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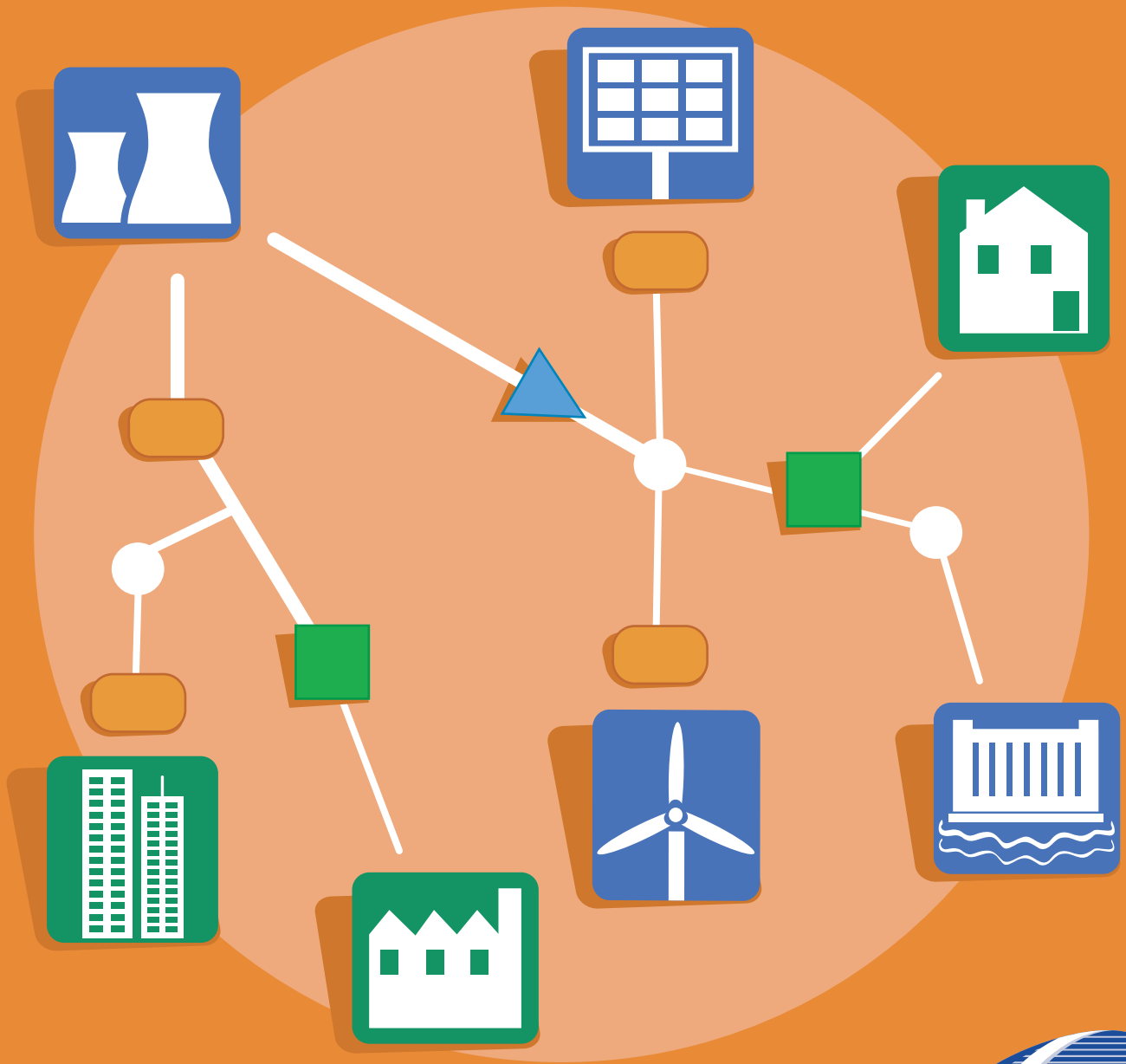

PROJECT SYNOPSES

EUR 21239

SIXTH FRAMEWORK PROGRAMME

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European **distributed energy resources** projects

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Contents

Research objectives

Europe's energy supply is characterised today by structural weaknesses and geopolitical, social and environmental shortcomings, particularly as regards security of supply and climate change. Energy is a major determinant of economic growth and these deficiencies can have a direct impact on EU growth, stability and the well-being of Europe's citizens. Therefore, energy supply security, mitigating climate change and economic competitiveness are the main drivers for energy research, within the context of sustainable development, a high-level EU objective.

By 2050, the World Energy Council envisages the global energy mix will be made up of at least eight energy sources (coal, oil, gas, nuclear, hydro, biomass, wind and solar) with none expected to have more than a 30% share of the market. Electricity can make this diverse supply portfolio possible whilst simultaneously meeting global energy and environmental demands. According to the International Energy Agency, in the coming decades electricity's share of the total energy market in OECD countries is expected to grow from 24% in 1970 to 40% in 2020, as more efficient and intelligent processes are introduced into industry, business, homes and transportation. Electricity is the most critical strategic infrastructure in our society today and its importance will increase in the future. Its direct importance in reliably delivering energy to point of use enables every other major technological infrastructure in our society.

Today, a complex reorganisation of the electricity power industry has started in Europe, encouraging competition in both the wholesale and retail sectors of the market. To facilitate the creation of an open single market in electricity, further effective interconnection of Member State national grids is needed. In the near future, power utilities may still operate regulated distribution systems, but in the longer term the production, brokerage and sale of electricity and new power services will be a competitive function of the unified electricity market. This will require the transformation of conventional electricity transmission and distribution grid into an interactive and unified power supply network. Major technological and regulatory changes will be the basis of this new electricity service paradigm, which is itself a prime driver for the

The Framework Programmes for Research

The main EU funding mechanism for research, technological development and demonstration is the Framework Programme (FP), which is mainly implemented through calls for proposals.

Projects from the previous FP5 (1998-2002) are well advanced, with many entering the critical phase of exploiting and disseminating their results. The total expenditure on European RTD projects for the large-scale integration of distributed energy resources and key enabling technologies within FP5 is of the order of €130 million, with an EC contribution of about €67 million.

The main objective of FP6, which runs from 2002 to 2006, is to contribute to the creation of a true European Research Area (ERA). ERA is a vision for the future of research in Europe, an internal market for science and technology. It fosters scientific excellence, competitiveness and innovation through the promotion of better co-operation and coordination between relevant actors at all levels.

FP6 is structured into 'Thematic Priorities'. RTD, including large-scale integration of distributed energy resources and key enabling technologies, is being implemented within Thematic Priority 6.1. 'Sustainable energy systems' which has a total budget of around €890 million. Currently, about €39 million of EU funding, matched by public and private investments, has been awarded to RTD projects for the large-scale integration of distributed energy resources and key enabling technologies in FP6. This will be reinforced via further calls (see Chapter 'Remaining calls for proposals in FP6').

More information on the FPs can be found on: www.cordis.lu

substantial European research effort in this area. Removing the geographical constraints on the delivery of power supplies will lead to increased competition and enhanced quality, reliability, security and safety.

Distributed generation (DG) will play a key role in this novel concept. This covers a broad range of technologies, including many renewable technologies that provide small-scale power at sites close to users. The greatest potential market for DG is displacing power supplied through the grid. On-site production minimises the transmission and distribution losses as well as the transmission and distribution costs, a significant part (above 30%) of the total electricity cost. As the demand for more and better quality electric power increases, DG can provide alternatives for reliable, cost-effective, premium power for homes and business. It can also offer customers continuity and reliability of supply, when a power outage occurs at home or in the neighbourhood, by restoring power in a short time.

Building upon the experience of the Fifth Framework Programme (1998-2002)

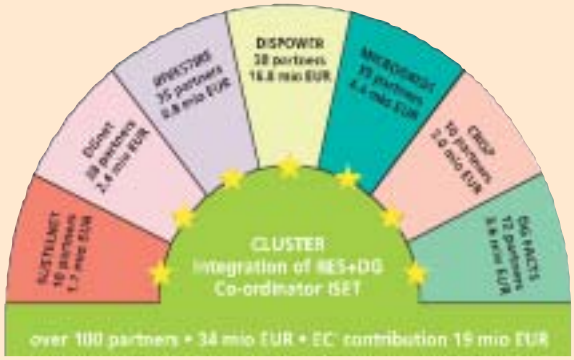
The Fifth Framework Programme was conceived to help solve problems and to respond to the major socio-economic challenges facing Europe. To maximise its impact, it focused on a limited number of research areas combining technological, industrial, economic, social and cultural aspects. A major innovation of the Fifth Framework Programme was the concept of 'Key actions' which mobilised a wide range of scientific and technological disciplines – both fundamental and applied – required to address a specific problem.

Research into the large-scale integration of distributed energy resources and key enabling technologies was carried out by the Non-Nuclear Energy Programme in the areas of integration of renewables, electricity transmission and distribution, and energy storage. The current portfolio of FP5-funded research projects in the field of large-scale integration of distributed energy resources and key enabling technologies is summarised in the table below.

The current portfolio of FP5-funded research projects in large-scale integration of distributed energy resources and key enabling technologies

Research area	Number of projects	Total cost (€ million)	EC funding (€ million)
DISTRIBUTED GENERATION	8	34,29	18,99
ELECTRICITY TRANSMISSION	4	9,74	5,72
STORAGE	15	45,31	20,73
HIGH TEMPERATURE SUPERCONDUCTORS	6	11,27	6,16
'Other' INTEGRATION PROJECTS	17	29,12	15,21
Total	**50**	**129,73**	**66,81**

The EU is thus contributing some €67 million to support 50 projects worth nearly €130 million of the total investment. Although most of these projects are still running, the main results within the research areas addressed can be summarised as follow:



The cluster of projects for integration of renewable energy sources and distributed generation: CLUSTER RES+DG (http://www.clusterintegration.org/)

Distributed Generation – A large cluster of projects for distributed energy resources is being established dealing with the effective integration of RES and DG. More than 100 partner organisations from industry, utilities and research organisations aim to coordinate knowledge amongst seven strategic projects funded under FP5, national programmes in this area, and by exchanging knowledge and experiences with project partners in the US, Japan and other OECD countries.

Electricity Transmission – Among others, the funded projects cover research activities such as open methodologies for assessing dynamic network security in real time, software and hardware tools to assess the benefits and impacts of embedding high-voltage direct current (HVDC) links in the largely HVAC European networks, and a harmonised pan-European specification for a new medium-voltage cable design providing reduced lifetime costs.

Storage – Energy storage has a pivotal role to play in the effort to combine a sustainable energy supply with the standard of technical services and products. For both stationary and transport applications, energy storage is of growing importance as it enables the smoothing of transient and/or intermittent loads, and downsizing of base-load capacity with substantial potential for energy and cost savings.

High-temperature Superconductors – The funded projects cover, material developments, conductor design and production techniques of HTS cable and transformers, as well as different aspects of Superconducting Magnetic Energy Storage systems in electricity networks.

'Other' Integration Projects – Among others, the project REMAC 2000 produced a roadmap highlighting the actions needed by public bodies to accelerate the RES market in the European Union and abroad.

Selected results for highlighting recently **achieved outcomes** of the RTD projects are presented in the **Examples of recently delivered FP5 project highlights**.

Background information and particular hyperlinks can be found in the brochure **"New ERA for Electricity in Europe"** (http://europa.eu.int/comm/research/energy/pdf/electricity_en.pdf).

Projects funded under the Sixth Framework Programme (2002-2006)

Electricity is one of the most important energy carriers in a future sustainable energy economy. It can provide a route towards gradually becoming progressively less dependent on fossil fuels, reducing greenhouse gas and pollutant emissions, and increasing the contribution of renewable energy sources. The transition towards future sustainable energy networks based on a large share of renewable and distributed generation requires the preparation of the European energy system for the large-scale integration of Distributed Energy Resources (DER). This concept will play a key role in transforming the conventional electricity transmission and distribution grid into a unified and interactive energy service network using common

European planning and operation methods and systems. The strategically important areas in which research is concentrated are: i) A new approach for large-scale implementation of Distributed Energy Resources (DER) in Europe, ii) Energy storage technologies and systems for grid-connected applications, and iii) the development of key enabling technologies. Following the first FP6 call for proposals in March 2003, four projects were selected for EC funding in this area, with a total EC contribution of about €23.4 million. The emphasis on the new instruments in FP6 – Integrated Projects and Networks of Excellence – highlights the scale of the effort required and the need for critical mass in order to achieve significant progress. The projects selected are shown in the table below. Summary of the projects is presented in the Annex – FP6 Project descriptions.

Project acronym	Type of action	Title	EU indicative funding (€ million)	Coordinator	Contact details
EU-DEEP	**IP**	The birth of a EUropean Distributed EnErgy Partnership that will help the large-scale implementation of distributed energy resources in Europe	15	Gaz de France	Etienne Gehain etienne.gehain@gazdefrance.com Tel. +33 1 4922 5965
ALISTORE	**NoE**	Advanced lithium energy storage systems based on the use of nano-powders and nano-composite electrodes/electrolytes	5	LRCS/CNRS	Anne Charbonnier anne.charbonnier@sc.u-picardie.fr Tel. +33 3 2282 7810
SUPER3C	**STREP**	Super Coated Conductor Cable	2.7	Nexans France S.A.	Jean-Maxime Saugrain jean_maxime.saugrain@nexans.com Tel. +33 1 5562 7318
IRED	**CA**	Integration of Renewable Energy Sources and Distributed Generation into the European Electricity Grid	0.7	ISET	Jürgen Schmid IRED@iset.uni-kassel.de Tel. +49 561 7294 345

Current and future research priorities

1. Remaining calls for proposals in FP6

The final major FP6 call for proposals for research projects in the area of electricity is planned to close in December 2004. A further limited call for Co-ordination and Specific Support Actions may take place in Autumn 2005, if considered necessary.

The call text and Work Programme provide full details of the research areas open in the call and the conditions of participation. These and other useful documents are available on the dedicated call page on the CORDIS website, accessible from: http://www.cordis.lu/sustdev/energy/

The strategically important areas in which research should be concentrated are: A new approach for large-scale implementation of Distributed Energy Resources (DER) in Europe and the development of key enabling technologies. The particular research topics open in these fields are:

- **Advanced grid architectures for the integration of DER within local distribution networks, including micro-grids (STREP)**
- **Operation concepts and tools for maximising the value of DG/RES in electrical power systems (IP)**
- **European network of excellence of DER laboratories for Pre-standardisation (NoE)**
- **Advanced power electronic converters for the future European Electricity Network (STREP)**
- **HTS Devices for Electricity Networks (STREP)**
- **Preparing the Future European Electricity Transmission Networks (CA)**
- **Co-ordination Action for European DER (CA)**

2. Looking towards the Seventh Framework Programme

At the beginning of 2005, the European Commission will present its proposal for the Union's Seventh Research Framework Programme (2006-2010). Along with specific information about the financial support schemes and implementation instruments, it will include the Commission's proposals for thematic research priorities.

The Commission has made strengthening European research a major objective in its Communication on the future financial framework of the Union[1], proposing to increase the European Union's research budget significantly. At the Barcelona European Council in March 2002, the EU set itself the objective of increasing the European research effort to 3% of the EU's GDP by 2010, two-thirds coming from private investment and one-third from the public sector.

In order to increase the impact of the European Union's action, it is proposed to organise FP7 around six major objectives:

Objective 1. Creating European centres of excellence through collaboration between laboratories.

Programmes to support transnational collaboration between research centres, universities and companies will be implemented using the FP6-type instruments, such as the Networks of Excellence and Integrated Projects.

Objective 2. Launching European technological initiatives

Technology platforms are being set up. They bring together different stakeholders to define a common research agenda which should mobilise a critical mass of public and private resources. This approach has been adopted in areas such as the hydrogen economy, with the creation of the 'European Hydrogen and Fuel Cell Technology Platform'.

Often, it will be possible to implement the research agenda by means of Integrated Projects. In a limited number of cases, a 'pan-European' approach appears appropriate, involving the implementation of large-scale 'joint technology initiatives'. An appropriate framework for their implementation is that of structures based on Article 171 of the Treaty[2], including possible joint undertakings.

Objective 3. Stimulating the creativity of basic research through competition between teams at European level

Open competition between individual research teams and support for them at European level would boost the dynamism, creativity and excellence of European research whilst increasing its visibility.

The Commission suggests the creation of a support mechanism (e.g. a European Research Council) for research projects conducted by individual teams which are in competition with each other at European level.

Objective 4. Making Europe more attractive to the best researchers

The European Union's objective is to promote the development of European scientific careers[3] while, at the same time, helping to make sure that researchers stay in Europe and attracting the best researchers to Europe. Against the background of growing competition at world level, it is necessary to strengthen the 'Marie Curie' actions which are being carried out for this purpose.

Objective 5. Developing research infrastructure of European interest

With the creation of the ESFRI Forum[4], an important step has been taken in the field of research infrastructures in Europe. It is proposed to strengthen this action through the introduction of support for the construction and operation of new research infrastructures of European interest.

Objective 6. Improving the coordination of national research programmes

Efforts have successfully been made to improve the coordination of national research programmes in the context of the FP6, and these efforts must be strengthened. This involves increasing the resources allocated to the ERA-NET activities for the networking of national programmes, extending the financial support they offer to research activities, and an increased effort towards the mutual opening-up of programmes.

1. "Building our common future – policy changes and budgetary means of the enlarged Union 2007-2013", COM (2004) 101 of 10.2.2004
2. "The Community may set up joint undertakings or any other structure necessary for the efficient execution of Community research, technological development and demonstration programmes."
3. As indicated in the Commission's Communication "Researchers in the European Research Area, one profession, multiple careers", COM (2003) of 18.07.2003.
4. ESFRI: European Strategy Forum on Research Infrastructure.

Examples of recently delivered FP5 project highlights

The project **DISPOWER** (see also http://www.dispower.org) covers a wide range of electricity and ICT-related topics. This project will prepare a new DG structure for power supply in regional, local and island grids. It is investigating basic solutions for technical problems involving DG in distribution networks, demonstrating the best solutions in the laboratory and in the field, and assessing the impacts. Research topics include grid stability and control, power quality and safety, socio-economic issues, planning, trading and operation tools, information, communication and electricity trading, and test facility provision. DISPOWER has successfully implemented software, hardware and training, which are targeted in the following:

MORE CARE DG Management software with AREVA's eterra SCADA (Supervision Control and data Acquisition Systems) is being integrated to allow operators to monitor and forecast the power production of wind farms in order to manage them economically and reliably from a grid perspective. Generic real-time interfaces between SCADA systems and wind-forecasting packages have been designed, based on the open and platform-independent standard. These interfaces are used to provide SCADA real-time data for the prediction packages, and to make forecast and generation schedules available for display and implementation through the SCADA user interface. This design has been tested and validated.

An experimental test field has been implemented to evaluate different innovative components for Renewable Energy hybrid systems, before their adoption in real plants in remote areas, such as small islands and mountain zones. The main components of the test field are: electrochemical storage system, PV generator, wind generator, battery inverter, diesel generator and electric loads. Electric operations and energy performance are being evaluated by a suitable monitoring system in order to assess long-term behaviour and reliability of hybrid technology under different conditions and configurations. Electric transients are being analysed and proper solutions are being detected to stabilise bus voltage during load insertions and disconnections.

An interactive operator training facility for power systems with dispersed generation is being developed to complement an existing training simulator by various models of distributed generation sources, as well as the appertaining control structures, and to establish the procurement of appropriate training programmes for both smaller dispersed generation-based systems as well as large transmission systems under the influence of strong wind generation.

The **European Network for the Integration of Renewable Energy Sources (RES) and Distributed Generation (DG)** is aimed at promoting the concept of DG+RES integration in the EU electricity system (see also www.dgnet.org). The initial expectations and objectives of this initiative have been widely covered, and ENIRDGnet has been a reference for the launching, coordination and development of activities addressed to consolidate a new DER-based model for the electricity market.
ENIRDGnet has successfully led major initiatives such as a **pan-European overview of the current status and the future evolution of DER by analysing the best practices and providing recommendations** in terms of:

i) Interconnection barriers, standardisation, commercial practices, role of DG in energy trading, institutional policy and regulatory framework, etc.
ii) A European mission to the US to exchange information on the current state of the art in both regions, and to build bridges for future co-operation with the main US stakeholders.
iii) An ambitious dissemination plan throughout the EU, involving organisation of a set of 15 country seminars and two international conferences to make energy stakeholders aware of the increasing benefits of DER.

The **MICROGRIDS** project is dealing with the large-scale integration of micro-generation to low-voltage grids (see also http://microgrids. power.ece.ntua.gr/). Microgrids comprise LV distribution systems with distributed energy sources (micro-turbines, fuel cells, PV, etc.) together with storage devices (flywheels, energy capacitors and batteries) and controllable loads, offering considerable control capabilities over the network operation.

Such systems are operated by interconnection to the grid, but are also islanded to increase reliability of supply, in case of external faults. **The operation of micro-sources in the network introduces considerable complexity in the workings of a LV grid, especially under islanded operation. Nevertheless, at the same time, it can provide distinct benefits to overall system performance if managed and coordinated efficiently.** From a customer point of view, microgrids provide both thermal and electricity needs. In addition, they enhance local reliability, reduce emissions, improve power quality by supporting voltage and reducing voltage dips, and have the potential to lower the cost of energy supply.

The objective of the **ABLE** project is to develop an advanced storage system, specially designed for small and medium-sized PV systems. This system comprises a VRLA battery of innovative design, optimised for very good reliability and a lower manufacturing cost, and a regulator directly integrated into the system. This concept ensures optimal management of the battery and anti-fraudulent use. It is expected that the concept could be a major improvement for the large-scale implementation of PV-Solar Home Systems within the framework of national rural electrification schemes.
The main results are: i) The **ABLE battery demonstrates performances comparable to those of flooded tubular batteries**, which are the reference in medium-size PV systems. **Its innovative design leads to significant reductions in the manufacturing costs.** ii) **The ABLE regulator includes a patented algorithm for energy management**, which takes into account the battery operating conditions over the previous eight days. The possibility of modular series/parallel association gives a high adaptability to the capacity and voltage of the PV system. iii) The project is now in its final stage, and tests on the complete storage system are ongoing over three axes: **indoor PV test, outdoor PV test, and user acceptance test**.

Car manufacturers worldwide are following the concept of a stronger, e.g. 42 V, board net for stability reasons. Use of the 'mild hybrid' approach with the starter-generator requires an energy supply and storage system which satisfies the high power demands of the vehicle, especially during recuperation, as well as the industrial demand in respect of costs, efficiency, lifetime and reliability.
Simulation results of the **SUPERCAR** project **show a fuel reduction of up to 20%**. Several improvements in the **double-layer capacitor** development could be achieved **by doubling the specific energy of the module and by increasing the specific power by a factor of 5.** New methods for low-cost electrode production have been developed and the set up and housing of the module designed with regard to automotive applications (http://www.upv.es/SUPERCAR).

In order to develop a hybrid system architecture for vehicles and to reach lower fuel consumption and a reduction in GHG emissions, a high-performance, long-life lithium-ion battery is required at affordable costs. The work performed by the **LION HEART** project was dedicated to specifying the design of the whole battery system within the first half of its duration. **Simulation results revealed that a 50 kW, 100 Li-Ion cells battery is needed.** The 7Ah "VL7PN" cell measures 145 mm long and 41 mm in diameter, and has a typical specific power of 1 700 W/kg. **The cell definition was optimised as regards the power energy and the safety behaviour in order to lead to lowest reaction under abuse conditions, as required by the hybrid vehicle market.** The dimensions and mechanical interfaces have been optimised with respect to volume, cooling constraints and life duration. Each module is controlled by an electronic board located on the module bus bar. The whole battery system is managed by an electronic calculator which is included in the battery system. **Five battery prototypes will be manufactured.**

The project HVDC (http://www.le.ac.uk/eg/research/groups/power/highvolt/HVDC/HVDCLinks.html) aims to establish a methodology and associated software and hardware tools will be produced to assess the potential technical, economic and environmental benefits and impacts of high-voltage DC (HVDC) transmission in the largely **HVAC** electrical power transmission and distribution systems of the European transmission network. The project will also assess the potential benefits of using more environmentally acceptable **HVDC** power cable systems. It will for the first time establish design tools and reliability prediction methods for **HVDC** cables systems to support compact cable design and assist transmission systems studies. New power cable deployment methods will also be assessed. This will assist the strategic development of the European transmission network, facilitate the trans-European energy market, reduce energy losses and generate environmental benefits.

FP6 Project Descriptions

The birth of a EUropean Distributed EnErgy Partnership that will help the large-scale implementation of distributed energy resources in Europe (EU-DEEP)

Contract number
SES6-CT-2003-503516

List of participants:
- Utilities (8): Gaz de France (FR), Tractebel (BE), Iberdrola (ES), RWE Energy (DE), Lodz Rgn Power (PL), Electricity Authority of Cyprus, EPA Attiki (EL), Latvenergo (LT)
- Equipment manufacturers and developers (9): Bowman (UK), Tedom (CZ), MTU (DE), SAFT (FR), Siemens PTD (DE), Siemens PSE (AT), Heletel (EL), ANCO (EL), Fagrel (IT)
- Technical research centres, academics (16): IIE-UPV (ES), IEA/LTH (SE), FEEM (IT), ICCS/NTUA (EL), VEIKI (HU), VTT (FI), RTU (LT), Labein (ES), Laborelec (BE), STRI (SE), Tübitak (TR), KULeuven (BE), AUTh (EL), FIT (CY), CENTER (ES), CRES (EL)
- Engineering companies, SMEs, banks (4): Technofi (FR), EnergoProjekt (PL), Transénergie (FR), Capitalia (IT)
- Regulators, national agencies (2): KAPE (PL), RAE (EL)

Projected total cost: €28.9 million

Maximum EC contribution: €15 million

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Project main goal(s)

In this Integrated Project, a group of eight leading European energy utilities have joined forces to remove, during the next five years, most of the technical and non-technical barriers which prevent a massive deployment of distributed energy resources (DER) in Europe. In partnership with manufacturers, research organisations, professionals, national agencies and a bank, they are following a demand-pull rather than a technology-push approach.

This new approach will provide five 'fast-tracks options' to speed up the large-scale implementation of DER in Europe. The project will define five market segments which will benefit from DER solutions, and foster the R&D required to adapt DER technologies to the demands of these segments. To achieve these objectives, a set of iterative R&D tasks will be required 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.

Key issues

Markets: Construct a European demand model, calibrated on an 80 million clients profile database (in at least eight countries). European organisations can appraise emerging DER markets through contracts with the ECG. Show how demand can be adapted in order to help DER technology fit the market requirements better. Demand for DER systems is optimised, thanks to a demand response (Local Trading Strategies) approach which succeeds in changing consumer energy demand patterns.
Technologies: Foster focused development and validation of DER technology (meeting precise demands from the European demand model). Existing and future EU Directives regarding various energy-related policies have the corresponding technologies to ensure proper field implementation. Specify key technology components and control approaches to enable the smooth integration of DER technologies in existing and future distribution networks. Regulatory bodies have access to the proper information to recommend DER integration in European energy grids.
Implementation of results: Communication and training programme to disseminate knowledge and competence to designers, engineering and maintenance companies, consultants, equipment providers, utilities, academic players, end-users...

Intermediate actors (consultants, engineering and maintenance companies, etc.) are ready to bring innovative solutions into operation. Create a European Competence Group (ECG) dedicated to future studies of DER technologies and market opportunities. Anyone worldwide willing to assess DER potential using a demand appraisal approach can rely on the ECG.

Technical approach

The work is divided into nine work packages, the first five of which are strongly interrelated:

In WP1: the demand for DER is detailed into demand segments that will provide a range of specifications from end-users.

In WP2: grid management issues are examined by simulating large penetration of DER in the segments identified in WP1. Equipment specifications are drawn up for safe and reliable connection to the grid, yet adapted to the demand segments identified in WP1.

In WP3: local trading strategies are studied and developed, with possible feedback to demand segments in WP1 and/or grid management in WP2. Equipment specifications are drawn up for the implementation of Local Trading Strategy (LTS) approaches adapted to the demand segments identified in WP1.

Meanwhile, market rules and regulations are also examined in WP2 on the basis of the specification from end-users from WP1, grid management issues in WP2, and the possibility of local trading strategies in WP3.

In WP4: the specifications for equipment are drawn up from end-user requirements obtained in WP1, and the equipment specifications obtained in WP2 and WP3. With these specifications, equipment manufacturers can perform research and finalise the development of their DER technologies.

In WP5: a one-year experimental measurement campaign will be prepared and will be used for each demand segment identified in WP1 in order to provide validated performances as regards grid connection issues and LTS approaches in WP2 and WP3, respectively.

This interaction will be repeated for five demand segments over the course of the five-year project, covering up to two types of demand segments in each of the three 'fundamental' market sectors (residential, commercial and industrial). The last four work packages are more linearly linked:

In WP6: the training activities exploit results obtained in WP2, WP3 and WP5. Feedback from training activities is expected in WP1 and WP8.

In WP7: dissemination will be carried out which should prepare DER stakeholders for the commercial exploitation of the project results by the ECG.

In WP8: the European Competence Group (ECG) will be built and will provide the business models for fast-track penetration of DER in Europe on the basis of all the results obtained in WP1, WP2, WP3, WP4, WP5 and WP6.

In WP9: is where the coordination and strategic management of the project takes place. (Tasks relative to technical risk management are performed in each work package.)

Expected achievements/impact

The main outputs brought by the innovative, demand-pull approach of the project will impact on all the stakeholders of DER (utilities, manufacturers, professionals, regulators and, ultimately, the end-users):

- **Five** fast-tracks options to DER, described by **five** coherent business models addressing the necessary DER technologies, energy market demand, financial means, and organisation of actors
- The results of R&D on improved DER equipments (generators, grid connection, storage and communication) for the **five** studied fast-track options
- Equipment specifications to connect DER to existing grids that will enable LTS approaches to be validated for the **five** fast-track options
- Improved software to simulate the electrical grid system with large DER penetration
- An in-depth understanding of the effect of large penetration of DER on the performances of the electrical grid system and on the electricity market
- Market rule recommendations to regulators and national agencies that will support the **five** studied fast-track options
- A comprehensive training and dissemination package targeting all stakeholders of DER in Europe, with a special emphasis on those concerned by the **five** studied fast-track options
- A European Competence Group (ECG), led by the utilities, which will create further fast-track options beyond the end of the project, using the methodology designed, developed and validated during the project.

Advanced lithium energy storage systems based on the use of nano-powders and nano-composite electrodes/electrolytes (ALISTORE)

Contract number:
SES6-CT-2003-503532

List of participants:
- Universities of Montpellier, Provence, P. Sabatier, Jules Verne and ICMB Bordeaux (FR),
- Universities of St Andrews and Kent (UK),
- Universities of Barcelona and Cordoba (ES),
- University of Delft (NL),
- University of Ljubljana (SI),
- Max Planck Institute (DE),
- Paul Scherrer Institute (CH),
- University of Roma La Sapienza (IT),
- University of Uppsala (SE),
- University of Warsaw (PL)

Maximum EC contribution: €5 million

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Project main goal(s)

The aim of the ALISTORE network is to bring together the core competencies of 15 excellent European university research groups in the field of energy storage to build a new integrated research structure able to:

- reduce redundancies and organise complementarities
- share expensive facilities and resources
- collaborate on mutual research objectives.

In order to address the next century's energy storage challenge, which is being dictated by the rising emerging ecological concerns linked to a more nomadic world, and to define the scientific direction to be pursued for the development of Advanced Li Energy Storage Systems with high energy and power density, which could be used in a downstream of applications, and enable

- the development of hybrid or electric vehicles
- the deployment of high-quality power
- the use of renewable energy sources.

The optimum goal is the desire to replace Europe at the forefront of Li-based energy storage technology.

Key issues

To achieve the above goals, current efforts are centred on five joint activities falling under the general scheme of research, benchmarking, education and training, knowledge dissemination, and management. ALISTORE's detailed research strategy is aimed at the search for economically viable batteries with high power, high energy, long lifetime and high safety, and capable of meeting automotive and grid-connected applications, and is the result of numerous discussions among partners. The general consensus is that a rich area of investigation lies behind the issue of nano-materials for energy storage, providing that we, and in particular the NoE, can gain a good understanding of: 1) how to synthesise, characterise, control and manipulate particles on a small scale; 2) how to fabricate nano-structured electrodes and electrolyte membranes; and 3) how to master interface compatibility while preserving high ionic diffusion. The ALISTORE network, by wisely integrating in a complementary way the 16 European research groups with wide fields of expertise, serves as the vehicle to: 1) address these scientific challenges, which could not be done by any one group alone, and 2) develop a new school of thinking centred on the positive attributes that nano-materials can have

within the field of energy storage. To rapidly establish each partner's main tasks/milestones necessary to realise our novel approach, six working sub-groups will cover the various aspects of the scientific project that have been defined.

Every three months, brainstorming sessions have been initiated for each group with the hope of: 1) developing trust, 2) learning or trying to share information, and engaging in passionate discussions, and 3) fostering interactions and defining at least a common objective as it turns out to be. Such discussions will end in a summary of the meeting, defining further actions and research endeavours to be dispatched to all ALISTORE partners. Such meeting reports also have the double purpose of monitoring research progress and advances. As a way of ensuring that such sub-group does not run counter to the integration spirit, each brainstorming leader will have the opportunity to share her/his views and research advances with all the other partners at the two ALISTORE bi-annual meetings.

Technical approach

Preparation of nano-materials is as important as determining their physical characteristics. This is not an easy task because of their small size, which is partly the reason why pursuing such research will involve the use of the most advanced tools in modern material, surface and electrochemical science. Since there is a large amount of equipment available among partners, restructuring is a prerequisite for further scientific collaboration. Clearly, this is one of the hardest integrating activities of all, i.e. how to restructure existing partner's equipment/facilities to those of the shared network. To restructure the existing facilities for use in the consortium, the concept of characterisation platforms (CP) has been initiated and we have planned the creation of at least four of them:

- NMR platform
- Microscopy platform
- Mossbauer platform
- XANES/EXAFS platform

together with the identification of unique skills (US) location to perform specific experiments. These platforms, fully open to all network members, will not be used solely as service centres, but merely as centres where each network user has to go to conduct his/her measurements on-site. This, therefore, will promote interactions between different groups with the hope of prompting new developments and facilitating the exchange and mobility of personnel. The integrating activity task herein is to establish a programme on how to implement the different facilities in the network, and to find the optimal way of using these facilities. In addition, and equally as important, ALISTORE will open up possibilities to apply for 'beam time' at institutes which, due to their nature, are not part of the network but have very unique and relevant equipment, for instance ISIS (UK) and Sundvik (SE).

Expected achievements/impact

Europe can currently claim access to numerous research laboratories working in the field of Li-based systems. However, Europe's effort is too isolated and fragmented to enable an efficient breakthrough in the field. One of the limiting factors is that, while most of the research groups have similar types of equipment to run routine experiments, many are now experiencing problems in buying up-to-date analytical tools needed to unlock the door to the solution of frontier fundamental/technological issues. The ALISTORE network will be the vehicle to share expensive facilities and to provide access at short notice to unique and relevant equipment such as synchrotron sources and so on to which we could not have access before.

Integration, through the various means proposed above, will not only enable the delivery of a greater amount of higher-quality science than would be possible with the individual members working on their own, but will also enhance the productivity and 'excellence' of each network member. Such excellence will result in numerous press releases, publications in the most renowned journals (e.g. Nature), and a large patent portfolio, all of which is essential for network sustainability. Integration will not only secure a sound scientific platform for battery research and training programmes (European Masters degree, summer schools and workshops) to ensure long-lasting leadershipbut, based on the numerous amounts of phone calls from industries witnessing interest in ALISTORE, we also anticipate ever-stronger industrial links between universities, industrial companies and SMEs. The creation of a European Economic Interest Group will provide a more powerful and focused mechanism to interact with European industry and handle patent rights.

The ALISTORE network comprises about two third of the European basic research capacity in the lithium battery research, whose earlier work contributed significantly to the present Li-ion technology. Based on their own scientific expertise, they all believe that the proposed advanced Li-battery, as the result of the inherent advantages of using nano-materials components which offer: 1) easier accommodation of structural strains so that a longer calendar life is favoured, 2) a shorter diffusion path that results in enhanced electrode power capabilities, 3) an increase in the surface vs. core volume ratio, leading to larger double-layer capacitance contribution, and 4) an enhanced solid state reactivity enabling kinetics limitations to be bypassed so that novel reactions implying staggering capacity gains and involving low-cost materials become feasible, which will offer tremendous cost gains over existing systems. Such a nano-materials approach that revolutionises the rules of electrochemistry is the most promising avenue for the combination of Wh/kg, W/kg, number of cycles to meet the above-mentioned goals. ALISTORE should enable European research organisations to curb the current trend and take the lead in new storage issues. The proposed advanced batteries will make it possible to restructure the electricity distribution system, and thereby allow us to reach the current targets for the use of renewable energies, and to produce affordable non-polluting electric and hybrid-electric vehicles.

Super-coated conductor cable (SUPER3C)

Contract number:
SES6-CT-2004-502615

List of participants:
- Nexans France, Zentrum fuer Funktionswerkstoffe (DE),
- Nexans Norway, Nexans Deutschland Industries (DE),
- Air Liquide (FR),
- Instituto de Ciencia de Materials de Barcelona (ES),
- Fundación LABEIN (ES),
- Institute of Electrical Engineering (SK),
- Nexans SuperConductors GmbH (DE),
- Tampere University of Technology (FI),
- E.ON Energie AG (DE),
- E.ON Engineering GmbH (DE),
- European High Temperature Superconductors GmbH & Co. KG (DE)

Projected total cost: €4.47 million

Maximum EC contribution: €2.7 million

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Project main goal(s)

Sooner or later, superconductors will have a large impact on electrical engineering because they have the potential to allow very high compactness to be combined with very high efficiencies. Previously, their use was limited by an extremely low critical temperature, making the cryogenic costs fairly high. Now, high-temperature superconductors are available which enable operation in liquid nitrogen between 65 and 77 K, i.e. at low cryogenic costs. Until now, all High Temperature Superconducting (HTS) cables have been manufactured with bismuth-based multifilamentary wires as current-carrying elements. However, these wires are expected to be replaced in the future by a second generation of HTS tapes, the $YBa_2Cu_3O_7$-x (YBCO) Coated Conductors (CC) which, as the result of a lower production cost, will allow for a wider use of HTS cables. The Super3C project therefore aims to establish the feasibility of a low-loss HTS AC cable using CC tapes as current-carrying elements. It comprises the development, manufacturing and testing of a functional model consisting of a one-phase, 30 meter long, 10 kV, 1 kA cable with its terminations.

Key issues

The main scientific and technological issues of the Super3C project are:

- The development of an optimal CC tape cross-sectional architecture leading to a critical current (I_c) of 400 A/cm-width on short IBAD/HR-PLD tape length (1 m),
- The establishment of an up-scaled processing technique that allows for the manufacturing of CC tapes in 100 m unit lengths with a critical current of 75 A for 4 mm-wide tapes
- The development of a cable design and a cable manufacturing process compatible with CC tapes
- The development of 10 kV outdoor terminations for CC cables
- The fabrication and successful testing of a functional model which will consist of a 30 m long, 10 kV, 1 kA one-phase CC cable with its terminations, and which is expected to require the manufacture of about 2 km of CC tapes
- The establishment of the suitability of IBAD/HR-PLD CC tapes for AC cables
- The establishment of the suitability of a chemically deposited YBCO layer for AC cables.

Technical approach

The HTS cable will be of the cold dielectric type and will require cooling with pressurised liquid nitrogen. The core will be composed of a flexible support surrounded by a HTS conductor separated through a lapped dielectric insulation from an HTS screen. Such a design will create a flow of current in the screen which will be opposite and equal in ampacity to the one in the conductor. As a consequence, the cable will not generate any significant magnetic field outside. The individual phases of such a cable system are electrically and thermally independent. The development and test of a one-phase functional model designed for AC applications will therefore provide the same output data, at a lower cost, as the test of an AC cable with three independent phases. For the CC tape fabrication, the work will be focused on the following technological routes:

- Use of low-cost stainless steel as a substrate tape
- Ion-Beam Assisted Deposition (IBAD) of a biaxially textured buffer layer
- High-Rate Pulsed Laser Deposition (HR-PLD) of YBCO film
- Physical vapour deposition (PVD) of the shunt/protecting layers.

IBAD and HR-PLD are well-established technologies that have to be scaled up to deliver the tape length demanded for the manufacturing of the functional model. The selection of these two processes aims at securing the CC tape delivery as well as possible. However, chemical deposition techniques may, in future, become attractive alternatives, in particular for the deposition of the YBCO layer. In an attempt to find a good compromise between securing the project and preparing the future in case chemical processes become competitive, the plan is to employ the dip-coating process developed at NSC within the framework of the European project SOLSULET to deposit a YBCO film on 20% of the IBAD-buffered substrate fabricated for the functional model. A first objective will be to demonstrate the suitability of a chemically deposited YBCO layer for AC cables. A second will be to set the basis for future developments aimed at defining the best combination of processes to further reduce the cost of CC tapes and, consequently, of CC cables.

Expected achievements/impact

The Super3C project aims, therefore, to establish the feasibility of a low-loss HTS energy cable using CC tapes. It comprises the development, manufacturing and testing of a functional model consisting of a one-phase, 30-m long, 10 kV, 1 kA cable with its terminations. It is expected to be the first HTS cable in the world using only CC tapes as current-carrying elements.
Besides the wide range of competences that it represents through the involvement of well-recognised groups, the Super3C project consortium guarantees access to world-leading processes for the manufacturing of the two most critical cable components – the HTS tape and the cryogenic envelope. Most of the HTS tapes will be made through Ion Beam Assisted Deposition (IBAD) and High Rate Pulsed Laser Deposition (HR-PLD), a combination of well-established processes leading to the highest performances, whereas the cryogenic envelope will be supplied by a team which has more than 20 years of experience in that field. In addition, the test, in a cable configuration, of a CC tape with a chemically deposited HTS layer will set the basis for future developments aiming to define the best combination of processes to further reduce the cost of CC tapes and, consequently, of CC cables.

Integration of Renewable Energy Sources and Distributed Generation into the European Electricity Grid (IRED)

Contract number:
SES6-CT-2004-503770

List of participants (organisation name, country)
- Institut für Solare Energieversorgungstechnik e.V. (Germany),
- CIDAE University Research Institute (Spain),
- Energy Research Centre Netherlands (Netherlands),
- EnerSearch AB (Sweden),
- CEA-GENEC Research Laboratory (France),
- Iberdrola SA (Spain),
- LABEIN Technological Centre(Spain),
- MVV Energie AG (Germany),
- Institute of Communication and Computer Systems/Nat. Tech. University of Athens (Greece),
- Tekes National Technology Agency (Finland)

Projected total cost: €1.15 million

Maximum EC contribution: €0.7 million

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Project main goal(s)

The increasing number of renewable energy sources and distributed generators requires new strategies for the operation and management of the electricity grid in order to maintain or even to improve the power supply reliability and quality in future. Further to this situation, liberalization of the grids leads to new management structures in which trading of energy and power is becoming increasing important. This trend is accompanied by new structures for communication and trading leading finally to digitally controlled interactive electricity grid.

The preparation for the transition from the conventional to the future grid management requires an interdisciplinary approach between research, industry, utilities and consumers, taking into account technical as well as socio-economic and regulatory issues.

The existing cluster on the integration of RES and DG represents the most important European initiative to provide means for the transition of the electricity grid into a digitally controlled one. By creating a systematic exchange of information inside the cluster and to international, national and regional policy- and programme makers and other actors in the field, a substantial higher dynamics in European Research will be resulting as a contribution to the ERA and providing European Industry with the means to gain leadership.

Key issues

The co-ordination action will be implemented by the following elements:

- The establishment of an expert-group covering important cross-cutting areas such as power-quality etc.
- The formation of a group of contact persons to national, regional and international policy and to programme makers and programme managers
- Set-up of a full data- and information-exchange system including the realization of links to relevant national, regional and international electronic-information systems
- Organization of conferences and workshops on the international and European level
- Exchange of personnel and joint supervision of theses and PhD-work by the participating institutions

- Production, exchange and dissemination of education material and good practice for higher education
- Organization of regular cluster-co-ordination meetings
- Identification and integration of forthcoming relevant projects and activities into the cluster

Technical approach

Seven projects which are supported by the European Commission under FP5 dealing with the integration of Renewable Energy Sources (RES) and Distributed Generation (DG). In order to concentrate efforts and to maximise critical mass, these seven projects have been bundled to create a cluster in January, 2002.

The subject of the co-ordination action is to extend the existing cluster activities in such a way that a real European added value by mobilising research will be obtained as a major contribution to the ERA. This extension will be realized by the inclusion of forthcoming projects supported by FP6, national and regional activities and by implementing the new instruments provided through FP6.

In contrast to the creation of a Network of Excellence (NoE), this CA will be more feasible since no fragmented research on the integration of RES and DG exists and structuring of this research can be performed from the very beginning. The most important elements of the CA will be the following:

- A systematic exchange of information and good practice by improving links to relevant research, to regulatory bodies and to policies and schemes on the European, the national, the regional and the international level.
- Set-up of strategic actions such as transnational co-operation, the organization and a co-ordination of common initiatives on standards, testing procedures and the establishment of common education and training.
- Identification of the highest priority research topics in the field of integration and formation of appropriate realization schemes.

Expected achievements/ impact

By increased dynamic in research, the transformation of the current electricity grid into an interactive one multiple benefits can be expected such as the creation of innovative products of the European industry leading to increased export, the realisation of an (electronic) e-energy market going a very much higher flexibility to match supply and demand and thus allowing for a higher integration rate of RES and DG into the electricity grid.

In respect to the substantial increase of renewable energy supply stated in the white book of the European Commission, the proposed action provides the infrastructure, necessary for the realization of the forgets stated in this book.

Finally an increased economics in the production, transmission and distribution of electricity will lead to more attractive energy prices for the benefit of all from the industry to the private consumer.

European Commission

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