdom. Whenever possible, an overview of the overall research funding institutions is given first, details about some particular actor latter, and a grouping by the type of funding provided is given. Wherever relevant data are clearly specified, funding is split for investigation areas: energy saving, renewable energy sources, fossil fuels, nuclear power, thermal power generation, and electricity distribution. This is a preliminary study and does not pretend to be exhaustive, since some national information is not easy to interpret and may be difficult to compare. CORDIS represents a fundamental source of information used in this overview; the other data sources are indicated at the end of every subsection (see section 1.3 – Data).

3.3 Belgium

3.3.1 Fund sources repartition

Belgium has three institutional levels: the Federal Government, the Community Government (French, Flemish and German-speaking Communities) on a cultural-linguistic base with autonomous politic competences, and the Regional Government (the Flemish, Walloon and Bruxelles Regions) on an economic-geographic base with politic-administrative competences on a local base. Belgium has a decentralised decision-making and governance system for R&D funding. Within it, the Federal level accounts for a restricted part or the total R&D funding (less than one-third). The Federal level provides funding for research of national interest such as security as well as for international research programmes such as space research. Fiscal incentives are also present at the federal level. Funding for basic research is the responsibility of the Communities. This includes both institutional funding, competitive funding across universities, and support to individual researchers. Funding for applied and technological research with a view of raising economic added value is under the Regions responsibility. This includes both direct funding to companies and funding of research centres and technology diffusion activities. The relative shares of the federal and federated entities in overall budgetary credits for R&D are as follows, according to the Federal Office for Science Policy (2003):

- 45.75% comes from the Flemish Community (including Community and Regional competencies);
- 29.63% from the federal state;
- 13.37% from the French Community;
- 10.23% from the Walloon Region;
- 1.02% from the Region of Brussels - Capital.

Total budgetary allocations from the public sector for R&D in Belgium amount to 1714 M€ in 2005. These funds are allocated to the following sectors:

- 26% to institutional funding to third-level education institutions and 12% for the large Research Funds. These are (partly) allocated on a competitive basis;
- 13% to scientific institutions;
- 18 % in the form of research action programmes, which are open to public research and /or private research performers, also including individual grants for researchers;
- 11% to industrial research (industrialists may also access private research funding – see previous line);
- 13% to supporting international research programmes.

In terms of objectives the following split is calculated:

- 42% for technological objectives;
- 25% for non-oriented research at universities;
- 19% for general universities funding
- 9% for socio-economic objectives.

Enterprises are the main funding source of R&D activities in Belgium (60%). The public sector funds 23.5% of total R&D activities, and foreign sources account for 13% of the total funding sources.

3.3.2 Examples of fund users

VITO is the Flemish institute for technological research. It is an independent and customer-driven research organization, VITO provides innovating, technological solutions and scientifically based advice and support, to stimulate sustainable development and to reinforce the economic and social structure in Flanders. Central to all projects is protecting the environment and encouraging sustainable use of energy and raw materials. The total annual budget is about 70 M€; of the total budget, 33 M€ was in the form of operating grants from the Flemish Government whilst the rest came through additional income generated by programme financing from assignments for industrial contract research or from the provision of specialized services.

Reference: http://cordis.europa.eu/erawatch/index.cfm
http://www.vito.be/english/

3.4 Denmark

3.4.1 Overview on fund sources

The main player in the Danish system is the Ministry of Science, Technology and Innovation which coordinates all research and innovation policies and most of the funding (about 1929 M€ in 2006, for the themes ICT; biotechnology, food and agriculture; nanotechnology, nanosciences, materials and new production technologies). The two most important institutions are the Danish Council for Independent Research (Det Frie Forskningsråd) and the Danish Councils for Strategic Research (Det Strategiske Forskningsråd), which are responsible for targeted research based on policy initiatives.

In addition to these two, there are also two separate foundations for basic science: the Danish National Research Foundation (Danmarks Grundforskningsfond) and the Danish National Advanced Technology Foundation (Højteknologifonden). Research is performed by universities, government research institutes (i.e. the ministry owned research institutes and the independent Approved Technological Service Institutes), in addition to R&D in companies.

Erhvervsfremmestyrelsen is the National Agency for Enterprise and Construction and supports regional development. This also includes public research and higher education as can be seen in the 2006 Regional Policy Growth Report.Vækstfonden is a government backed venture capital investment company. Vækstfonden provides funding to fast-growing Danish companies and act as a fund-of-funds investor in the private equity sector in the Nordic region.

Table 2.1 - Danish research funding

	Source (%)	Total budget
Ministry of Science, Technology and Innovation	Government: National 100%	1929 M€ (2006)
Danish Council for Strategic Research	Government: National 100%	56,7 M€ (2006)
Danish National Research Foundation	Government: National 100%	24,5 M€ (2004)
Energinet.dk	From tariff on electricity bill	17 M€ per year
Danish National Advanced Technology Foundation	Government: National 20%	2150 M€ (2005-2012)

3.4.2 Funding agencies in the Energy sector

The Danish Energy Authority administers the Energy Research Programme, ERP, (Energiforskningsprogrammet - EFP) to fund energy R&D projects. In 2007 approximately 55 million DKK (about 7M€) were made available for project funding. The Danish Energy Association is a commercial and professional organisation for Danish energy companies. It is managed and financed by its member companies, mainly the electricity companies, and works to secure for them the freest and most favourable conditions for competition and development in order to ensure development, growth and well-being in Denmark.

The Danish Energy Association is a meeting point for three members' associations: the Dansk Energi - Net, an association for electricity grid and transmission companies (66 companies), Dansk Elhandel, an association for electricity trading companies (12 companies), Dansk Energi - Produktion, an association for electricity production companies (9 companies).Dansk Energi has its own research department - previously DEFU, which is engaged in security-related R&D activities.

The Strategic Research Council (Det Strategiske Forskningsråd) manages funding for energy research projects concerning renewable energy technologies and energy conservation. In 2007 approximately 105 million DKK (about 13.5M€) were made available. The Danish National Advanced Technology Foundation *(*Højteknologifonden) in 2005 and 2006 has funded energy technology projects for about 50 million DKK (6.5M€).

3.4.3 Focus on Energinet.dk

The Energinet.dk is a company responsible for the operation of the Danish electricity and natural gas transmission system since January 2005. As the owner of the overall infrastructure, Energinet.dk mission is to maintain the security of supply. The Danish Minister for Transport and Energy is the sole owner of Energinet.dk on behalf of the Danish state and ensures that Energinet.dk complies with the provisions of the Danish Act on Energinet Denmark. It provides funding for R&D on environmentally friendly electricity production technologies by means of a special tariff of DKK/KWh 0.004 (0.0054 €cent/KWh), which all electricity consumers pay via their electricity bills. Energinet.dk's economy is based on a break-even principle as the executive order on the financial regulation of Energinet.dk only allows the company to include the costs of efficient operations plus the return on the equity. This means that all the required for the activities in question are covered by the tariff. The consequence of the self-financing principle is that over time the financial result for the year will be nil, when disregarding the rate of return on the net capital.

References: http://www.ens.dk/sw11492.asp
http://www.energinet.dk/en/menu/Frontpage.htm

3.5 Finland

3.5.1 Overview on fund sources

The Government is supported in matters related to research, technology and innovation policy by a high level advisory body, the Science and Technology Policy Council of Finland. The Council is responsible for the strategic development and coordination of Finnish science and technology policy as well as of the national innovation system as a whole. The key ministries with respect to research policy are the Ministry of Education and the Ministry of Trade and Industry (KTM). The Finnish research system is rather decentralised, as there are 20 universities 31 polytechnics and 20 government research institutes in Finland.

Funds are administrated by two R&D funding agencies: Academy of Finland and Tekes, the Finnish Funding Agency for Technology and Innovation. The Academy of Finland provides funding for high-level scientific research, acts as a science and science policy expert and works to strengthen the position of Finnish science and research. Annually the Academy issues funding decisions are worth around 200 million euros. Tekes is the main public funding organisation for research and development in Finland, for the year 2006 it provided 466 M€, namely:

- 271M€ to corporate projects;
- 195 M€ to university, research institute and polytechnic projects.

2157 R&D projects have been financed, of which:

- 1428 corporate projects;
- 729 university, research institute and polytechnic projects.

The following programmes concern energy research:

- DENSY is the Finnish national technology programme for distributed energy systems. This comprises local small-sized units for producing power, heating or cooling. A wide selection of fuels and production technology is covered. DENSY will run during 2003-2007. The total budget is estimated to exceed 50 M€.
- SAFIR 2003 – 2006 is the Finnish public research programme on nuclear power plant safety. The programme is administrated by the steering group that has been nominated by the Ministry of Trade and Industry (KTM). The whole programme is managed by the VTT coordination unit, the programme director and the project managers of the individual research projects. The main funding sources 2005of the programme were the state Nuclear Waste Management Fund (VYR) with 2.7 M€, and the Technical Research Centre of Finland (VTT) with 1.4 M€. KTM, VTT, Radiation and Nuclear Safety Authority (STUK), and the power companies Teollisuuden Voima Oy (TVO) and Fortum Oyj along with National Technology Agency Tekes and Helsinki and Lappeenranta Universities of Technology are represented in the steering group of the programme.

Table 2.2 - Finnish research funding (2006 data)

	Source (%)	**Total budget**
Ministry of Education	Government: National 94%; Non-profit 6%	605,4 M€
Ministry of Trade and Industry	Government: National 100%	976,2 M€
Academy of Finland	Government: National 99.4%; Abroad: EU 0.1%; Abroad: Other 0.5%	207,8 M€
Finnish Funding Agency for Technology and Innovation (Tekes)	Government: National 99%; Abroad: EU 1%	466 M€
Technical Research Centre of Finland(VTT)	Government: National 57%;Industry 34%;Abroad: EU 8%;Abroad: Other 1%	225,1 M€

3.5.2 Example of public/private partnership

In the energy sector the main contractor is the Technical Research Centre of Finland (VTT), a public research institute which receives from the government a basic support for its yearly budget. The rest is achieved through dedicated projects, where VTT acts as a subcontractor to enterprises. VTT is an impartial expert organisation. Its objective is to develop new technologies, create new innovations and value added thus increasing customer's competitiveness. With its know how VTT produces research, development, testing and information services to public sector and companies as well as international organisations. The main R&D themes concerning energy research are: nuclear and fossil power generation, materials, the paper industry and emission control.

References: http://www.research.fi/en/
http://www.tekes.fi/eng/
http://www.vtt.fi/?lang=en

3.6 France

3.6.1 Research system situation

Aside fully funded public research, the French system includes competitive funds representing a share of the government R&D spending. In 2005, the credit for payments of the National Agency for Research (350 M€) which funds research on the basis of calls for projects corresponded to 2.5% of the GDP. This is expected to increase significantly in the future: commitment authorization 2006 is 800 M€ and the objective of the Government is to reach 1400 M€ by 2010. The scientific community is paying special attention to the extent this increase will not be done at the detriment of direct funding to research structures. The Government is also striving to increase industrial sector research For instance, new schemes have been put in place to do so by the Ministry of Industry, like the Competitiveness Clusters and the Agency for Industrial Innovation, both aimed at providing support to private projects associating public partners. The Ministry for Higher Education and Research has also introduced specific measures to reinforce partnership between the public and private sector.

3.6.2 Repartition of funding source

The Research Ministry has a generic programme supporting industrial research and a dedicated programme for fuel cells, developed by National Research Centres (CNRS) and a French government-funded technological research organisation (CEA).
Research funding 2007 includes:

- National Government Budget : 267,8 M€ (79% of the total);
- MIRES (Mission recherche et enseignement supérieur) : 21,3 M€ ;
- Pluridisciplinary research programmes : 3,7 M€;
- CNRS 2,3 M€.

The French Environment and Energy Management Agency (ADEME) is funding research on energy, air, noise, transport, waste, polluted soil and sites, and environmental management. The 2007 budget has been 343 M€ (a 260 M€ action budget and an operating budget of 83M€).
The Atomic Energy Commission provides about 3,1 M€ (69% government, 31% private industry) to nuclear power studies.

3.6.3 The special case of EDF

Electricité de France (EDF) was formerly a Public Establishment with Industrial and Commercial Character (so-called EPIC) subject to the "principle of speciality", with the right to sell electricity. EDF's status of 'EPIC' gave it an advantage over its rivals during the process of the opening of the electricity market, because it was benefiting of the limitless guarantee of the State. For this reason, in November 2004 EDF changed its status to a Public Company (Société Anonyme), where the capital remains predominantly public (the State keeps 70% of stock and voting rights). The current Public

Company statute enables EDF to grow its own capital stocks thanks to the entry of private investors, and accord to EDF an unfair competitive advantage.

Nowadays, EDF R&D has more than 250 research projects in the domain of electricity production, commercial deployment, transmission systems, ICT and environment. These projects are evaluated with an actualisation method, in order to estimate the creation of added value and to valorise research results. According to 2003 data EDF R&D's budget was about 424 M€, of which 25% devoted to environment research themes; personnel is 2400 of which 32% women. In 2004, EDF launched the Gavet hydro power scheme for an investment of 160 M€. About €3 billion are committed to other renewable.

References: http://www2.ademe.fr/servlet/getDoc?id=38480&m=3&cid=96
http://www.cnrs.fr/
www.edf.fr/

3.7 Germany

3.7.1 Public fund source repartition

The Federal Government is drawing up guidelines for an overarching strategy to study and develop new, secure, economic and environmentally sound sources of energy under the leadership of the Federal Ministry of Education and Research (BMBF) and the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU).

The overall 6000 M€ programme is to finance measures in the following technology sectors:
- modern and highly efficient power station technologies based on coal and gas,
- hydrogen and fuel-cell technologies (e.g. national innovation programme: hydrogen and fuel-cell technologies; additional 35 M€ per annum with effect from 2007),
- efficient utilization of energy,
- renewable sources of energy (i.e. test field for offshore wind energy plants; additional 40 million euro per annum)

Further investment on energy technologies R&D totals 2000 M€ between 2006 and 2009.

Research and development in the Energy Research Programme (in € 1,000)

	Actual	Planned	Projected data[1]			
	2003	2004	2005	2006	2007	2008
BMWA						
Efficient energy conversion	65,958	78,496	71,244	70,994	70,994	70,994
Nuclear safety and repository research	24,125	25,500	23,605	23,480	23,480	23,480
BMU						
Renewable energies	67,798	60,083	80,394	83,366	88,366	93,366
BMVEL						
Bioenergy	5,422	5,117	10,000	10,000	10,000	10,000
BMBF						
Centres of the Helmholtz Association						
Efficient energy conversion	36,621	39,607	42,155	42,012	42,134	44,270
Renewable energies	24,396	26,442	28,267	28,307	28,613	30,271
Nuclear safety research	29,260	31,178	31,147	31,133	31,126	31,022
Fusion research	115,298	115,000	115,000	115,000	115,000	114,900
Networks of basic research into renewable energy and energy conservation	6,600	9,830	11,100	10,100	10,100	10,100
Total	375,478	391,253	412,912	414,392	419,813	428,403

[1] The 2005 to 2008 figures partly include funds from the Innovation Initiative of the Federal Government; they are subject to approval by parliament

Fig. 2.1 – Germany funds repartition in the period 2003-2008.

3.7.2 Energy research agencies

Germany is a Federal Republic made up of 16 States, known in German as *Länder* (since Land is the literal German word for "country"). The Federal Government and the Länder together spent approximately 15.9 billion Euro on research and development (2003 data). The state thus financed a total of 32% of all R&D expenditure in Germany. 4.7 billion Euro of this was spent on basic institutional funding for the following research organizations:

- German Research Association (DFG),;
- the centres of the Helmholtz Association (HFG);
- the Max Planck Society (MPG);
- the Fraunhofer Society (FHG) ;
- the institutions of the Leibniz Association and the academies.

Project Management Jülich (PTJ) undertakes project management for various contractors, for example the Federal Ministry of Education and Research (BMBF), the Federal Ministry of Economics and Labour (BMWA), the Federal Ministry for the Environment (BMU) and numerous federal state ministries. PTJ is also the national contact point for certain EU-supported research and technology programmes and it coordinates activities for bilateral international cooperation and for the International Energy Agency.

References: http://www.energyagency.at/enr/ptj.htm
http://www.helmholtz.de/en/index.html
http://www.fraunhofer.de/EN/index.jsp

3.8 Italy

3.8.1 Overview on the research system

The Italian research system has to overcome some imbalances and problems that still hinder the full development of its potential. A long-standing weakness of the Italian science system is the low level of investment in R&D activities, compared to the position of the country's economic system among those of the most industrialized nations (in 2003 in Italy, the ratio of business enterprises expenditure on R&D over GDP is 0.55%, compared to an EU average of 1.23). By consequence, Italian companies show scant capability to compete in the high-tech international markets.
The Italian ratio Universities' expenditures over GDP is 0.38 compared to EU's 0.42. To face this problem, national policies have undertaken a mixed strategy that uses a manifold set of tools to guide the spontaneous behavior of the public and private actors that form the research system.
The main public actors that are going to implement these policies are the Ministry of University and Research (MIUR) (mostly involved in basic research policy, the national plan for the years 2004-2006 of MIUR provides 10 M€/year in the energy research area) and the Ministry for Economic Development (with a bias towards innovation-oriented research). The various funding schemes address fundamental and applied research, public and private research and national and international co-operation.

Italy counted 77 universities at the end of 2004. Most of them were public, and their first role in the R&D field is to carry on basic research. Then there are ten large research agencies supervised by MIUR. Public research institution's expenditure in 2003 was about 2600 M€, and Universities' was about 5000 M€. The largest research agencies are the National Research Council (CNR) and the Agency for New technologies, Energy and Environment (ENEA) - both multidisciplinary. The National Institute of Statistic (ISTAT) and the National Institute of Nuclear Physics (INFN) are the 3rd and 4th institutions in terms of size, they only do research in a specific field.

Table 2.3 - Italian research funding (2006 data)

	Source (%)	Total budget
Ministry of University and Research (MIUR)	Government: National 100%	10 M€
Ministry for Economic Developement	Government: National 100%	1,6 M€
National Istitute for Nuclear Physics (INFN)	Government: National 99%	250 M€
National Research Council (CNR)	Government: National 78%; Government: Regional 2%; Industry 4%;Abroad: EU 3%	821 M€
Italian National Agency for New Technologies, Energy and the Environment (ENEA)	Government: National 70%	284 M€
Agency for the European Research Promotion (APRE)	Non-profit 50%;Abroad: EU 40%;Abroad: Other 10%	1,2 M€
Italian System Research (RdS)	From tariff on electricity bill	80 M€

3.8.2 Main research actors and funding schemes in the energy sector

ENEA, the Italian National Agency for New Technologies, Energy and the Environment is a public undertaking operating in the fields of energy, the environment and new technologies to support competitiveness and sustainable development. In 2006 ENEA received 284 M€, and 70% of this budget comes from public funding.

CESI Ricerca S.p.A. has been operating since 1st January 2006 with the mission to develop research activities funded at the national and international level in the electricity and energy field. CESI Ricerca S.p.A. is a publicly-controlled Company: ENEA holds 51% of its shares and CESI, the "Italian Electrotechnical Centre of Experiences Giacinto Motta" S.p.A., holds the remaining 49%. The combined participation of the public and private sector guarantees that the objectives of CESI Ricerca are in agreement with the Country's energy strategy and the needs of the operators of the electricity sector.

ENEL is the national electricity supplier. ENEL plan program envisages the development of technologies and plants for the reduction of greenhouse gases covered by a 4100 M€ investment in the next five years (2007-2011). ENEL's plan, once accomplished, will allow reduction of CO_2 gases released in the atmosphere by at least 4 million ton/y.

Public research on the power system is covered by a dedicated scheme, Ricerca di Sistema (RdS), whose funding comes from a levy on the electricity fee, nowadays about 0,03 €cent / kWh, for a total budget of about 80 M€ per year. The yearly investment plan is established by the Italian Electricity Authority. RdS is focusing on improvement of the Italian power system - relevant research themes pertain to power production, environment protection, power transmission and end uses of electricity

3.8.3 Focus on a Public/private partnership

Since 1963 to 1992 ENEL was a public utility that financed a research structure devoted to the electric sector. After the reception of the EU directive on the electricity market liberalisation (96/92/CE, received in Italy in January 2006 [10]) ENEL depleted quite all research activities and most of their R&D personnel was transferred to CESI. CESI was participated by ENEL, TERNA, and other power sector stakeholders. Most of CESI research on power systems was funded through the RdS scheme. In 2006, this direct fund assignment to a private society was deemed not to comply with EU rules about non-distortion of market competition, hence a new non-profit society was created, CESI Ricerca S.p.A., of which 51% now belongs to ENEA. This company is now receiving most of the yearly RdS funding.

Reference: http://www.enea.it/com/ingl/default.htm
http://www.cesi.it/default.asp
http://www.enel.it/
http://www.ricercadisistema.it/

3.9 Netherlands

3.9.1 Research funding structure

Companies and the government are the most important financial backers of scientific research in the Netherlands, with a share of 52% and 36%, respectively. Other financial backers are medical funds, foreign companies and the European Commission. According to the data provided by the Dutch science policy and research organizations, publication by the Ministry of Education, Culture and Science in connection with the Dutch presidency of the European Union in 31 December 2004, the total funding in the Netherlands is € 8.1 billion, this amount encompass also the fund for the national education system.

Two-thirds of public funding comes from the Ministry of Education, Culture and Science (OCW), followed by the Ministries of Economic Affairs (EZ), Agriculture, Nature and Food Quality (LNV) and Transport, Public Works and Water Management (V&W). The Ministry of Education, Culture and Science (OCW) finances the universities and several large research organizations. The Ministry of Economic Affairs provides funding for the following research themes: Generic Industry oriented innovation policy instruments, energy research, micro-electronics, ICT, ecology and biotech space and aviation.

3.9.2 Main public funding agencies

The research funding agencies are:

- The Netherlands Organisation for Scientific Research (NWO) spent 382 M€ on research in 2001. Most of this will go to the 13 Dutch universities; a quarter will be spent on funding research and investment at NWO institutes. The lion's share of this budget (291 M€) is provided by the OCW, the remaining funds come from sources such as the Ministry of Economic Affairs and from the NWO general reserve.

- The Technology Foundation (STW) is the Dutch funding agency for applied university research. STW can fund research projects from any field, although most grant applications belong to science and technology. Funding for STW comes partly from the Ministry of Economic Affairs and partly from the Ministry of Science and Education. The latter part, about two thirds, is channelled via the NOW. The Ministry of Economic Affairs supplies about one third of the budget of the Technology Foundation. Moreover some of the budget comes from the proceeds of the intellectual property rights.

- SenterNovem is an agency of the Ministry of Economic Affairs that is responsible for the execution of subsidies, credits, fiscal arrangements and programmes in the area of technology, energy, environment, sustainable development, export and international co-operation. The goal is to reinforce the position of business and research institutes in the Netherlands. SenterNovem has around 1000 M€ of policy funds available per year.

Table 2.4 - Netherlands research funding (2006 data)

	Source (%)	**Total budget**
Ministry of Economic Affairs	Government: National 100%	539 M€
Netherlands Organisation for Scientific Research	Government: National 100%	500 M€
Technology Foundation (STW)	Government: National 100%	46 M€
SenterNovem	Government: National 95%	1000 M€
Netherlands Organisation for Applied Scientific Research (TNO)	Government: National 35%; Industry 65%	561,9 M€
Energy research Centre of the Netherlands (LTI)	Government: National 35%	65 M€

3.9.3 Example of public-private partnership

The mission of the Energy research Centre of the Netherlands (LTI) is to develop high-level knowledge and technology for the transition to sustainable energy management. They partner with industry in the development and implementation of product, processes and technologies. They closely work together with Dutch and foreign universities and research institutes and perform a bridging function with implementation by carrying out technological research. About 35% of their fund comes from the Dutch national Government. The remaining funding depends on servicing a wide array of public and private interests and collaborating with universities and companies all over Europe. They are a market-oriented research centre.

References: http://www.nwo.nl/nwohome.nsf/pages/SPPD_5R2QE7_Eng
http://www.tno.nl/index.cfm?Taal=2

3.10 Norway

3.10.1 Relation with the European Community

Norway is not an EC member, but its relations with the EC are mainly governed by the Agreement on the European Economic Area (EEA). The EEA Agreement is in force since 01/01/1994 and extends the Single Market legislation, with the exception of Agriculture and Fisheries, from the EC Member States to Norway, Iceland and Liechtenstein. Through the EEA Agreement, Norway also participates, albeit with no voting rights, in a number of EC Agencies and programmes, covering i.e. enterprise, environment, education and research programmes.

3.10.2 Public funding sources and user examples

The Ministry of Education and Research and the Ministry of Trade and Industry are the most important contributors to the budget of the Research Council of Norway.
Among the projects financed, the following are linked to the energy field:
- RENERGI, that is a Research Council program for clean energy for the future, in the year 2005 had a budget of NOK 160 millions (about 20M€). In addition, The Ministry of Transport and

Communications has granted NOK 226 millions (about 3M€) to promote the development of environmental technologies, Hydrogen and alternative fuels in the transport sector.
- PETROMAKS, that is a Research Council program to optimize management of petroleum resources, in 2005 had a budget 2005 of 30 million dollars (about 21.5M€).

Enova SF was created in 2002, it is a public enterprise owned by the Royal Norwegian Ministry of Petroleum and Energy. Enova manages an Energy Fund with a budget of NOK 5 billion (app 650 million Euro) over a ten-year period and finances programmes and initiatives that support and underpin national objectives. Enova SF's main mission is to contribute to environmentally sound and rational use and production of energy, relying on financial instruments and incentives to stimulate market actors and mechanisms to achieve national energy policy goals.

The establishment of Enova SF signals a shift in Norway's organization and implementation of its energy efficiency and renewable energy policy. By gathering strategic policy responsibilities in a small, flexible and market oriented organization, Norway has wanted to create a pro-active agency that has the capacity to stimulate energy efficiency by motivating cost-effective and environmentally sound investment decisions. Enova SF enjoys considerable freedom with regard to the choice and composition of its strategic foci and policy measures. Enova SF advises the Ministry in questions relating to energy efficiency and new renewable energy.

Table 2.5 - Norwegian research funding (2006 data)

	Source (%)	**Total budget**
The Research Council of Norway (RCN)	Government: National 98%; Abroad: Other 2%	580 M€
The Norwegian University of Science and Technology (NTNU)	Government: National 90%; Government: Regional 2%; Industry 5%; Non-profit 1%; Abroad: EU 1%	483 M€
Ministry of Trade and Industry	Government: National 100%	504 M€ (expenditures)
SINTEF	Government: National 38.4%; Industry 37.9%	200 M€

The SINTEF Group is the largest research organisation in Scandinavia. SINTEF's goal is to contribute to wealth creation and to the sound and sustainable development of society. SINTEF generates new knowledge and solutions for customers, based on research and development in technology, the natural sciences, medicine and the social sciences. SINTEF was established in 1950 by the Norwegian Institute of Technology (NTH), which now forms part of the Norwegian University of Science and Technology (NTNU). SINTEF had a double intention: the first one was to encourage technological and other types of industrially oriented research at the Institute, the second one was also to meet the need for research and development in the public and private sectors.

The SINTEF Group was founded in the mid-80's. Today the SINTEF Group consists of seven research divisions (Health Research, ICT, Building and Infrastructure, Marine, Materials and Chemistry, Petroleum and Energy, Technology and Society). SINTEF has established a SINTEF Holding in order to separate their activity in the commercial sector from core scientific activities. SINTEF Holding is a tax-paying entity, which comprises a strategic ownership portfolio and a number of recently established companies.

References: http://ec.europa.eu/external_relations/eea/index.htm
http://www.enova.no/?itemid=425

http://www.sintef.no/
http://www.nve.no

3.11 Spain

3.11.1 Overview on the research system

The Ministry of Education and Science (MEC) and the Ministry of Industry, Tourism and Trade (MITYC) are the most important actors for the implementation of the "Spanish National Plan for Scientific Research, Development and Technological Innovation". Other ministries have sector competences in relation to R&D, such as the Ministry of Defence, the Ministry of the Environment and the Ministry of Health and Care. Finally, the Ministry of Economy and Finance is responsible for performing statistical and economical studies in relation to the general public services. The Centre for the Development of Industrial Technology (CDTI) receive from the Spanish Government around 270 M€. It belongs to the MITYC and it is especially involved in the implementation of research, development and innovation programmes addressing enterprises. The Spanish Patent and Trademark Office (OEPM) is a very useful information source on Spanish research results and performers.

There are two main consultative and support bodies in the Spanish R&D system: the "General Council of Science and Technology" and the "Advisory Council for Science and Technology Policy". The former has the main objective of coordinating the Autonomous Communities (or regional governments) and the relations between them and the central administration. The latter has been created to promote the participation of society in the R&D policy. Certain R&D national entities also support the government in policy-making activities, such as the Spanish National research Council (CSIC), the largest public research body in Spain. The Ministry of Education and Science encompasses up to fifteen organizations, between them it is worth noting the Spanish National Research Council (CSIC), the Research Centre for Energy Environment and Technology (CIEMAT), the National Commission for the Evaluation of Research Activities (CNEAI), and the National Museum of Science and Technology (MNCT).

In particular, CIEMAT is an Organism of the Ministry of Education and Science, is a Public Research Agency for excellence in energy and environment, as well as in many vanguard technologies and in various areas of fundamental research. Its areas of activity are:

- Energy Systems Analysis;
- Nuclear Fission (Nuclear Safety, Radioactive Waste, Nuclear Innovation);
- Renewable Energy (Biomass, Wind, Photovoltaic, Energy Efficiency in Buildings, Solar Concentrating Systems, Environmental Applications of Solar Energy and Characterization of Solar Radiation);
- Combustion and Gasification (Energy Value of Fuels and Waste, Fuel Cells and Integrated Systems, Numerical Simulation and Modelling of Technological Processes).

3.11.2 Energy research actors

The Spanish National Research Council receive a total budget of 530 M€ (2004); the fund sources are the National Government (76%), Regional Governments (6%), Industry (8%), EU (8%) and Other (3%). The main research themes are: control and care of the environment; production, distribution and rational utilisation of energy; agricultural production and technology; Industrial production and technology; exploration and exploitation of space and defence.

Red Eléctrica d’Espana (REE) was the first company in the world devoted exclusively to electricity transmission and operation of the network, it has been created in 1985. Nowadays, transmission is seen as a separate activity from generation and distribution. This system led to a radical change in the structure and working of the Spanish electricity sector which was one of the models for the deregulation of systems in other countries. The experience acquired nationally allows Red Eléctrica to carry out other business activities in foreign countries. The internationalisation strategy has led to the creation of Red Eléctrica Internacional, for the purpose of channelling and promoting the Group's business in foreign countries such as investment in transmission assets and advice and consultancy projects.

References: http://petra2.ciemat.es/
http://www.ree.es/apps/home.asp

3.12 Sweden

3.12.1 Research system description

In Sweden, there are two main performers of research. The leading performer is the business enterprise sector (the sector's investments in R&D amounted to SEK 72 billions, about 7800 M€, in 2003). The second main performer is the higher education sector with the universities as the main actors (this sector's investment in R&D amounted to SEK 21 billions, about 2240 M€, in 2003). The government sector and the private non-profit sector act mainly as financiers of research (their investments in R&D account to 4 % of the total R&D expenditure, 1% of which is of public origin). This means that Sweden fulfils the goal set by the EU to invest at least 3 % of the GDP in R&D and that the business enterprise sector accounts for at least two thirds of these investments.

Table 2.6 - Swedish research funding

	Source (%)	**Total budget**
Knowledge Foundation	Non-profit 100%	470 M€
Swedish Foundation for Strategic Research (SFF)	Non-profit 100%	About 53 M€
Swedish Research Council	Government: National 89%; Non-profit 11%	About 283 M€
Swedish Energy Agency (STEM)	Government: National 100%	About 89 M€

The Swedish Energy Agency (STEM) is the central administrative authority for matters concerning the promotion of reliable, efficient and ecofriendly supply and use of energy. The Agency is actively engaged in joint international efforts regarding energy research issues and other matters. It works through its involvement at various levels of the International Energy Agency (IEA) and in various R&D programmes under way in the EU. Research funding in the year 2006 has been of 815 SEK million (about 89M€).

Formas, The Swedish Research Council for Environment, Agricultural Sciences and Spatial Planning, has a yearly budget of about 600 million SEK (about 64 M€). It is an agency under the ministry of sustainable development. Formas also gets financial allocations from the ministry of agriculture. Formas is supposed to encourage and support scientifically significant research related to sustainable development. This means e.g. the areas of the environment, agricultural sciences, forestry and spatial planning, including building sciences and community systems. The projects supported cover a wide range of approaches from basic research to more applied efforts. The Board consists of 13 members where an electoral community of researchers elects seven members from Swedish universities and the government appoints the chairman and another five members. Formas is headed by a Director General and has about 50 employees. The research of Formas is divided into three principal areas: Environment and nature, Agricultural sciences, animals and food, and spatial planning. Formas participated in the Energy Foresight and has recently made a food foresight as a part in there new strategy for food and agricultural research [11].

The objective of the Swedish Foundation for Strategic Research (SFF) is to support re-search and postgraduate studies in science, engineering and medicine in order to strengthen research environments of the highest scientific quality in an international perspective for the purpose of strengthening Sweden's future competitiveness. The annual research funding is about 500 million SEK (about 53 M€). SSF is lead by a Governing Board of 11 members appointed by the Swedish government. The secretariat consists of about 15 persons and is headed by an executive director. Examples of programmes run by SSF are Strategic research centres, Strategic framework grants, and Individual grants. SSF participated in the first Swedish Technology foresight (2000).

3.12.2 An example of public-private collaboration

Elforsk AB started operations in 1993 and is owned jointly by Svensk Energi (Swedenergy) and Svenska Kraftnät (The Swedish National Grid). Its overall aim is to coordinate the industry's joint research and development. Proposals for R&D projects come from their owner companies, Elforsk staff members and external collaboration partners, and are evaluated with the support of their programme councils. When funding has been secured, Elforsk orders project implementation from one of the owner companies, a university department, a manufacturer or a consultant, and is then responsible for quality assurance. Elforsk's final task is to transfer project results to the funding-providers so that they can be put to practical use. Only projects that are guaranteed sufficient funding can be carried out. Elforsk has no fixed source of financing for its operations, even for staff costs, which is rather exceptional for an R&D organisation. Elforsk's working method is unusual, not only in Sweden. The underlying idea behind this model is obvious: only projects directly demanded by the customers are pursued. In various contexts, the Elforsk model is put forward as an example of how universities, public agencies and industries can work together towards common goals.

References: http://www.energimyndigheten.se/
http://www.nordicenergy.net/
http://www.elforsk.se/

3.13 Nordic Energy Perspectives

In the north of Europe a fruitful cooperation has been settled. Nordic Energy Perspectives is an interdisciplinary energy research project which, from a holistic perspective, analyses and creates new insights into the consequences for energy markets and energy systems of the goals and instruments of energy policy in the light of new conditions. The project's aim is to provide better bases for decisions on energy and environmental policy at both national and international levels. It is intended to contribute to constructive dialogue between researchers, politicians, authorities and actors on the energy markets [12].

A first phase of the project has been carried out during April 2005 – September 2006. The most part of financiers of the Nordic Energy Perspectives project are encompassed in the previous subsections, they are: Nordic Council of Ministers, Nordic Energy Research, Swedish Energy Agency, Elforsk, SwedEnergy and its member companies, Enova, EBL-Norwegian Electricity Industry Association, Finnish Energy Industries, Tekes-Finnish Funding Agency for Technology and Innovation, Finnish Ministry of Trade and Industry, The Swedish District Heating Association, Swedish Bioenergy Association, The Swedish Gas Association, Confederation of Swedish Enterprise, Svenska Kraftnät and Statoil. Elforsk has been the host of the project. The research group is interdisciplinary and has included researchers from colleges, universities, institutes and research companies of the participant countries.

A good project management has been responsible for the positive coordination work. The participants have also striven actively for a rapid and extensive dissemination of the results. The clear distribution of responsibilities and the project's well-planned organisation have ensured that results and deliveries come on time and maintain high quality.

Around fifteen current research issues have been analysed. Some of these issues have been analysed in detail, while others have been studied more generally. Hence, for each investigated theme, a contact for further dialogue is identified. An objective of Nordic Energy Perspectives has been to create a forum for fact-based discussion and dialogue between decision-makers and other energy actors from different disciplines and different countries. Today this forum is fully active.

References: www.nordicenergyperspectives.org
www.nordicenergy.net

3.13 United Kingdom

3.13.1 Research fund sources

The Department of Trade and Industry (DTI) supports the largest number of schemes.

- Around £20M (29.7 M€) into low carbon and renewable energy;
- £50M (74.4 M€) for wave and tidal stream demonstration projects;
- Capital grants totalling £117m (174.1 M€) have been made to offshore wind farms and £66M (98.2 M€) allocate to biomass projects;
- The recent Carbon Abatement Technology (CAT) strategy allocates £ 50M (74,4M€) for demonstration of clean coal technologies and carbon capture and storage.

The Department of Food and Rural Affairs (DEFRA's) provision of evidence for and monitoring of progress on its energy efficiency policy objectives with approximately £ 3M (4.5 M€). The Health & Safety Executive's (HSE's) work on nuclear safety research (£1.5M, 2.2 M€ supplemented by an additional £6.7 M, 10 M€ from reactor licensees). The Carbon Trust has over 90 R&D projects in its portfolio worth in total around £ 22M (32.7 M€). The work of the Energy Technology Institute (ETI) will primarily occupy the middle ground between the longer-term research funded by the UK's Research Councils and the deployment of proven technologies.

Core funding will be provided on a 50:50 public private partnership basis, with the ambition, when fully operational, to inject some £100 M (146 M€) per year into UK-based energy research. The Institute will have a lifetime of at least 10 years. Seven major companies have pledged a total of £ 32.5M (48.3 M€) to support the ETI.

Table 2.7 - English research funding (2006)

	Source (%)	Total budget
Department of Trade and Industry	Government: National 100%	624.4 M€
Engineering and Physical Sciences Research Council EPSRC	Government: National 100%	Approximately 730 M€
Research Councils UK	Government: National 100%	About 105 M€, prevision for 2008
Office of Science and Innovation - Office of Science and Technology OST-OSI	Government: National 100%	4387 M€
The Royal Society	Government: National 75%; Industry 25%	59 M€

3.13.2 Focus on OST_OSI and Research Council

In April 2006 the Office of Science and Technology and the Innovation Group (both within the Department of Trade and Industry) merged to form the Office of Science and Innovation (OST-OSI). The Office of Science and Innovation is responsible for UK Science Policy and for funding basic research allocated via the Research Councils. It aims to maximise the contribution made by science, engineering and technology skills and resources to the UK's economic development.
OSI - OST is a research funder, it is responsible for developing and coordinating Government policy on science and technology both Nationally and Internationally and for coordinating the funding for basic research to the Research Councils.

The Research Councils support high quality basic, strategic and applied research and related post-graduate training. The current expenditure on energy related research and training is approximately £40m (59.52 m€) and this is planned to rise to about £70M (104.17 M€) by 2008.
The Research Councils (RC) are research funding agencies in specific domains. They fund academic research only. Industry may participate to specific research programmes but does not receive funding. The following RC are somewhat connected to the energy sector:

- NERC: Natural Environment Research Council - terrestrial, marine and freshwater biology and Earth, atmospheric, hydrological, oceanographic and polar sciences and Earth observation;
- EPSRC: the Engineering and Physical Sciences Research Council: UK Government's leading funding agency for research and training in engineering and the physical sciences;
- ESRC: the Economic and Social Research Council: UK's leading research funding and training agency addressing economic and social concerns. Issues considered include economic competitiveness, the effectiveness of public services and policy, and our quality of life;
- UKERC: the UK Energy Research Centre's mission is to be the UK's pre-eminent centre of research, and source of authoritative information and leadership, on sustainable energy systems. UKERC undertakes world-class research addressing whole-systems aspects of energy supply and use, while developing and maintaining the means to enable cohesive UK research in energy.

3.13.3 Examples of public-private partnership

The Royal Society is the independent scientific academy of the UK dedicated to promoting excellence in science. The Society plays an influential role in national and international science policy and supports developments in science engineering and technology in a wide range of ways.

Its status is a not-for-profit company. The Society has focused its core activities around the followings topics: publications, funding future scientists excellence and education. The Royal Society funds more than 1600 of the UK's best scientists every year from postdoctoral level to senior professorships. Its priorities are on the themes: health, environment, energy, mobility/transport, security and space, ICT, biotechnology, food and agriculture, nanotechnology, nanosciences, materials and new production technologies and socio-economic sciences. The total annual budget is about 59 M€ (2006). The sources of funds are from National Government about 75% and Industry 25%. The Society receives most of its funds through an annual grant-in-aid from the Parliament. The funding is issued by the Office of Science and Innovation (OST - OSI). About 30% of its funding is raised through fundraising events and donation from companies and bequests. About the allocation of funds, 80% of the resources of the Royal Society are allocated to funding scientists and researchers through post doctoral fellowships and professorships, the remaining 20% is used for the running of the Society and fundraising events.

Ofgem is the electricity and gas regulator in Britain. The first priority of Ofgem is to protect consumers promoting competition and regulating the monopoly companies which run the gas and electricity networks. Other priorities and influences include helping to secure Britain’s energy supplies by promoting competitive gas and electricity markets and contributing to the drive to curb climate change and other work aimed at sustainable development.

Ofgem is governed by an Authority, consisting of non-executive and executive members and a non-executive chair. Non-executive members bring experience and expertise, from a range of areas including industry, social policy environmental work, finance and Europe. The Executive members of the Authority are Ofgem’s Chief Executive and three Managing Directors. The Authority determines strategy, sets policy priorities and takes decisions on a range of matters, including price controls and enforcement. The Authority's powers are provided for under the Gas Act 1986, the Electricity Act 1989, the Utilities Act 2000, the Competition Act 1998 and the Enterprise Act 2002.
Ofgem endeavours to keep its operations transparent through publishing the minutes of its Authority meetings and a full and thorough consultation in developing decisions. Ofgem recovers its costs from the licensed companies regulated, that are obliged to pay an annual licence. Ofgem is independent of the companies regulated. They operate under a five-year cost control regime that runs 2004-2009.

References: www.rcuk.ac.uk/
http://www.berr.gov.uk/files/file35751.pdf
www.royalsoc.ac.uk/
http://www.ofgem.gov.uk/

3.14 EU R&D investments as a percentage of GDP

At present, less than 2% of Europe's wealth (GDP) is devoted to research, which compares with 2.5% in the USA and more than 3% in Japan. The European Union is striving to approach the goal of devoting 3% of GDP to research. This is an important part of the so-called “Lisbon-strategy” which consists of a Partnership between the European Union and the Member States to transform Europe in a vibrant knowledge economy, in order to boost economic growth, create more and better jobs and ensure lasting prosperity trough concrete measures. However, since the 3% goal was set in 2002, progress remained slow: in 2003 the average GDP research contribution in Europe was about 1.23%, in 2007 reached about 1.84 % [13].

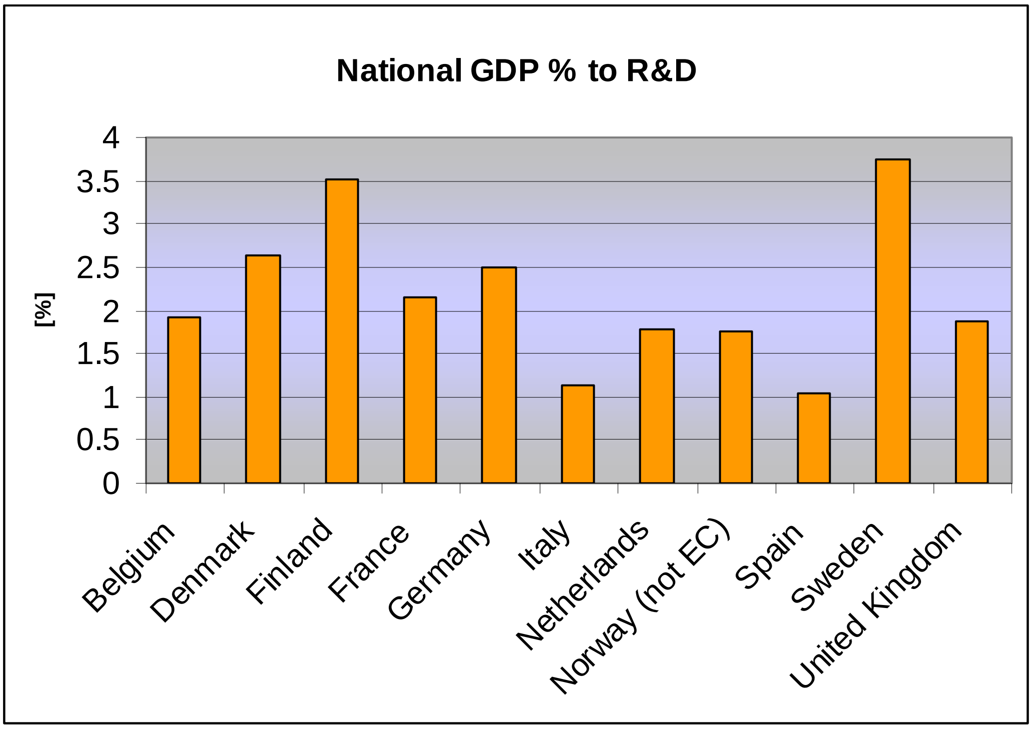

Fig. 2.2 – National GDP in % invested in R&D.

As shown in figure, R&D investment of the set of the EU countries analysed is quite different. Sweden has the main percentage of GDP devoted to research (about 4%), also Finland invests a wide percentage (about 3.5%). Denmark and Germany provide about 2.5%, and also France is over the European mean with around 2.1%. Belgium, United Kingdom, Netherlands are in line with the EU mean and are growing towards 2%, finally Italy and Spain devote lower investments, around 1%. GDP data here considered are referred to 2006 and come from the International Monetary Fund (IMF), an international organization that oversees the global financial system.

3.15.1 Energy research funding comparison

In the following we summarize data related to the energy research funding each considered country, in order to perform a comparison. Those data encompass funds coming from both sources: public and public/private partnership, i.e. for each country the relevant national Ministries, the main energy research Institutes and the other main energy research actors on a national basis have been taken into account. It is important to note that, some data may be not accurate or up-to-date because it is difficult to establish specific R&D funding per sector, while overall data are usually available. To by pass these difficulties, where economic data are provided without a sector distinction, a proportional method has been applied in order to obtain an approximate estimation of the amount provided to the energy sector specifically. In the case of Denmark, France, Italy, Norway and Sweden, the estimation comes from considering a percentage of about 8% devoted to energy sector as far as Ministry funds is concerned. In the case of Belgium, Finland, Netherlands, Spain and United Kingdom, the total national R&D budget in all sectors has been divided by the number of themes it covers, so as to estimate the amount associated to the energy sector. In other situations, like Germany, specific sector data are clearly defined and have been reported in the previous sub-sections.

Following these assumptions a comparison of these data is proposed, thus considering the estimation character of these amount, which objective is to have a panorama of the national investment on R&D energy sector of these analysed countries.

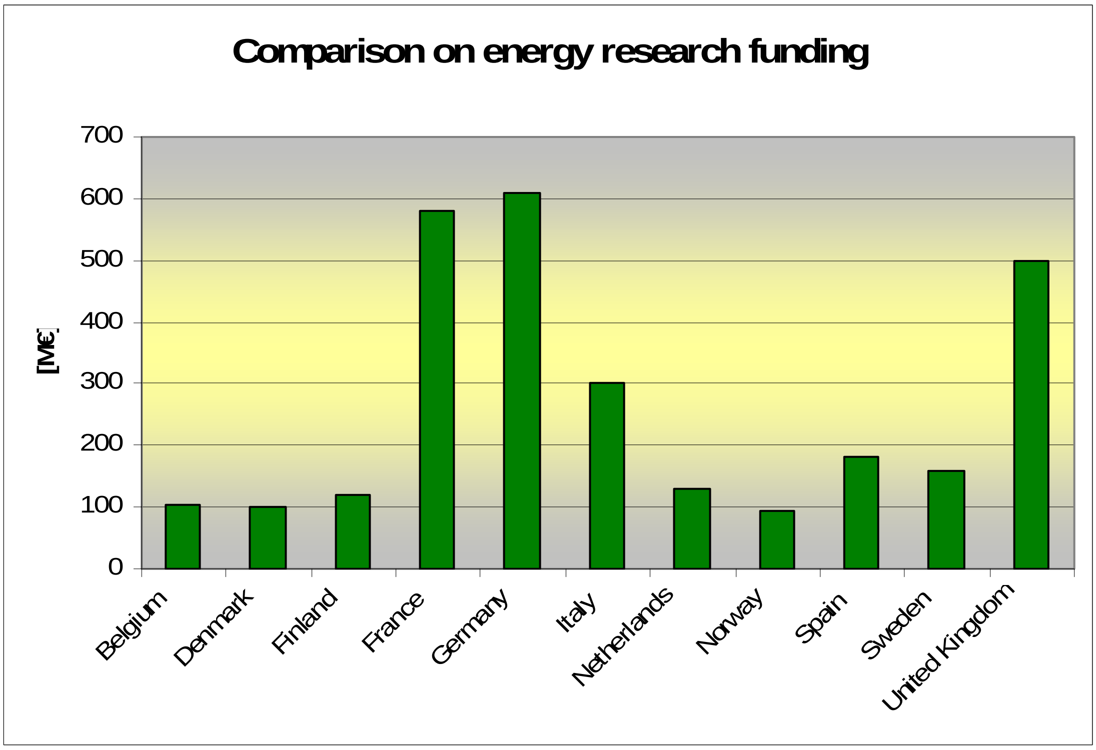

Fig. 2.3 – Funding for energy research in Europe (2006).

As shown in Fig. 2.3, sums range from 100 to 600 M€. The Federal Government of Germany has planned a wide investment to develop modern energy technologies between 2006 and 2009. France data encompass EdF research budget, which results into a high investment on research on the energy field. The United Kingdom also provides a wide budget to investigate in every energy research areas. The Italian budget devoted to energy research is mainly composed by the contributions provided by some research Institutes with public/private partnership. In Spain, the main funding source is the national Government. In Denmark, the contribution comes, as for the aforementioned countries, from research Institutes with public/private partnership and from a tariff on electricity bill. The Netherlands and Belgium R&D expenditure is managed at the federal level and the budget injected by each single Region is considerable, so there is also a Regional Government contribution besides the National one and those provided by collaborations with industry. In Finland, in the energy sector the main contractor is the Technical Research Centre of Finland (VTT).. Norway has a wide ten-year project, called SenterNovem, and the Research Council provides additional funds.

3.16 EC research programmes

In the 7th Framework Programme (2007-2013), new initiatives have been launched, as the European Research Council, that will have an important impact on the European research landscape. The EU Research Framework Programme is explicitly designed to support the creation of the European Research Area (ERA). These initiatives has been introduced to improve the coordination of research activities and programmes. They include the European Technology Platforms, through which industry and other stakeholders develop shared long-term visions and strategic research agendas in areas of business interest, and the bottom-up 'ERA-Net' scheme which supports the coordination of national and regional programmes.

Policy coordination is addressed through the 'open method of coordination' and the use of voluntary guidelines and recommendations. This is stimulating a process of debate and reforms at national level, which has resulted in all Member States setting national R&D investment targets in the context of the overall EU 3% of GDP R&D investment objective and taking measures to improve their research and innovation systems. Furthermore, one example of an organization that aims to help the international information exchange is presented, it is the Energy Technology Data Exchange (ETDE).

3.16.1 The European Research Area

The European Research Council (ERC) is a recent but vital instrument for the construction of a European Research Area (ERA) as a common market for knowledge creation and utilization. With the ERC and more broadly the 7th framework program, the EC has seriously begun to promote frontier research as a key aspect of competitiveness in a knowledge society. This necessary development, long advocated by the scientific community, is of course strongly endorsed by the ERC Scientific Council. EC has to face the competitiveness of the USA research system and the emerging giant economies of China and India as well as several other Asian and Australasian countries (Japan, S.Korea, Taiwan, Singapore, Australia). It is commonly argued that the major problem for research in Europe is fragmentation of efforts. Fragmentation is indeed an important problem, but it goes hand in hand with inadequacy of overall resources, due to vast disparities in R&D investment levels across the countries of Europe. According to the Commission's "Key Figures 2007 on Science, Technology and Innovation", total (public and private) national R&D expenditure on Civil R&D (GERD) in the EU varied tenfold, between 0.39 and 3.86% of GDP in 2006, the average being only 1.84% of GDP. The comparable R&D funding levels in the USA, Japan and S. Korea are currently 2.67%, 3.17% and 2.99%, respectively.

The idea of a European Research Area (ERA) grew out of the realisation that research in Europe suffers from three weaknesses: insufficient funding, lack of an environment to stimulate research and exploit results, the fragmented nature of activities and the dispersal of resources. The objective of the European Research Area initiative is the creation of an "internal market" in research, an area of free movement of knowledge, researchers and technology, with the aim of increasing cooperation, stimulating competition and achieving a better allocation of resources. Other important points are the improvement of the coordination of national research activities and policies, and the development of a European research policy which takes account of all relevant aspects of other EU and national policies.

ERA coordination projects are the principal means for the EC Sixth Framework Programme for Research and Technological Development to support the cooperation and coordination of research activities carried out at national or regional level. At present about 20 ERA coordination initiatives relevant to the thematic priority Information Society Technologies (IST) have been launched with the support of the European Commission. The majority is funded by Directorate General (DG) Information Society, some of them by DG Research.

ERA has been created in 2000, once ERA has been achieved, the concept of European research will be as familiar as those of the single market or the single currency are today. This concept will be useful to uptake the barriers to the information sharing, that in some cases still exist. Many initiatives have been taken by the EC and Member States. But there are still strong national and institutional barriers which prevent ERA from becoming a reality.

Reference: http://ec.europa.eu/research/era/index_en.html

3.16.2 European Technology Platforms

R&D has a vital role to play in addressing major economic, technological or societal challenges, and their interplay in a sustainable development perspective. European Technology Platforms can provide a means to foster effective public-private partnerships between the research community, industry and policy makers in order to deliver the impetus to mobilise the research and innovation effort towards achieving a common goal. The role of Technology Platforms in stimulating more effective R&D,

particularly in the private sector, can contribute directly to develop the European Research Area and increasing investment in R&D towards the 3% of GDP target.

In essence, a Technology Platform (TP) is a mechanism to bring together all interested stakeholders to develop a long-term vision to address a specific challenge, create a coherent, dynamic strategy to achieve that vision and steer the implementation of an action plan to deliver agreed programmes of activities and optimise the benefits for all parties. The elaboration and follow-up of a Strategic Research Agenda form a crucial part of the implementation strategy, to optimise the contribution of RTD to the process. In achieving its wider goals, a TP should, in a medium to long term perspective, generate sustainable competitiveness and world leadership for the EU in the field concerned, by stimulating increased and more effective investment in R&D, accelerating innovation and eliminating the barriers to the deployment and growth of new technologies.

Reference: http://cordis.europa.eu/technology-platforms/home_en.html

3.16.3 The ERA-NET Scheme

The objective of the ERA-NET scheme is to step up the cooperation and coordination of research activities carried out at national or regional level in the Member States and Associated States through: the networking of research activities conducted at national or regional level, and the mutual opening of national and regional research programmes. The scheme will contribute to making a reality of the European Research Area by improving the coherence and coordination across Europe of such research programmes. The scheme will also enable national systems to take on tasks collectively that they would not have been able to tackle independently. Both networking and mutual opening require a progressive approach. The ERA-NET scheme therefore has a long-term perspective that must also allow for the different way that research is organised in different Member States and Associated States.

Reference: http://cordis.europa.eu/coordination/era-net.htm

3.16.4 ETDE

One example of a worldwide organization formed in 1987 to strengthen international information exchange is the Energy Technology Data Exchange (ETDE). It involves a group of countries/entities who have chosen to co-operate to meet a key information need in a more cost-effective way. ETDE is considered an Implementing Agreement under the International Energy Agency (IEA) Framework for Technology Co-operation structure. The ETDE Implementing Agreement serves as a legal basis for the collaboration and its mission is to provide governments, industry and the research community in the member countries with access to the widest range of information on energy research, science and technology and to increase dissemination of this information to developing countries.

ETDE's goals are:

a) To compile and maintain a shared database on information related to energy research and technology;
b) To disseminate information related to energy research and technology;
c) To explore, and where appropriate develop, other ways of collecting and disseminating information related to energy research and technology;
d) To support the work of the International Energy Agency.

ETDE is managed on a day to day basis by an entity that serves as Operating Agent (OA). The Operating Agent for ETDE is the U.S. Department of Energy's Office of Scientific and Technical Information in Oak Ridge, TN, USA. Some of the major functions include receiving and processing database input and full text from member countries and other sources, holding the organisational structure and also maintaining ETDEWEB, distributed searching, and key authority tools. The OA is guided by an Executive Committee made up of delegates from each participating country. The Executive Committee is lead by a Chairperson and two Vice-Chairs. A Technical Working Group, also made up of delegates from each country, provides advice and recommendations on the technical aspects of the exchange.

The ETDE members (also known as Contracting Parties) participate on a cost- and task-sharing basis. An annual fee is required to fund basic operations of ETDE. Each member is also asked to ensure that the energy-related information published within its borders is provided as input into ETDE's Energy Database, and thus available to members and approved non-members through ETDEWEB and other available sources. Members are also highly encouraged to attend Executive Committee and Technical Working Group meetings and participate actively in electronic discussions.

The main Internet tool for disseminating the energy research and technology information that they collect and exchange is the ETDE World Energy Base or ETDEWEB. ETDE World Energy Base (ETDEWEB) is the largest collection of energy research and technology literature in the world. With a growing total of over 4 million abstracted and indexed records in the full collection (over 3 884 000 bibliographic records and more than 183 000 full text documents), users have access to a wealth of information contributed by ETDE's member countries and international partners. While ETDE began the database in 1987, historical energy-related information from the U.S. Department of Energy's Office of Scientific and Technical Information databases is also included, adding coverage back to 1974.

The ETDE Energy Database contains a wealth of information on a variety of energy-related topics. While primarily considered a scientific and technical database, users will also find information targeted to policymakers and consumers. Thanks to the addition of subject-related categories and thesaurus terms (keywords) being added to records in the database, users can better target the information to get more precise results than are usually possible by just using Internet searching. The following pie chart represents the subject contents of the database for the last five years (2001-2005). These are very broad categories, but represent the diversity of coverage. The high percentages in the physics and materials area, although valid, are a bit higher than normal due to recent work with publishers to cover some older material.

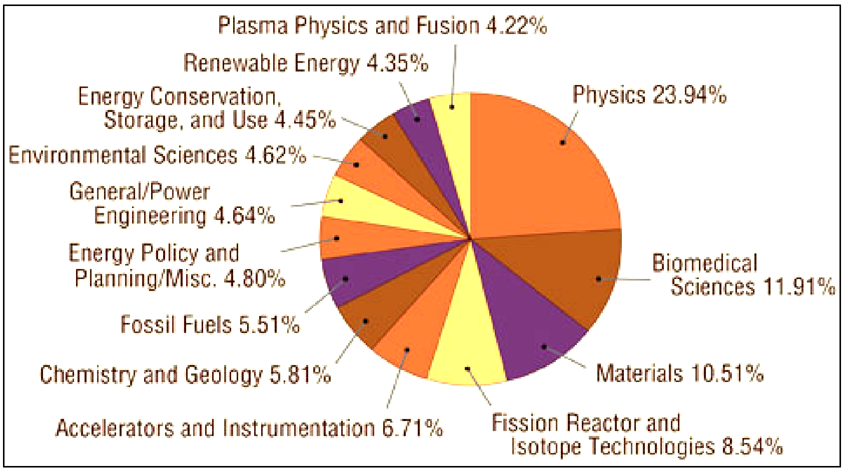

Fig. 3.1 – ETDE publications, subdivided by argument.

Subject categories are used by ETDE to classify records. Typically, these fall into four general types:

a) representing energy sources (e.g., coal, lignite, and peat, solar energy, wind energy);

b) representing energy production, utilization, and management, (e.g., fossil-fueled power plants nd energy conservation, consumption, and utilization);

c) representing energy conversion and storage (e.g., direct energy conversion and energy storage);
d) accommodating the basic information developed in support of energy production, conversion, and utilization, (e.g., chemistry and physics).

It is important to highlight that in the ETDEWEB 24 publications on Power Transmission and Distribution topics can be identified, but unfortunately they cannot be accessible by an Italian operator since Italy is no more an ETDE member from October 2004.

ETDE's Energy Database is available to anyone in an ETDE member country, and since 2004, to many developing countries. This benefit leads to invaluable opportunities for those in commercial and academic settings, as well as for those in government organizations. Any individual, organization, library, or institution in an ETDE member country or approved developing country is eligible to access ETDE's database. The exchange of full-text documents that are not easily available elsewhere is another important aspect of ETDE's information sharing. This non-conventional literature (also known as grey literature) includes documents such as government reports, technical papers, and some conference proceedings. If full text is available from the Operating Agent electronically, these links will be part of the database record in the various products.

ETDE's Energy Database is built through a myriad of collaborative efforts, many organizations are also involved. Member countries bear the primary responsibility for input to the database. Their efforts include expending resources to acquire/locate documents published within their borders that are within the subject scope of the database, translation (if necessary), cataloguing records bibliographically, providing abstracts and subject indexing, and ensuring an availability source, including the provision of electronic full text when possible. Each member may have a number of partnerships in place with other organizations/publishers within their country to facilitate this process.

Reference: https://www.etde.org/

4. BARRIERS ANALYSIS

This chapter analyses specific barriers to information sharing, dissemination and uptake of results in energy research by resorting to specific study cases. The overview carried out in chapter 3 shows that some countries (Sweden, United Kingdom, Norway, Germany, Italy) invest important public funding in energy research and deal with themes linked to the main subjects of GRID, i.e., power systems controls in the broader perspective of power systems security. Hence some relevant study cases have been identified in these countries:

- management of support programmes and research priorities by the *Julich Project Traeger*, on behalf of various federal entities in Germany, for example the Federal Ministry of Education and Research (BMBF), the Federal Ministry of Economics and Labour (BMWA), the Federal Ministry for the Environment (BMU) and federal state ministries. The case of a large public research body, the *Fraunhoefer,* is also considered as a specific instance;
- the Sweden's national energy research programme, managed by *STEM, the Swedish Energy Agency*
- Italy's fund for power system research *(Ricerca di Sistema);*
- British public research for the power sector carried out on behalf of the UK Energy Research Centre which undertakes research addressing whole-systems aspects of energy supply and use in the UK, and OFGEM, the regulator of the electricity and gas markets in Great Britain. OFGEM performed an analysis on barriers that hamper technology transfer. A significant case is reported, which was the subject of a UK parliamentary debate, concerning household utilisation of distributed generation, where current rules for grid insertion appear de-facto inadequate;
- Norway's BAS project, focusing on vulnerability of the national power system in the perspective of serious threats like intentional man-made attacks and natural disasters in a national security context.

Relevant contact points were identified to deepen the issue on the above case studies. Interviews were carried out based on a questionnaire (see Annex 1). The rest of the chapter provides a survey of four EU endeavours aimed at analysing and/or overcoming such barriers at the EU level:

- a comparative study funded by EC DG TREN to study mechanisms, results and good practices in terms of innovation and transfer of results of energy RTD in national and Community's programmes; the study provides among other an analysis of the so-called *interfacial* barriers to innovation.
- The *ERA-NET* scheme*:* a permanent Framework for Technology Co-operation established under the aegid of the International Energy Agency (IEA), whose objective is to step up cooperation and coordination of research activities carried out at national or regional level in the Member States and Associated States. More specifically, the tenets of ETDE, the Energy Technology Data Exchange are reviewed. It is a multilateral organization formed in 1987 to strengthen international information exchange within the IEA framework for technology cooperation;
- The *EU-DEEP* project, aimed at identifying promising business models to ease large scale penetration of Distributed Energy Resources in Europe;
- *RELIANCE,* a Coordination Action involving several European transmission system operators and utilities to optimise reliability of power supply by a systemic approach [14], which involves establishing a European Centre for Electrical Networks, aimed to design, select, fund and manage joint R&D and innovation projects dealing with electricity transmission.

The three latter actions provide three different models to establish R&D cooperation in the energy sector, hence three different ways to identify and overcome existing barriers to R&D results sharing.

RELIANCE and EU-DEEP also share with GRID a scenario where the EU transport system must comply with increased cross-border exchange and growing penetration of distributed energy sources.

4.2 The Fraunhofer Institute and the Juelich Research Centre, Germany

The Fraunhofer-Gesellschaft undertakes applied research of direct utility to private and public enterprise and of wide benefit to society. In Germany 56 Fraunhofer Institutes are present, with about 12 500 employees. The annual research total budget is about 1200 M€, roughly 2/3 of this sum is generated through contract research on behalf of industry and publicly funded research projects. The Fraunhofer-Gesellschaft is also active on an international level.

In particular, the Fraunhofer Institute for Secure Information Technology (SIT) develops innovations that protect information, devices, services and networks. The Institute's goal in all the activities is to design security concepts that are as user-friendly as possible by placing human beings in the focus. As a specialist in IT security, SIT covers a wide spectrum of relevant technologies and topics, regarding also GRID related subjects. The R&D Department Secure Processes and Infrastructures (SPI) are dedicated to the holistic view of the security of work processes, development processes and business processes. The results of these investigations are disseminated in training courses and open seminars as well as used in studies. Services can be offered in the form of consultation.

The Fraunhofer Institute actively participates in the EU research information exchange and is takes a favourable attitude towards research results sharing. Language barriers were not detected (about 80% of documentation is in English). Administrative barriers were not detected. The FhG-SIT does not make difference between international and national information sharing. Legal constraints exist only for very sensitive research areas, mainly military research.

There is no general procedure in the use of research results, the dissemination and the exploitation rights are always subject of the contract. All results are protected by copyright. Two main cases are underlined: licensed results or free availability. SIT's funds are provided for one third from public source, the remaining comes from third party funds. This partnership may explain the mixture of the modality of the results exploitation. In case of contract based research and development done for a third party, the handling of property rights and the exploitation strategies are specified in the contract. All arrangements are possible: the client may get the right to use and exploit results only itself, FhG-SIT may keep these rights or both partners will use the project outcomes. If the client obtains the exploitation rights it depends on its strategy under which conditions third parties can use the results. In these events, for a third part, it is necessary to pay a fee in order to obtain the documentation required and to have assistance by the organization for clarifications. On the other hand, some of FhG-SIT results (e.g. studies, software) are freely available also for, on the web site is presented a list of document that are reachable by download facilities. A list of research projects and topics is available in English, moreover a project manager is indicated for address further questions.

One can conclude that in the case of Fraunhofer, for most valuable results coming from private/public partnership the main barrier is the presence of fees for the acquisition of research results, and these mechanism could be found also in other case of research involving private companies.

A further case worth considering is the Juelich Research Centre (PTJ), since from the overview carried out in the previous section on Energy RTD public funding in energy research, the Juelich has a prominent executive role related to public domain programmes linked to Energy, as well as in many other domains (Biotech, materials, environment and sustainability, navigation and marine technology etc.). They are the executive agency (projekt traeger) which undertakes management of support programmes and research priorities for various contractors, for example the Federal Ministry of

Education and Research (BMBF), the Federal Ministry of Economics and Labour (BMWA), the Federal Ministry for the Environment (BMU) and numerous federal state ministries. PTJ is also the national contact point for certain EU-supported research and technology programmes and it coordinates activities for bilateral international cooperation and for the International Energy Agency.

The Technology Transfer Department is devoted to initiate contacts between scientific institutes and industrial companies who wish to cooperate with Research Centre Jülich. The web site of this institute quotes a 'cooperation' mechanism where interested parties enter in a joint project with the Juelich or become licensees for specific technologies. Within the organizational structure of the Research Centre, the staff members of the Technology Transfer Department work as versatile service providers and coordinators. In doing so, they fulfil a function which is becoming more and more important for the Research Centre as a whole: the acquisition of additional funds for research and development from industry and national and international support programmes.

The spectrum of opportunities given extends from scientific and technical services through contract research to R&D cooperation with shared efforts and strategic partnerships. The Technology Transfer Department is also the first contact point in coordinating nationally and internationally financed support projects. Collaboration schemes include:

- Licence services to industry and small and medium-sized business for the take up of, patented, development results of the Research Centre;
- Cooperation with partners for further development of R&D results and subsequent exploitation;
- Contract work and a wide range of research themes (e.g. linked to materials testing, semiconductor technology and chemicals analysis).

The range of offers to business enterprises is wide, although mainly addressed to issues concerning power generation and renewable, energy transportation and power system security are not a main focus.

4.3 STEM, Sweden

The Swedish Energy Agency is responsible for Sweden’s national energy research programme. Working closely with universities and business, it finances technical research and knowledge development. The results of this research are intended to support development of the country’s energy system, while also finding applications in commercial activities and supporting robust energy and climate policy decisions. The Agency works with six thematic areas: Energy system studies, the Building as an Energy System, the Transport sector, Energy-intensive Industry, Fuel-based Energy Systems and the Power System. STEM commits research to universities, research and technology institutes and to industrial research. Basic research and other energy research at universities and technology institutes are usually 100%-financed by state funding. However, the closer to market some technology, product or service becomes, the higher the proportion of the costs financed by industry. Applied research & development work, may receive only a maximum of 50% public funding by STEM, compliant to EU rules.

The STEM also funds competence centres, i.e. forums for research cooperation between universities, companies and the Swedish Energy Agency. Research is concentrated on companies’ long-term interests, and can often range over several disciplines. The intention is that universities become involved in meeting the research needs of industry, while at the same time delivering results of an assured high scientific quality.

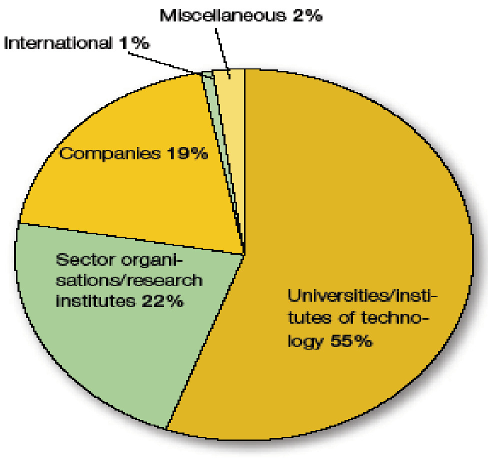

FIGURE 2: *Recipients of funding in 2006*

Fig 4.1 – Subdivision of STEM funding in 2006

The STEM objective is to spread and use research results, so in principle research results are available for free. Networks among Nordic countries, the EU and the International Energy Agency (IEA) are valued as important instruments to exchange and disseminate knowledge and skills. For instance, STEM is involved in the EU-DEEP project, described in section 4.9.

The spreading activity is part of STEM's mission, so there are no barriers to dissemination beyond national borders. The only possible limitations concern themes related to national security. In event of EU collaboration projects, a wide documentation is available in English, although most reports are available in Swedish only. In most cases the final report explains not only the results but also the methodology to achieve them. STEM believes that to check the methodology in other contexts may contribute to its development and may be instrumental to test the results achieved and to deepen the study carried on by comparing its outcomes in different situations.

No administrative barriers exist to result dissemination and exploitation. Research results are classified and a Publications Service is present on STEM web site. The detailed research reports are also available upon request within some working days. For each specific research subject, contact persons are made available. They provide for free consultation about the specific result they are responsible for. There are no fees to pay in order to exploit fully public research results.

In proportion to its GDP, Sweden invests more in research and development than does any other EU country [15]. For a small and R&D-orientated country such as Sweden, international cooperation and monitoring of the business climate is therefore a large and essential part both of energy research policy and of energy policy.

The Swedish Energy Agency participates in the work of the International Energy Agency (IEA). It is therefore important that Sweden's research environments are appealing for international investors. In some areas, it is more cost-effective to work with other countries, or to purchase the results from them, than to establish Sweden's own research. Another international area that may affect research is standardisation: although this is mainly of interest for industry, various elements of research may also be involved. STEM is involved in the objectives and selection of coming programmes, it is also partly financing most of the research projects that receive their basic financing from the Sixth Framework Programme. The Swedish Energy Agency is a member of four ERA-NETs (see section 3.5): bioenergy, hydrogen, solar cells and innovative energy research. The scope of these projects is to be able to work together more closely and coordinate research and development work that would otherwise be carried out at the national level.

Sweden's investment on energy R&D is only 0.8% of the world total, even if Sweden has a high GDP percentage devoted to R&D, their investment are carefully focused to improve the Swedish innovation system also paying attention to new technologies originating outside the country. A summary of a study underlining the problems in the Sweden R&D policies is here provided [16].

Persistent under-spends by STEM suggest that the present funding instruments are not adequately adapted to user needs, especially in demonstration projects. STEM has been able to increase the proportion of demonstration projects among its new project commitments across the period of the programme to date, but there is a need for much more radical change in the way the programme mission is conceptualised.

The programme is doing a good deal of useful work. However, research dominates the programme, probably to a greater extent than is intended. The programme portfolio is very wide. There are almost no areas of international significance where the programme does not have activities. Many projects are small, in part reflecting the heavy use of the Swedish university system, which undertakes almost half the projects in the programme.

The programme is playing an important role in creating individual networks within the research and industrial communities, but lacks an identity and a community of its own. The projects outputs were also felt to be not well transmitted among projects and to the outside world.

Management of the programme at the detailed level was generally competent, following good practices in the agencies' respective areas of specialisation. Within STEM, individual sub-programmes were well organised and steered. The high-level goals for the programme are too abstract to be useful, however, and the result is lack of concrete goals at the lower levels.

STEM's results reporting practice has become very impressive, but there did not appear to be a consistent way of linking low-level sub-programmes to the high-level goals for the overall programme . The STEM's intention to increase its use of analytical tools (such as foresight and road mapping) to supplement wide stakeholder consultation in developing future strategy is supported. But there needs to be a much more explicit strategy for linking detailed actions in a prioritised way to the overall policy and programme goals.

Systematic evaluation is a key tool in modern public administration, and the Swedish energy agencies have historically played a leading role in this area in Sweden. Many of the evaluations were sub-critical in size, and their quality was somewhat variable as result. Taken together, those involving foreign experts raised a number of important and recurring issues. These comments are very familiar from other evaluations of Swedish research and, to a large extent, correspond to known problems in the way research is organised and funded in Sweden.

It emerged the critique of the 'Swedish model' of focusing this kind of technological effort on the university sector. STEM rightly highlights this point in its year 2000 strategy for R, D&D. The system itself suffers from fragmentation and its strong focus on PhD education as the way to provide the foot soldiers for the research army, which further fragments the effort. STEM argues that the missing ingredient is an energy research institute, and there is some truth in this, but institutes are not the only mechanisms for creating the needed concentration of effort and end-user focus.

4.4 Italian System Research (RdS), Italy

In 2000, a fund for the electricity sector has been established, it comes from a levy on the costumer electricity fee, nowadays is about 0,03 €cent/kWh for a total budget of about 80 M€/year. It has been created to give fund to the Italian Research of System [17].

In the period 2000-2004, about 310 M€ were accumulated in the so-called “Cassa Conguaglio”. A scientific and technical committee - the CERSE, was established in 2002 to define a 3-years Plan (2002-2005) for the attribution of this Fund [18]. Four thematic areas were identified (System management, energy sources and production, energy transmission and distribution, end uses). Relevant research projects pertain to two categories:

- Type “A”: projects totally financed by the Fund, they concern basic research, results are entirely disseminated;
- Type “B”: projects partially financed by the Fund, following the EU rules, results are disseminated according to the participant agreement, but the general information related to the studies done is available.

According the 3-years Plan, some research projects can be directly financed by the Fund, but in 2006 EU Commission stated that this direct fund assignment to a private society was not conform to the rules. The Italian Electrotechnical Centre of Experiences Giacinto Motta (CESI) could not benefit of this Fund and for this reason a new non-profit society has been created, called CESI Ricerca S.p.A., of which 51% belongs to the Italian National Agency for New Technologies, Energy and the Environment (ENEA) and CESI S.p.A. holds the remaining 49%.

On 23/03/2006, this Plan has been approved by the National Government and the EU Commission recognised the correct research funding attribution [19]. Part of the fund collected into “Cassa Conguaglio” (for a total of 60 M€) was assigned to public institutions for specific “A” type projects: CESI Ricerca (35 M€/year), the National Research Centre (CNR, 5 M€/year) and ENEA (20 M€/year). The remaining fund is reserved to type “B” projects and will be assigned by call for tender. The main barrier identified in the Italian context is the complex set of rules in activating a research programme. To by pass this problem, the Italian Ministry of Product Activity is working towards an operative R&D funding system.

In the years 2003-2005 CESI performed the DISSEMINA project, it concerns the dissemination and the transfer of the results of the Italian System Research (RdS) to the technological community, the transmission system operator and the wide public. According to [20] the main expected results of DISSEMINA concern:

- start-up of results transfer to stakeholders, and subsequent experimentation, validation and re-engineering;
- establishment of a scientific and technical community concerning Italian System Research;
- dissemination of the broader impact results to a wide public.
-

In DISSEMINA, special attention was paid to legal and administrative barriers and to results transfer and a set of rules to codify an agreement has been proposed. Although documentation is publicly available, even if the study has been carried out in a national context, the Italian language used for the redaction of the relevant report is undoubtedly a barrier to research result sharing.

4.5 UKERK, OFGEM, United Kingdom

The UK Energy Research Centre (UKERK) is the UK's most important research centre, and source of authoritative information and leadership on sustainable energy systems. UKERK undertakes world-class research addressing whole-systems aspects of energy supply and use, while developing and maintaining the means to enable cohesive UK research in energy. UKERK coordinates the energy research in the university centres. No barriers due to language, bureaucracy or legal constraints exist. Research results are public, if third parties want to exploit them have to pay a fee, whose amount is variable and depends on the importance of the subject. However, some results uptake can be hampered by barriers related to regulatory matters, lack of information and lack of incentives in view of the cost. A significant case concerns household utilisation of distributed generation, where current rules for grid insertion, appear *de-facto* inadequate, as stated by the UK Parliament web site [21] and the UK 's gas and electricity regulator (OFGEM) one. A brief excerpt from both sites is provided in the next two subsections.

4.5.1 UK Government

The UK Parliament faced the theme of technical barriers of distributed energy production in a Committee on Trade and Industry publication dated 30 January 2007 [21]. In the text are discussed the barriers found for the use of this technology and the way for tackling them to household take-up.
Local energy technologies have been available to households for a number of years, yet to date, take-up in the sector has been very low. This is because individuals face a number of hurdles when it comes to the purchase, installation and operation of local energy systems. The various obstacles are well-documented. Last year's Energy Review report, *The Energy Challenge*, bracketed these into three categories: practical barriers, relating to issues such as planning and grid connection; information barriers; and cost constraints.

The Government welcomed the Committee's report and answered with a report dated 24 May 2007. The report explains the mechanisms to promote distributed energy in most of its forms. Possible incentives for renewable heat technologies are studied. As announced in the Energy Review report the Government is also undertaking (by means of OFGEM) a comprehensive review of the incentives and barriers that impact on distributed electricity generation (including Combined Heat & Power, CHP). Barriers to take-up are mainly of the following typologies:
a) Planning and Regulatory
b) Receiving full value for produced energy
c) Metering
d) Lack of incentives for commercial energy suppliers
e) Lack of information

4.5.2 OFGEM

OFGEM's role is to protect the interests of consumers by promoting competition where possible, and through regulation only where necessary. OFGEM operates under the direction and governance of the Gas and Electricity Markets Authority, which makes all major decisions and sets policy priorities for OFGEM. The report provided from an OFGEM office-worker focuses on the barriers that hamper ‘technology transfer’ from successful research to commercial deployment [22].

Privatisation of the UK power sector has brought new influences and opportunities, but also introduced a need of progress in engineering innovation to respond to UK Government renewable energy policies. Regulation created a competitive pressure through comparative benchmarking and financial incentives. The development of a new technology is not enough, indeed it must be associated to political, commercial and regulatory aspects. Cross sector working groups, involving stakeholders, government and regulators must be encouraged.

An organic process must be established for a successful technology transfer from Research and Development through to Demonstration and commercial Deployment (the so called RDD&D chain). Barriers to Technology Transfer are deeply-rooted, and they are compounded in the liberalised market. Public funded research has often provided only reports or laboratory demonstration as results, but no useful applications.

In the following, the possible causes for the barriers are listed [22].

1. *Low participation by privatised companies results in absence of technology PULL and also poor communication with those developing research ideas, i.e. weaker industrial PUSH*
2. *Incentives in universities recognise academic excellence, but are not balanced with drivers for demonstration and deployment*
3. *Regulatory frameworks have tended to encourage short term thinking (focussed on, for example, 5 year review periods) while innovation timescales are invariably longer*
4. *Innovative solutions will only be purchased by a company when they are proven, but this requires evidence of operation in a live power system environment; proving requires user participation and risk management; demonstrator projects get in the way of day job priorities for skills and system access*
5. *New technology may result in teething problems but regulatory frameworks may penalise any power interruptions that are caused.*
6. *Companies are unlikely to accept additional risk without commensurate reward, but regulatory frameworks may not have been designed with this in mind, resulting in unintended barriers*
7. *Innovation that addresses cross-boundary or whole-system issues is easily thwarted by lack of data as information is held by separate organisations and not to common formats.*
8. *Conventional procurement processes (e.g. competitive tenders) may be infeasible where innovation is concerned (typically a single provider).*

4.6 FFI, Norway

Norway is not an EU member, but it participates, albeit with no voting rights, in a number of EC Agencies and programmes, following the Agreement on the European Economic Area (EEA) since 01/01/1994 (see section 2). The Norwegian Defence Research Establishment (FFI) is the prime institution responsible for defence-related research in Norway. The Establishment is also the chief adviser on defence-related science and technology to the Ministry of Defence and the Norwegian Armed Forces' military organization.

FFI developed a research project, called BAS3, on a subject of direct relevance to GRID. BAS3 is focused on vulnerability of the national power system in the perspective of the more serious threats as intentional man-made attacks and natural disasters in a national security context. Based on results of the study, FFI recommended a minimum package of measures, emphasizing ICT security, increased ability to re-establish power supply after outages, robustness of important assets and nodes, emergency planning and training.

Unfortunately, most of BAS3 outcome is currently available in Norwegian only and this is a barrier noted, although summary and final reports in English exist[1] [23]. This text explains the project series "Beskyttelse av samfunnet" (BAS), roughly translated to "Protection of the Society", these projects have analysed the vulnerabilities of Norway's telecommunication services and electric power supply

[1] Also worth noting that circulation of those reports was kept quite limited to concerned parties.

sector, and have suggested measures to reduce them. One of the main topics of the BAS projects is the impact of deregulation of former state-owned infrastructure of Norway's electric power sector in 1991.

A trend toward increased vulnerability can be observed following the aforementioned deregulation. In the document is underlined the shift in the perception of the electric power supply's status in the society. Previously, electricity was widely regarded as one of the critical, basic functions of our society. However, the deregulation has promoted an attitude towards regarding electricity as a normal commercial commodity, whose main purpose is to create revenues in a competitive market. Risk acceptance levels in the sector have changed because of this. While protection against extreme challenges previously was a major part of the development of the sector, the focus is now firmly set on everyday challenges.

The effects of the deregulation are presented, that means a centralising of businesses, reductions of staff, increased dependence on well-functioning information systems and less frequent maintenance of the infrastructure. In addition, a continuous increase in domestic consumption of electricity is no longer met by a corresponding increase in generation and transmission capacities, due to environmental and economic constraints. The system experiences heavily reduced margins, and it grows increasingly complex. Because of this, even minor challenges to the system may lead to widespread blackouts.

The main steps of the vulnerability power transmission system analysis process in the BAS projects are presented in FFI document [24]. The methodology is clearly inspired by traditional risk analysis, where risk is defined as the product of the probability of an event and its consequences. Similarly, the BAS projects focuses on the vulnerability of infrastructure services ("probability"), and impacts due to service disruption ("consequences"). Vulnerability analysis seeks to identify "problem areas" within the infrastructure and the services provided by it.

Impact analysis aims to map the consequences of severe service disruption, both in everyday situations and in situations of crisis or war. Based on the vulnerability analysis, effective measures to reduce the vulnerabilities are identified. The final step of the process is to perform a cost-effectiveness analysis of different measures, in order to establish an ideal combination of measures that may serve as the project's recommendation.

The complex issues that the BAS projects analyse demand use of several tools and methods, both qualitative and quantitative. No single method is able to handle all the problems that the BAS projects analyse. The following tools and methods have been used during the BAS projects: seminar games, use of scenarios, causal mapping, multi criteria analysis (MCA), fault tree analysis and probabilistic cost estimation. The methodology proposed seems to be quite generic, and relatively straight forward to apply in a different context.

4.7 The EC Commission study about R&D results transfer

The EC Commission has recently developed a study on the mechanism of results transfer in national and Community's programmes, in matter of energy R&D [14]. The study ended in 2005, hence all its results are now available [25]. A desk analysis on a set of EU countries has been conducted. What follows provides a summary of the study context. An extract of the study purpose and conclusions about the so-called *interfacial barriers* to innovation processes is presented in Annex 1.

In the actual context, the liberalisation of energy markets, the response to the EU Directives and to the Kyoto protocol, and also tensions in the fossil fuel markets simultaneously require the development and validation of robust business models. Here, a business model is a validated technology exploitation plan at manufacturer or energy company level, that enables the most successful technologies to add commercial value to existing businesses. New business models must therefore address the removal of critical interfacial barriers, in order to guarantee effective sales of the new knowledge. Because of the future uncertainty of energy markets worldwide, manufacturers and energy companies combine their portfolios of technologies and business models to augment the number of value options they can sell to their clients.

Future business models will inevitably involve new sets of energy players, resulting from the policy goals of market liberalisation, unbundling of energy companies and the full application of the 1996 IEM (Integrated Energy Market) Directive by Member States. The advent of new players will most probably mean new interfacial barriers.

With the term "interfacial barriers" it means these barriers that naturally exist, such as people's resistance to change, or are artificially created, such as the national technological standards inherited from a century of industrial growth in the European energy sector. Interfacial barriers are a part of the so-called micro barriers to the diffusion of new energy technologies and may arise from behavioural, cultural, environmental, financial, human capacity, legal, political, institutional, and technological factors. These micro barriers can be identified and addressed directly through focused, committed actions from individual stakeholders.

During the FP6 integrated RTD projects are promoted, the goal is to try to reduce some interfacial barriers, implementing collaborative projects with IPR rules and responsibilities that are real incentives to transfer knowledge and technology. This pillar addresses the design of public support measures which will demonstrably help reduce or remove the interfacial barriers that prevent knowledge gained using public funds from reaching market application. Indeed, reducing the number of interfaces, will nevertheless run counter to the general trends of liberalisation and unbundling that are being introduced for wider reasons across the energy sector.

Many companies, universities, and governmental organizations now have an "Office of Technology Transfer" dedicated to identifying research results of potential commercial interest, and to developing strategies for how to exploit them. They then address interfacial barriers in order to make the process work better. For instance, on a given research result that may be of interest; since patents are normally only issued for practical processes, applying for a patent will require someone (not necessarily the researcher) to come up with a specific practical process that depends on the result. Another consideration is commercial value: there are, for instance, many ways to accomplish nuclear fusion in a laboratory. But, in practice, the ones of commercial interest are those that put out more energy than they take in, such as the most promising one validated within the ITER programme. As a result, technology transfer processes are very often involving multidisciplinary teams, including scientists, engineers, economists and marketers. Increasingly in today's liberalised market, there also needs to be the engagement of regulatory authorities who determine the nature of the 'playing field' and have the authority to address the barriers that may arise in new situations.

4.8 The RELIANCE Project

The Coordination Action entitled “CooRdination perspectives of the European transmission network research activities to optimise the reLIAbility of power supply, usiNg a systemiC approach, involving growing distributed generation and renewable energy markEts”, in short RELIANCE, is funded by the European Commission Sixth Research and Technological Development Framework Programme. It started in October 2005 and is planned for 2 years. RELIANCE’s team is multidisciplinary and is composed by a group of eight Transmission System Operators (TSO), one Power Producer, one Distribution System Operator (DSO) and several Research Centres at the initiative of Tractebel Engeneering .

During the GRID workshop of the past 20 June 2007, the project speaker summarized their activities [26]. He underlined the complementarities of the RELIANCE and GRID projects. RELIANCE main directions are:

- To maintain the reliability of the system;
- To facilitate the massing penetration of renewable;
- To improve robustness;
- To increase the sustainability dimension of the grid.

RELIANCE shares its main motivation with GRID: the existing interconnections between national transmission systems were not designed to handle intensive cross-border transactions, nor massive penetration of wind generation and other dispersed energy sources. All theses changes increase operational problems. Network failures have become more common since the mid 90’s in Europe. New cost effective solutions are therefore needed to avoid major power disruptions while supporting the integration of the electricity markets and the integration of renewable energy sources.

Although the optimization of the European system in terms of security, robustness and cost efficiency is in the interest of the European citizens and industry, no body is responsible to deliver this common good. Furthermore, there is currently no adequate mechanism to identify, prioritize, set up, fund and manage R&D projects on European-wide transmission system issues. The above mentioned problems and challenges are shared and cannot be solved separately in each country. For example, it is necessary to develop a common approach to pan-European observability and controllability of the transmission system that is challenged by the intermittency of wind generation. Similarly, the implementation of innovative algorithms, methods and related exchanged information tools need to be updated to cope with very large size problems. A joint effort increases the chance of success while reducing the risk and the cost of this R&D effort [27].

The solution to some local problems could be developed on a common basis, with the collaboration of those region that suffers similarly, with an economy of scale as main benefit, as a result of a European common effort.

RELIANCE proposes to establish a European Centre for Electrical Networks, aimed to design, select, fund and manage joint R&D and innovation projects dealing with electricity transmission activities that have an European dimension (hereinafter: the Organisation). All European electricity consumers will benefit from the R&D results supplied by this future Organisation, so they should all contribute to its R&D costs through a transmission tariff pass-through mechanism approved by the national regulatory authorities. There are two types of R&D projects, classified according to their funding mechanism: Pan European and External projects.

“Pan European Projects” are those which must be performed in a framework of full cooperation between TSO’s, in order to obtain reliable and useful knowledge. These projects are funded by the electricity consumers of the participating TSO countries. The Organisation implements an Open Access policy for the Pan European Project outputs. Results are generally published and the Intellectual Property belongs to the R&D Organisation. This allows the R&D Organisation to patent some solutions and control the access to the results by giving a competitive advantage to the European stakeholders requesting exploitation rights. The participating TSO members are granted an irrevocable non-exclusive license at no cost. Access rules for the exploitation of the patented knowledge by any other player are set by the Executive Board. This approach favours the fastest implementation of innovative ideas by the market players.

The following general features can be identified:
- They have to be considered of the highest strategic priority for the Organization;
- They require an in-depth knowledge of the network operations at European level;
- They deal with issues, which are so far not fully addressed, due to the lack of a common Institutional framework.

Pan-European projects are basically subdivided into three categories:
- Integration projects directly addressing topics with cross-border impact and TSO integration in terms of the technical and economic functioning of the transmission system (as observability of the pan-European system and related cross-border information exchange, cross-border investments, new methods for congestion management, etc.);
- Fundamental research projects that have an impact at a European power system-wide level with long term vision;
- Generic system projects addressing common critical transmission system issues in operations, technology and management with national impact.

These projects if addressed jointly would greatly reduce costs and improve the quality of results through the use of multi country data sets. Pan European projects are first ranked by the Stakeholders and Scientific Advisory Boards of the Organisation; then the Management Board, using the results of the ranking, proposes to the Executive Board for approval the so called "*Activity Plan*". This is a well balanced portfolio of projects over a 5 years time span (with possible yearly revision). In terms of funding the projects are financed with a membership fee paid directly by the TSOs.

<u>External Projects</u> are projects funded through additional financial resources provided on a project by project basis by any stakeholder (TSO, Generator, Regulator, Trader, Supplier, Manufacturer, etc.) or group of stakeholders interacting with the Transmission System, the intellectual property belongs to the entities that have funded the R&D tasks. Exploitation rights are negotiated on a case by case basis between the Organisation and the entities funding the external projects, before the R&D tasks are launched. This rule is not binding. Still, results obtained with reasonable alternative methods would not be radically different, given the sums involved.
They must satisfy two main requirements:
- To be compatible with the mission statement of the Organization;
- To be compatible with the realization of the five year Activity Plan, as this has to be the main focus of the Organisation.

The aim is to offer a flexible scheme, which would allow direct interaction with stakeholders facilitating the access to the information and the knowledge on the Transmission System. The Organization could also provide a reliable and transparent framework for stakeholders willing to develop joint research initiatives on the power transmission network in Europe. The selection of topics is left to the financing parties, knowing that all the relevant stakeholders can directly propose initiatives, within dedicated confidentiality agreement set forth by the financing bodies. R&D projects ("Pan European" and "External") are proposed by the Management Board and approved by the

Executive Board. Except for those that are carried out internally, projects are awarded to public or private R&D providers through a tendering process.

4.9 EU-DEEP

In 2004 a group of eight European energy utilities proposed an Integrated Project, called EU-DEEP, to remove, in five years and a half, most of the technical and non-technical barriers which prevent a massive deployment of Distributed Energy Resources (DER) in Europe [28]. An energy resource is known as "distributed" when it provides energy close to the point of consumption [29]. For example a combined heat and power unit for a hospital, or a wind mill for a factory. DER systems can provide electric and/or thermal power. In any one of these cases, the electrical power of the generator is generally lower than 10 MW, in most cases the generator is connected to the electrical grid. Several generators can also be inter-connected through interactive and sophisticated grids, and can in this case form a "virtual power plant".

This approach is basically different from the traditional model of centralized production of electricity by large power plants (thermal or nuclear). The European Commission has therefore identified the large scale penetration of decentralised energy as one of the priorities of its 6th Framework Programme for Research and Development (FP6). It aims to double by 2010 the share of renewable energies sources from 12% to 24% of the European electrical production. It included the "energy vector - electricity" in the work programme of its last call for proposals for R&D project, with an associated budget of several tens of million euros. It has been running since the 1st of January 2004 up to 30th June 2009 (66 months duration).

The EU-DEEP Consortium is composed of 39 partners from 9 countries of the EU, 5 accessing states and Turkey. The partners are of various types (energy operators, industrial manufacturers, research centres, academics, professionals and national agencies), and gather various competences (from the development of electric equipments to the analysis of the energy markets mechanisms).

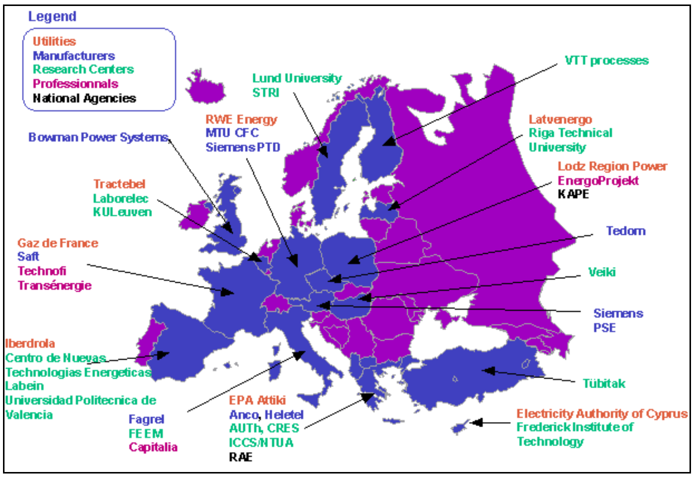

Fig. 4.1 – EU-DEEP partners.

EU-DEEP Project aims to implement a demand-pull rather than technology-push approach. This new approach will provide five "fast-tracks options" to speed up the large-scale implementation of DER in Europe, by defining five market segments which will benefit from DER solutions, and fostering the R&D required to adapt DER technologies to the demands of these segments. A European Competence Group will be created to exploit commercially, beyond the end of the project, the development of the methodology to create the fast-track options.

This development requires a set of iterative R&D tasks by utilities, research laboratories, manufacturers of generator sets, storage and grid connection equipment, and investment bodies to qualify the prospects of the newly defined market segments. This work will be completed by one-year experimental measurements campaigns to gather realistic data on the life cycle costs of the candidate technologies. In order to validate the new demand-pull approach, a minimum of five market segments must be studied in the three market sectors (industrial, commercial and residential) for one or two types of DER demands ("incremental-DER" from existing DER applications, and/or "DER-breakthrough" from the study of disruptive behaviours introduced by new trading mechanisms). Manufacturers should then be in a position to launch industrialisation tasks of the most promising DER solutions. In addition, regulatory bodies will be able to release some of the barriers which still prevent more DER solutions from reaching market applications.

During the development of the EU-DEEP work programme, it has been noticed that the barriers to DER implementation can be grouped in the following five types:

a) Market integration: what are the most robust DER business models on expanding or new markets which will benefit both to end-users and utilities.

b) Regulation adaptation: how can regulatory bodies design market rules (through incentives, tariffs and directives) that will increase the benefits promised by DER.

c) Connection technologies to the grid: what are the innovative solutions which will connect DER generator sets to existing grids, so that utilities can offer new services to end-users, while providing the appropriate power quality and security.

d) Grid impact: how to improve on existing grid management strategies to increase the amount of connected DER while creating overall positive impacts at the transmission / distribution levels.

e) DER systems: how to finalise the development of prototype DER systems (generator, storage, grid connection and communication) in order to fit best the requirements of energy markets.

5. CONCLUSIONS

This report was aimed at investigating the barriers to innovation in the energy sector in the European context. Specific focus was given to issues concerning the security of the power system by investigating relevant case studies.
Innovation processes are indeed very often inhibited by interfacial barriers that impede new knowledge gained in RTD projects from reaching market applications: these barriers either naturally exist, such as people's resistance to change, or are artificially created, such as the national technological standards inherited from a century of industrial growth in the European energy sector. Interfacial barriers may arise from *behavioural, cultural, environmental, financial, human capacity, legal, political, institutional,* and *technological* factors. The case studies investigated highlight most of these factors:

- The Italian case may only partly be explained by the relative immaturity of the Italian research fund 'Ricerca di Sistema'. This was established in 2000, but it is still to be really opened to active participation of many subjects EU-wide: until now all funding was allocated to an incumbent institution, CESI, participated by Italian stakeholders, and to its successor CESIRicerca. In that case the main barrier identified is of an *institutional* nature, concerns the complex set of rules for fund assignment – which may reflect a national *policy* in favour of the incumbent. This may represent a barrier not only for the Italian national research system but also to information sharing in a European context.

- The Norvegian case study concerns a methodology that seems to be helpful for the power transmission system security. It seems not to have a complex actuation and it may be possible to propose it to other European countries as a cross border methodology. In that case barriers appear to be related to the *institutional* and *cultural* framework where the project was developed, i.e. civil defense. The project was developed by a defense institute: its outcomes were widely disseminated in Northern countries, but there was no push to disseminate widely in Europe, to the point that project reports are not available in English.

- Although the Swedish case did not highlight substantial interfacial barriers, STEM argues that *environmental* and *human capacity* issues exist. The 'Swedish model' focuses technological effort on the university sector, and this makes difficult to link low-level sub-programmes to the high-level goals for the overall programme. Persistent under-spends by STEM suggest that the present funding instruments are not adequately adapted to user needs, especially in demonstration projects.

- Barriers of a *financial* nature, e.g. the presence of significant fees for the acquisition of research results, which were noted concerning the Fraunhofer case, may be of course predicated of any research result due to significant private investment.

- The main barrier found in United Kingdom case study is related to *technical* issues not properly addressed by the *regulatory* framework, and applies to most European countries: the absence of key European technical standards concerning grid connection of distributed generators like renewable electricity, slows down industrialisation and commercialisation of products and services in that area across Europe. Companies are unlikely to accept additional risk without commensurate reward, but regulatory frameworks have not been designed with this in mind, resulting in unintended barriers.

The above confirms the findings of the EU Commission study about R&D result transfer, which focused on the mechanism of information transfer in general terms, and individuated such *interfacial* *barriers* as the main obstacle to the diffusion of new energy technologies. These barriers can be identified and addressed directly through focused, committed actions from individual stakeholders. Consortium Agreements, i.e. the mechanisms for research results sharing within collaborative R&D projects funded by the EC are to some extent paradigmatic, because they establish a set of general rules for sharing and disseminating their foreground knowledge and results. Such mechanisms are not often in place in nationally funded research, because most of it does not usually involve the concerned stakeholders' categories.

One of the main motivations for introducing a European Research Area was to help overcoming these barriers, by creating a free movement of knowledge, researchers and technology. ERA underlines the importance of coordination of national research activities and policies, towards the full deployment of a European research policy, where information sharing is a pillar. The ERA-NET scheme is to step up the network of research activities and the mutual opening of national and regional research programmes. One example of this approach is the RELIANCE project. It considers that a number of problems are local, but solutions could be developed on a common basis with a common European effort, reaching an economy of scale as the main benefit. RELIANCE prospects the creation of an Organisation that supervises on the whole European transmission power system. Another collaboration has been established between eight European energy utilities, with the EU-DEEP project. Its objective is to face the specific barriers which prevent a massive deployment of Distributed Energy Resources in Europe. The solution is approached with a co-operation work, typical of these kinds of projects.

Annex 1. Questionnaire form for “Analysis of the barriers”

1) Your coordinates

1.1 Name & Surname

……………………………………………………………………………………….

1.2 Name of the organization (university/company/institution/research centre)

……………………………………………………………………………………….

1.3 Country

……………………………………………………………………………………….

1.4 Contact mail address

……………………………………………………………………………………….

2) Degree of involvement in “**ICT vulnerabilities of power systems and the relevant defence methodologies**”?

High ☐ Medium ☐ Low ☐

2.1 Are you engaged in projects still in progress?

Yes ☐ No ☐

2.2 If no, when the study is ended?

……………………………………………………………………………………….

3) Are you favourable in principle to share your research results?

Yes ☐ No ☐

3.1 What level of sharing you would agree?

Partial ☐ Total ☐

3.2 With which kind of organisation you would prefer to share information with?

University ☐ Research institute ☐ TSOs ☐ Company ☐ Other ☐

4) Have you ever asked information to foreign research institutes?

Yes ☐ No ☐

4.1 If yes, to which country?

………………………………………..……………………………………….

4.2 To which kind of organisation?

.……………………………………………………………………………….

4.3 Did you obtain the information you required?

Yes ☐ No ☐

4.4 Did you find any difficulties?

Yes ☐ No ☐

4.5 If yes, which kind of difficulties?

Bureaucracy ☐ Confidentiality ☐ Fees to be paid ☐ Other ☐

4.6 Once you obtained the requested information, to which extent did you succeed in using it?

High ☐ Medium ☐ Low ☐

To help the activation of a coordination action for “results sharing” on the GRID’s research topics, in the vision of a wide and fruitful European collaboration, please indicate your background about the barriers identified by the following items (subdivided respectively in 4 categories):

I) National law restriction and constraints

a. Is there any national law that restricts or forbids the circulation of information out of the country context?
   Yes ☐ No ☐
b. Have any rules been defined to share research results with foreign countries?
   Yes ☐ No ☐
c. If yes, are they clear?
   Yes ☐ No ☐
d. Do research subjects exist that are considered "confidential", so there is not circulation of information about them?
   Yes ☐ No ☐
e. Is there a "supervisor" that decides the openness/confidentiality of results from research?
   Yes ☐ No ☐

II) Unavailability or scarcity of information

e. Are project results reported in English language?
   Yes ☐ No ☐
f. If yes in what percentage?
   Around 20% ☐ Around 50% ☐ Around 80% ☐
g. Are results clearly explained in the above reports?
   Yes ☐ No ☐
h. Do reports explain project methodologies?
   Yes ☐ No ☐
i. If yes, are you available to learn alternative methodologies and/or different approaches for solving similar problems?
   Yes ☐ No ☐
j. Do you think it is important to reproduce the study in another context?
   Yes ☐ No ☐
k. If someone was demanding you for any documentation, how much time is approximately necessary to obtain it?
   Some working days ☐ Some working weeks ☐ More ☐

III) Absence of legal, administrative or technical supports to applicants

l. Does the organization provide a reference person to contact for information on a specific research theme?
   Yes ☐ No ☐
m. Normally this person is aware of the content of the developed research?
   Yes ☐ No ☐
n. What is the level of bureaucracy complexity to obtain your results?
   Low ☐ Medium ☐ High ☐

IV) **Costs associated to the research result transfer**

o. Is the access to research results completely free?
Yes ☐ No ☐

p. If no, could you give more details about the fee agreements?
Susbscription☐ Fee per document ☐ Pay to download a document☐ Other☐

q. Are consultancy fees required to achieve further explanations and details on research results?
Yes ☐ No☐

r. How do you judge the technology transfer process?
Easy☐ Challenging ☐ Difficult☐

s. Transfer duration time
Some weeks ☐ Some months ☐ About a year☐ More ☐

t. Average transfer costs
Low☐ Medium☐ High☐

u. Main reason (e.g. asset investments, organisational or structural change required, staff training/adaptation costs, lack of suitable norms/regulations…)?
……………………………………………………………………………………..

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European Commission

EUR 23267 EN – Joint Research Centre – Institute for the Protection and Security of the Citizen
Title: Analysis of the barriers to the uptake of R&D results in the power sectorCurrent efforts concerning ICT security of the power grid
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Luxembourg: Office for Official Publications of the European Communities
2008 – 66 pp. – 21 x 29.7 cm
EUR – Scientific and Technical Research series – ISSN 1018-5593

Abstract
Power grid vulnerabilities are European wide problems, they cannot be solved individually but require a coordinated European effort. GRID aims at establishing a roadmap for collaborative R&D on power grid security, also based on exchange of information about national, regional and European research projects. Collaborative research programmes might benefit from a mutual exchange of approaches, experiences, and results. However, cross fertilisation may be hampered by existing barriers of an institutional, socio-economic and technical nature. This report investigates barriers to exploitation of national research results in a European context.