



Survey Report

**Research & Technology Development
and Innovation (RTD&I) Programmes
in SOLAR-ERA.NET
Countries and Regions**

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Table of Contents

What is SOLAR-ERA.NET?	3
Introduction and Overview	4
Austria	5
Belgium - Flanders.....	8
Belgium - Wallonie.....	10
Cyprus	13
Finland.....	15
France	18
Germany.....	22
Germany - North Rhine Westphalia.....	25
Greece.....	27
Italy - Puglia.....	29
Italy - Sicily.....	34
The Netherlands	38
Poland	41
Spain	43
Sweden.....	47
Switzerland	50
Turkey.....	54
United Kingdom	56

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What is SOLAR-ERA.NET?

SOLAR-ERA.NET - the Network and its Objectives

SOLAR-ERA.NET is a network that brings together more than 20 RTD and innovation programmes in the field of solar electricity technologies in the European Research Area. The network of national and regional funding organisations has been established in order to increase transnational cooperation between RTD and innovation programmes and to contribute to achieving the objectives of the Solar Europe Industry Initiative (SEII) through dedicated transnational activities (especially transnational calls). SOLAR-ERA.NET is an EU funded FP7 project running from 2012 to 2016. Through the support of the funding organisations, more than 100 MEUR shall be mobilised for transnational RTD and innovation projects.

SOLAR-ERA.NET - the Context

SOLAR-ERA.NET is a European network of national and regional funding organisations and RTD and innovation programmes in the field of solar electricity generation, i.e. photovoltaics (PV) and concentrating solar power (CSP) / solar thermal electricity (STE). SOLAR-ERA.NET shall carry out the coordination and support actions for the implementation of the SEII between national and regional RTD and innovation programmes. The SEII is embedded in the European Strategic Energy Technology Plan (SET-Plan) which aims to increase, coordinate and focus EU support on key low-carbon energy technologies in order to achieve Europe's 2020 energy objectives in the future. The SEII is a joint initiative of the industry sector, EC and member states. The objective of the SEII is to boost the development of the PV and CSP sector beyond "business-as-usual" in the areas of Research and Development, Demonstration and Deployment. For the concerned solar electricity technologies Implementation Plans have been developed setting out priorities for RTD in Europe.

SOLAR-ERA.NET - the Activities

SOLAR-ERA.NET's goal is to undertake joint strategic planning, programming and activities for RTD and innovation in the area of solar electricity generation. Joint activities, namely joint calls, are defined for key topics and priorities in accordance with the Solar Europe Industry Initiative (SEII), based on the Strategic Energy Technology (SET) Plan and its related Implementation Plans for PV and CSP. In order to define and support the best joint activities, strategic information exchange and use of implementation tools will be carried out among the network participants and associates from key stakeholder groups.

Introduction and Overview

This Survey Report presents key features of countries and regions and their respective programmes involved in SOLAR-ERA.NET, namely:

- Organisations Involved in SOLAR-ERA.NET and solar electricity Research, Technology Development and Innovation (RTD&I) programming
- Context and trends
- Set-up and strategy of the programme(s) involved
- Objectives
- Priorities

The states and their programme(s) are presented side by side in the same format. The goal of this report is to provide an essential overview over each of the country / region and their programme(s) involved in SOLAR-ERA.NET. The report is not intended to make any direct comparisons, less than any evaluation of the programmes.

Some very general observations can be made by looking at the states and programmes presented in more detail in this survey report:

- There are 19 SOLAR-ERA.NET consortium partners from 17 countries and regions representing more than 20 RTD&I (sub) programmes.
- Solar power technologies (PV and CSP) are mostly embedded in larger RTD&I programmes. Thematically, PV and CSP are often part of broader programmes focusing renewable energy, energy (production and efficiency), climate, materials, research, innovation, industrial and / or regional development or creation of business opportunities. With respect to the value chain, some programmes can cover virtually the whole range from (very basic materials) lab to (high through-put) fab or, with respect to SOLAR-ERA.NET and its orientation towards supporting the Solar Europe Industry Initiative, programmes involved tend to focus on technology development, demonstration and market introduction. A few countries have specific (sub) programmes dedicated on solar energy or certain solar technologies. Yet, some larger programmes also define targeted initiatives for solar electricity RTD&I that can be similar to what one may or may not name a “programme”.
- Obviously, the specific objectives, priorities and strategies reflect this great diversity of how RTD&I programmes are oriented towards value chain and technology portfolio. Some countries have extensive work programmes on solar electricity technologies whereas other countries are about to create critical mass and opportunities for their research and industry community through SOLAR-ERA.NET.
- Although most states and programmes do not have a budget specified for solar electricity technologies, their funding spent on PV and CSP is assessed as far as can be provided by the partners. The programmes respectively countries involved cover a large share of public spend on solar electricity RTD&I in Europe. This share amounts to more than 100 MEUR for the participating programmes respectively states. Some programmes are indirectly involved in SOLAR-ERA.NET and can eventually fund projects initiated through SOLAR-ERA.NET transnational calls.

To conclude, the Survey Reports shows in a concise manner the different countries / regions and their programmes allowing for a better understanding of how they work in their respective environment and their position in the European / international context. It is estimated that the larger part of public funding provided by national and regional agencies is directly or indirectly linked to SOLAR-ERA.NET potentially allowing for increasing outreach, impact and efficiency of public funding in solar electricity RTD&I – both on the individual level of each programme and on the European level.

Austria

Update October 2014 – Authors: Anita Hipfinger, Elvira Lutter, Ulrike Rohrmeister

Organisations involved in SOLAR-ERA.NET and solar electricity RTD&I programmes

Three organisations are formally involved in SOLAR-ERA.NET: The Austrian Climate and Energy Fund (KLIEN), the Ministry for Transport, Innovation and Technology (bmvit) and the Austrian Research Promotion Agency (FFG).

The Austrian Climate and Energy Fund (Klima- und Energiefonds) was established in 2007 by the Climate and Energy Fund Law or KLI.EN-FondsG (Federal Law Gazette I no. 40/2007 as amended in Federal Law Gazette I no. 37/2009). The Federal Fund is owned by the Republic of Austria, represented by the Federal Ministry of Transport, Innovation and Technology (bmvit) and the Federal Ministry of Agriculture, Forestry, Environment and Water (bmlfuw). The fund is a strategic instrument of the Austrian Federal Government for research, development and innovation to address the ‘Grand Societal Challenges’ secure, clean and efficient energy, smart, green and integrated transport and climate action.

The annual budget of the fund is up to 150 MEUR dedicated to sustainable energy and mobility projects in the area of research, demonstration and market penetration. To allocate funds, concrete programmes (approx. 20 per year) are developed by the Climate and Energy Fund. The fund is, among others, responsible and owner of the national energy RTD programme with an annual budget of up to 35 MEUR, “Smart Cities – FIT for SET” dedicated to the demonstration of new energy technologies in the urban environment, “Solar Thermal – Large Scale Solar Systems” and the “PV Förderaktion”, an investment subsidy programme for PV plants < 5 kWp. FFG is the executive agency of KLIEN (among others) for managing the energy RTD programme.

In October 2013, the research programme “Stadt der Zukunft” (engl. City of the Future) was launched. The programme is owned the Ministry for Transport, Innovation and Technology. The aim is to support the development of new technologies, technological (sub)systems and services for urban regions. The focus is on the building, the neighbourhood and the city. The budget amounts to 9.4 MEUR. FFG is the executive agency for this programme.

The Austrian Research Promotion Agency (FFG) – owned by the Ministry for Transport, Innovation and Technology (bmvit) and the Ministry of Economy, Family and Youth (bmwfj) – is the national funding institution for applied research and development. In the FFG two divisions support research projects of all energy matters: the Thematic Programmes and the General Programmes.

The Energy Research Program is one of the research and technology programmes managed in the Thematic Programmes. The Energy Research Programme of the Climate and Energy Fund also provides the framework for the management of SOLAR-ERA.NET.

Context and trends

The motto of the Austrian Energy Research Strategy (2010) is “Making the Zero Carbon Society Possible” reflecting the fact that energy research is crucial for achieving classic energy policy objectives. The strategy therefore focuses as much on supply security, climate protection, environmental compatibility and affordability as on research and technology policy goals such as strengthening the business location by means of enhancing technological competence and market leadership in specialised areas.

Energy research plays a central role in research funding: more than 15% of all FFG funding is available to the field of energy and related environmental issues (average 2008 – 2012).

The Austrian photovoltaic industry is highly diversified covering production of PV modules, converters and tracking systems as well as other PV components and devices. Furthermore there is a high density of planning and installation companies for PV systems as well as specialized institutions and universities, which play an important role in international photovoltaic research & development (R&D). Within those economic sectors a total of 4847 persons are employed full-time which raises solar technology to an overall substantial and yet growing market. The average system price of a grid-connected 1 kWp photovoltaic plant in Austria decreased from 3'579 kEuro/kWp in 2010 to 2'698 kEuro/kWp in 2012, i.e. a reduction of 24,6%. This observation confirms a high economic learning rate, which is highly correlating to the still increasing world market. Especially the development of building integrated photovoltaic elements is of high importance for Austria, which reflects in both R&D promotion programmes (e.g. Energy Research Programme, 'Stadt der Zukunft) and market-related funding mechanisms. High added value seems to be achievable in this market branch. Furthermore, due to the increased deployment of PV-systems, the question of PV grid integration becomes an important national issue for Smart Grids.

Set-up and strategy of the programme involved.

The relevant programs are based on the "Energy Research Strategy for Austria", the results of the "Strategy Process e2050", evaluations of previous calls as well as regular stakeholder dialogue on topics of future research funding with representatives from industry and research. The outcomes of these discussions are also incorporated in programme design and priority setting.

Objectives

The main objectives of the solar electricity emphasis within the Energy Research Programme are:

- Cost reduction through mass production
- Increased efficiency of modules/collectors
- Efficient manufacturing processes
- Use of new materials
- Extended component service life.

The focus of "City of the Future" is the integration of PV in buildings, in particular: new materials, design, flexible solutions for existing buildings, multi-functional integration into new buildings and PV glazing.

Priorities

The thematic priorities/topics eligible for funding of the Photovoltaic emphasis within the Energy Research Programme are:

- Development and demonstration of modules for functional building integration (e.g. new integration concepts, multifunctional concepts, etc.) and for special applications (e.g. consumer products, emergency telephones, etc.) and suitable (mechanical and electrical) installation systems for standard-compliant and economically efficient integration;
- Development of material combinations and manufacturing processes for flexible photovoltaic elements (films, coatings, spray processes, inkjet printing, substrates) for building and special applications;
- Development of innovative components (modules, encapsulation, inverter, cabling, connector systems, etc.) which help to reduce system losses, increase system voltage and efficiency and optimise system design;
- Optimisation and increase of the overall performance and lifetime of all components through cost-

efficient, readily available and non-toxic materials, system concepts ensuring long lifetime even under extreme ambient conditions;

- Development and testing of new quality assurance methods and tools at component and system level, e.g. simulation and early detection of defects and failures, fire protection, prediction methods for energy yield or the provision of grid energy services, monitoring of performance parameters of PV systems, etc.

The thematic priorities/topics eligible for funding of the Solar Thermal Energy emphasis within the Energy Research Programme are:

- New materials (e.g. polymer materials, nanomaterials) for collectors and system components;
- Standardised system solutions for large-scale solar thermal systems (> 0.5 MW) offering a better price/performance ratio, e.g. (self-supporting) collector fields, aerodynamic collector geometries, optimised hydraulics, innovative control systems, calculation and simulation tools for designing systems with guaranteed performance;
- Testing methods for lifetime prediction under realistic service conditions (e.g. specimen and component testing for plastic collector components).

Table 1: Austria – General Information on Solar Electricity RTD&I Programming

Programme	Thematic or Research Programmes (Energy Research Programme, City of the Future)	General Programme
Ownership	Austrian Climate and Energy Fund (KLIEN) and Ministry of Transport, Innovation and Technology (bmvit)	Ministry for Transport, Innovation and Technology (bmvit) and the Ministry of Economy, Family and Youth (bmwfj)
Management	Austrian Research Promotion Agency (FFG)	Austrian Research Promotion Agency (FFG)
Focus	energy efficiency, renewable energies, smart grids, smart energy systems and electro-mobility	any thematic focus on energy possible
Time Frame	since 2007, one call/year	since 1968, executed in 7 advisory board sessions on funding/year
Budget (average)	approx. 25-35 MEUR for the total call (no indicative budget for PV and CSP projects)	no indicative budget
Finance resources	national RTD funding	national RTD funding
Number of solar electricity technology projects currently running with public support (out of total number of projects running)	Energy Research Programme: 17 solar electricity projects (all PV) out of 135 ongoing projects City of the Future: 2 solar electricity projects out of 24 ongoing projects.	approx. 11 PV, 5 solar thermal new projects in 2012
Programme-specific RTD spend for Solar Electricity out of global spend 2013	see below	see below
Total public RTD spend 2013 for solar electricity technologies	approx. 7 MEUR out of 42 MEUR	approx. 7,5 MEUR for renewable energy
Website	ffg.at/1-Ausschreibung-Energieforschung	ffg.at/programm-basisprogramm

Belgium - Flanders

Update November 2014 – Author: Elsie De Clercq

Organisations involved in SOLAR-ERA.NET and solar electricity RTD&I programmes

IWT - Institute for the promotion of Innovation by Science and Technology in Flanders – is formally involved in SOLAR-ERA.NET. IWT is a governmental agency, established by the Flemish Government in 1991. Since innovation policy is a regional matter in Belgium, the mission of IWT is to support and promote R&D and innovation in the Flemish industry. All companies established in the Flemish region, SME's included, can request IWT support for their research projects and make use of IWT services. The total budget of IWT amounts 323 MEUR support in 2013. IWT has approximately 120 FTE employees. The scope of the funding is quite broad and organised horizontal (i.e. open for all thematics) including industrial R&D projects, EUREKA-projects, feasibility studies and innovation projects for SME's (with an open call), support to industrial networks (generic sectorial research, technological advisory services, innovation stimulation), support to universities for strategic basic research (SBO), support to higher education engineering schools for technology diffusion actions (TETRA), individual grants for PhD and post-doc research, support to universities for exploitation of their R&D-results and support to larger "ad hoc " initiatives as decided by the Flemish government.

Context and trends

In the context of SOLAR-ERA.NET the involved IWT programmes are "Industrial Research and Development programme" ("O&O") and "innovation programme for SME's" ("KMO-IP")

The industrial R&D funding programme ("O&O") provides direct support to firms for research and development projects initiated with the purpose of developing innovative solutions. With innovation is meant that the projects must result in new knowledge that has practical applications leading to the creation of economic added value and possibly other benefits for Flemish society. Industrial R&D projects are considered targeted research and have as their main beneficiary the firm(s) directly involved in it. The programme is open to all firms with (future) activities in the Flemish region, capable of creating sufficient added value over time by applying the project results. By added value is meant benefits such as job creation and capital investment. The targeted innovation can be technological or non-technological in nature. All industrial R&D projects that support the acquisition of knowledge for the purpose of innovation are in principle eligible for support, regardless of whether the activities are of a technological nature. For SMEs there is the "innovation programme for SME's" tailored to SME needs ("KMO-IP").

Set-up and strategy of the programme involved

An industrial R&D project ("O&O") is a project of research and development carried out by one or several enterprises, sometimes in collaboration with research partners. It takes as its starting point a concrete problem or opportunity for which it is necessary to develop further knowledge and whose realisation implies considerable uncertainty.

Distinction is made between two project types: research projects (50% funding level) and development projects (25% funding level).

SME innovation projects ("KMO-IP") contribute to the realisation of an innovation. This may involve the development of a completely new or significantly innovative (improved) product, process, service or concept.

Innovation or improvement should be understood here as 'innovative for the company and with a clear impact on the business activities.'

The funding for an SME innovation project is calculated on the basis of the acceptable costs. The basic funding rate is 35% (25% + 10% extra funding for SMEs). The funding may not exceed 250 kEUR.

Priority is given to projects with a higher risk and an important expected impact in Flanders on an economic and possibly broader societal level.

Objectives

IWT's industrial R&D funding programme ("O&O") and innovation programme for SME's ("KMO-IP") provide direct support to firms for research and development projects initiated with the purpose of developing innovative solutions. The projects must result in new knowledge that has practical applications leading to the creation of economic added value and possibly other benefits for Flemish society.

Priorities

The IWT programmes are not limited to certain thematic fields: all knowledge and application fields are eligible. Only projects for military applications will not be funded.

Table 2: Flanders – General Information on Solar Electricity RTD&I Programming

Programme	O&O programme, KMO programme included
Ownership	IWT
Management	IWT
Focus	Companies located in Flanders No thematic focus
Time Frame	Open programme
Budget (average)	approx. 140 MEUR/year
Finance resources	Flemish region
Number of solar electricity technology projects currently running with public support (out of total number of projects running)	13
Programme-specific RTD spend for Solar Electricity out of global spend 2013	1.8 MEUR
Total public RTD spend for solar electricity technologies	8,5 MEUR
Website	www.iwt.be

Belgium - Wallonie

Update October 2014 – Authors: Laurence Polain, Julie Marlier

Organisations involved in SOLAR-ERA.NET and solar electricity RTD&I programmes

Service Public de Wallonie is the legal administration in charge of implementing and controlling aids granted to industries, academia and research centers in Wallonia. It promotes regional policy for economy, employment, training, research and Energy. The SPW is also competent in administration of European research Programmes.

The DGOATLPE (Directorate General Operational for Spatial planning, Housing, Heritage and Energy - DGO4) is in charge of implementing technical aspects (market and research) in Energy (bioenergy, solar PV, CSP, hydro, wind power, grids, energy efficiency), while the DG OEER (Directorate General Operational for Economy, Employment and Research - DGO6) assigned to the funding of international research programmes through the Directorate for federal and International Programmes. This Directorate is also in charge of the administration of many ERA-Nets and is also coordinator of one. Within the SOLAR-ERA.NET proposal, the two DG's collaborate for higher efficiency.

Laurence Polain is Energy Projects Officer at the DGOATLPE and delegate for Belgium/Wallonia in the Solar Europe Industry Initiative - SEII Team. Julie Marlier is Era-Nets Projects Officer at the DG OEER.

Context and trends

Belgium National renewable energy action plan fixed a national target of 13% renewable energy in 2020 according to the European Directive. Towards this goal, the intermediary objectives of 2011 and 2012 have already been beaten. Late 2012, projections hoped to reach between 4,8 and 7 GW of PV installed in 2020. In 2012, about 2,65 cumulated PV GWp were installed in Belgium. In 2013, the estimation of power capacity of PV installed nationally approach the 3 GWp.

This national target of 13% renewable energy in 2020 isn't translated yet into regional objectives. So there are no specific objectives available for PV at this level for the moment.

Even if PV is doing better than the early objectives in order to participate to reach the 13%, we can notice that the study "2020 keep on track" (<http://www.Keepontrack.eu>) gives worried conclusions for Belgium.

However a study (http://www.icedd.be/17/index.php?option=com_k2&view=item&id=1228&lang=en) made by ICEDD, VITO and the Federal Planning Bureau shows that Belgium could reach 100% of renewable energy sources by the year 2050. Following the different scenarios tested, PV reaches 50 GW and even 170 GW in the PV oriented scenario.

The development of the photovoltaic sector in Wallonia builds itself on an increasing strong research workforce (Mapping: <http://energie.wallonie.be/fr/le-comice-solaire-photovoltaique.html?IDC=7980>) involving more than 23 research entities within Universities, Research Centers and High schools, a broad industrial activity (Mapping: <http://www.pvmapping.be/>) delivered by SMEs, medium and worldwide companies and market deployment incentives. The support of the regional PV research and innovation programme can be expected to continue with a focus on innovative applied research activities, rapid technology transfer, industrial developments, new products for niche markets, support activities (e.g. training, education, Certification) as well as reinforcement of international involvement.

Set-up and strategy of the programme involved

Photovoltaic solar energy is expected to play an important role in the Walloon renewable energy target for 2020. A photovoltaic implementation plan named "Solwatt" was established. It included a broad support for PV installations, training of installers and R&D. These activities are now included in the "Qualiwatt"-plan giving support to PV installations in accordance with the budgetary constraints of public services. This plan contains measures for the training and Certification of installers and includes support criteria concerning the choice of facilities.

DGO4 has funded industrial, development and support activities research projects in the various sustainable energy fields like energy efficiency, rational use of energy, renewable energy (e.g. PV, CSP, solar thermal, wind turbines, bioenergy, geothermal energy) but also on smart grids, smart cities, carbone capture, fuel cells, storage and nuclear fusion. Energy research projects have benefitted of DGO4 financial support with roughly 3 MEUR per year. Moreover, DGO4 grants support activities and investments in the various sustainable energy fields for public and private entities as well as for households through a DGO4 global annual budget of approximately 100 MEUR.

Concerning DGO6, on the one hand, the funding of international research projects such as ERA-Nets is done through a global annual budget of 10 MEUR. On the other hand, the funding of regional research projects on various fields is done through a DGO6 global annual budget of approximately 150 MEUR.

To put it in a nutshell, within SPW (DGO4 and DGO6), energy research projects (international and regional) benefit of approximately 30 MEUR per year (approx. 3 MEUR DGO4 and 27 MEUR DGO6).

Objectives

The main objectives on Photovoltaics aim for:

- Cost reduction: cheap and/or third generation solar cells
- Concentrated photovoltaic systems
- Manufacturing processes of silicon solar cells (e.g. laser technologies)
- Increasing efficiency and optimisation of PV systems (all chain approach): improve the efficiency, production simulation/prediction, the reliability, recyclability, eco-conception, modularity, trackers, BIPV, BOS,...
- Developing economic activities (application oriented approach): transfer of the scientific results into practical solutions as well as industrial processes and products. The collaboration with the industry is an important issue.
- New economic and social acceptance/participation

Concerning Concentrated Solar Power – CSP technologies, there is no voluntary specific support to the sector in Wallonia due to obvious climatic conditions. However the public services support industrial research development projects with a view to export markets.

Priorities

The thematic priorities on Photovoltaics are:

- Material options for new solar cell technologies (i.e. organic solar cells, Grätzel solar cells)
- New multifunctional products for building integrated PV
- Concentrated solar PV (e.g. optical/lens design, tracker)
- Integration and penetration of PV in electrical grids
- Manufacturing processes for new solar cell technologies (e.g. laser technologies, thin film, CIGS)
- Solar simulator and control tests
- Development of high efficiency solar cells (e.g. heterojunction solar cells, photon management)

The thematic priorities on Concentrated Solar Power:

- Integrated simulation tools (i.e. modelling, simulation and analysis of concentrators, towers)
- Development of generic concepts (e.g. new concentrators optical/thermal design)
- Specific technologies (innovation in steam generators, high resistant temperature coating, better mirror reflectivity, alternative passivation layers, chemical-mechanical durability)

Table 3: Belgium – Wallonia – General Information on Solar Electricity RTD&I Programming

Programme	DGO4 research programme R&D Solwatt, ERable, Reliable, AIE PVPS	DGO6 research programme SOLAR-ERA.NET, SMARTGRID, QWALITY, Appels Plan Marshal Mecatech, Guichet Entreprises
Ownership	Walloon Directorate General Operational for Spatial planning, Housing, Heritage and Energy-DGO4	Directorate General Operational for Economy, Employment and Research-DGO6
Management	DGO4	DGO6
Focus	PV, Energy efficiency and Renewable energies, Smart Grids	Industrial research
Time Frame	Since 2000, on an annual basis	Mostly on an annual basis
Budget (average)	approx.3 MEUR/year funded by DGO4	approx. 160 MEUR/ year funded by DGO6
Finance resources	DGO4 energy research budget	DGO6 research budget
Number of solar electricity technology projects currently running with public support (out of total number of projects running)	approx. 4 (out of 20)	12 (+/- 1300)
Programme-specific RTD spend for Solar Electricity out of global spend 2013	0 MEUR (out of 6,5 MEUR)	0 MEUR (176 MEUR)
Total public running RTD spend for solar electricity technologies	1,78 MEUR	9,43 MEUR
Website	http://energie.wallonie.be/fr/les-programmes-mobilisateurs.html?IDC=7826	http://recherche-technologie.wallonie.be/

Cyprus

Update August 2014 – Authors: Christakis Theocharous, Ioanna Sergidou Loizou

Organisations involved in SOLAR-ERA.NET and solar electricity RTD&I programmes

The Research Promotion Foundation (RPF) is the organisation which is involved in SOLAR-ERA.NET. The Research Promotion Foundation is the sole organisation in Cyprus, responsible for ownership and management of national funding programmes for research and technological development. The RPF is an independent organisation governed by a twelve-member Board of Directors, appointed by the Council of Ministers, its main objective being the promotion of scientific and technological research in Cyprus.

Context and trends

In designing its Research Funding Programmes, the RPF takes into account parameters such as National and European Policies, international scientific trends, industrial needs and the research potential of Cypriot research institutions.

National policies on energy matters include the National Action Plan for Renewable Energy, prepared by The Ministry of Commerce, Industry and Tourism (in cooperation with other competent institutions like the Ministry of Agriculture, Natural Resources and Environment, the Ministry of Interior, the Electricity Authority of Cyprus and the Cyprus Energy Regulatory Authority-CERA). According to the Plan prepared in accordance with Directive 2009/28/EC and the local RES potential per technology, it is estimated that the final energy consumption for 2020 will reach 2 023 000 toe (ton of oil equivalent). The target that was set foresees a contribution of 13% from Renewable Energy Sources (RES) equal to 263 000 toe, including solar energy. By analysing the measures taken in each sector, it was estimated that for the achievement of the 2020 target, 23,5% of heating and cooling and 16% of electricity generation, which correspond to 124 000 toe and 101 000 toe respectively, must come from RES. The RES technologies that are quantified in the Action Plan for Renewable Energy for the purposes of energy generation are wind generators, photovoltaic and concentrated solar systems and biogas systems.

The RPF in its planning for preparation of the future framework of programmes (beginning in 2014), intends to administer thematic stakeholder forums to discuss national research policies. In the context of selecting the thematic areas of the Energy Action/Programme, the RPF will invite stakeholders from the industry, the academic sector and from relevant governmental departments.

Set-up and strategy of the programme involved

Solar electricity technologies are covered by the “Energy Action” of the “Technology” Programme which supports projects within all scientific disciplines of Energy. The Programme supports mainly applied research projects, having as their main target, the improvement of existing products, the development of new products or services and the implementation of innovative production methods in order to enhance the competitiveness of the Cypriot enterprises.

The Energy Action supports topics in the areas of Renewable Energy Sources and Optimised Production, Utilisation and Saving of Energy.

It should be emphasised that Energy related projects are also being funded by Horizontal National Funding Programmes such as the Research for Enterprises, the Support for Young Researchers and the Infrastructures Programmes.

Objectives

The objectives of the Energy Action include the promotion of collaboration among research organisations, enterprises, public-benefit organisations and competent authorities, in order to produce innovative products, services, processes and policies that will contribute to the development of energy saving systems, the improvement of energy performance through rational energy use and storage. Great emphasis is also placed on the decrease of energy demand by monitoring energy consumption without adverse effects on productivity and quality of life. Furthermore, the Action supports the strengthening of research initiatives that will enrich the national energy system, enabling Cyprus to comply with EU directives with respect to the use of renewable energy sources for partial coverage of national energy demands.

Priorities

The Technology Programme does not include an Action specifically for solar electricity technologies, nonetheless solar electricity technologies are incorporated in two main sets of thematic areas of the Energy Action, each comprised of indicative scientific subjects summarised as follows:

- Thematic Area «Renewable Energy Sources»: Wind energy – Photovoltaic systems, Solar energy systems, Utilisation of non-fossil renewable energy sources such as wave, hydro, geothermal, tidal and biomass, biofuels etc., New applications and renewable energy systems, Development of technologies for storage, transportation and exploitation of renewable energy sources and Integration of renewable energy sources in energy systems
- Thematic Area «Optimised Production, Utilisation and Saving of Energy»: New applications of mechanical energy, Development and optimisation of energy production systems, Exploration, mining and exploitation of energy sources, Optimisation of fuel technologies, New systems for rational and efficient energy management, New systems for monitoring and reduction of energy consumption and losses, Energy conservation systems for industry, transport and the primary sector of industry and Energy and environmental design of buildings, such as optimal heating and a/c systems, shell insulations etc.

Table 4: Cyprus – General Information on Solar Electricity RTD&I Programming

Programme	Technology Programme – Energy Action (including Photovoltaics/solar energy)
Ownership	Research Promotion Foundation
Management	Research Promotion Foundation
Focus	Renewable Energy Sources and Optimised Production, Utilisation and Saving of Energy
Time Frame	since 2008, executed annually until 2012 (projects running until 2015)
Budget (average)	350 – 600 kEUR/year
Finance resources	national government RTD funds, and EU Structural Funds
Number of solar electricity technology projects currently running with public support (out of total number of projects running)	approx. 5 (out of 12 projects running in the frame of the “Energy Action” – the numbers do not include the solar electricity projects which are run within the frame of other national programmes)
Programme-specific RTD spend for Solar Electricity out of global spend 2013	Approx. 150 kEUR out of 300 kEUR for new projects
Total public RTD spend 2013 for solar electricity technologies	Not recorded
Website	www.research.org.cy

Finland

Update August 2014 - Author: Karin Wikman

Organisation involved in SOLAR-ERA.NET and solar electricity RTD&I programmes

Tekes is participating in the SOLAR-ERA.NET both as programme owner and manager. Tekes funding for development of innovations that aim at growth and new business operations is around 580 MEUR annually. About half of the funding is for top-down programme type activities, the other half for bottom-up activities.

Tekes is not running a specific programme on solar energy. Top-down solar energy activities are run under the umbrella of several programs. Bottom-up, enterprise driven activities are complementing the programme driven efforts. Main Tekes' programs that are funding solar energy projects and providing programme services (mentoring, coaching, networking, studies, internationalization activities, seminars etc):

- Groove – Growth from renewable (international value chains)
- Green Growth (green business models)
- Witty City and Public Procurement (large scale deployment, systemic solutions)

Context and trends

In recent decades, Finland has been among the leading industrialised countries to use renewable energy, bioenergy in particular. For over 20 years Finland has aimed to produce as much electricity as possible through combined heat and power plants (CHP). Finland has a decentralised and versatile energy system, based on both large and small energy production plants and diverse energy sources. Securing energy supply, competitive energy prices and meeting the EU's common energy and climate goals are core elements.

The National Energy and Climate Strategy, approved by the Government in March 2013 determine the energy policy lines to be followed. Key objectives of the strategy update included ensuring that the targets for 2020 are achieved and to prepare a pathway towards meeting the long-term energy and climate objectives set by the EU. These include reducing raising the share of renewable energy to an average of one fifth of total consumption (38% for Finland). The strategy update doesn't mention any specific targets for solar energy, but promoting small-scale electricity generation is included. Work on the roadmap for a carbon-neutral society 2050 has also begun. Solar energy related issues are dealt with more in detail in this work.

Set-up and strategy of the programmes involved

Tekes' programmes and initiatives are topical entities targeted at financial and expert services. Within the programmes and initiatives, businesses and public research units can develop new know-how, build networks and have an impact on the development of their field. There are 16 programmes running and 3 under preparation. Current programmes relevant for Solar Energy support are:

- Groove – Growth from Renewables 2010–2014 (SMEs, services and business models, international value chains, BOS)
- Green Growth 2011-2015 (green and sustainable business models)
- Witty City 2013-2016 (City level demonstrations, building Integration, end customer and urban planning aspects) and Innovative Procurement 2012-2016

All programmes develop their own implementation plans, which detail the activities and calls to be launched.. Businesses can apply for funding throughout the year. The application periods for research partners are announced separately. Funding is granted for the development of internationally competitive products and services, the renewal of business processes and market analyses. In addition to R&D funding Tekes' services include mentoring, company funding for young innovative growth companies, seed capital, accelerator services and different kinds of activities supporting growth and internationalization. The programmes participate also in bilateral calls with other countries in or outside Europe.

The activities of Tekes are complemented by

- Energy investment support scheme run by the Ministry of Economy and Employment. Investment support for solar energy demonstrations can cover up to 30% of eligible costs
- Funding for basic/fundamental solar energy research by the Academy of Finland
- SHOKs (Strategic Centres for Science, Technology and Innovation - public private partnerships for long-term cooperation) and Energy technology cluster programme (mainly for SMEs and regional innovation hubs) gather energy industry and academia around important themes, including renewable energy

Objectives

No specific qualitative objectives or targets are set for solar energy alone in any of the programmes. Different programmes have different targets, mainly on cluster and macro economy level (eg turnover increase, trade balance, working places created, productivity etc). The individual projects to be funded are chosen by evaluating them as a whole:

- Intended business or other utilization
- Technology, innovation or know-how to be developed
- Cooperation to be developed or utilized
- Societal and environmental wellbeing factors to be promoted
- Resources to be used
- Impact of Tekes' funding and expert work

Priorities

No thematic priorities are given for solar energy projects. Projects may spend their efforts on, for instance, development of PV solutions and technologies, industrial processes and products, cost reduction / optimisation of PV systems, automation, building integration, energy system level solutions, demonstrations at city level, bio-solar solutions and all other aspects contributing to innovative forerunner solutions and development of a new home market.

Table 5: Finland – General Information on Solar Electricity RTD&I Programming

Programmes	Tekes: Groove, Witty City, Functional Materials, Innovative Procurement*
Ownership	TEKES
Management	TEKES
Focus	Including solar energy development (PV, solar thermal)
Time Frame	Mostly 4 years
Budget (average)	approx. 100 MEUR /programme of which around 50% is funded by Tekes
Finance resources	State budget, via Ministry of Economy and Employment
Number of solar electricity technology projects currently running with public support (out of total number of projects running)	14 research projects, 18 company projects (out of hundreds)
Programme-specific RTD spend for Solar Electricity out of global spend 2013	6,5 MEUR public funding (40 MEUR)
Total public RTD spend 2013 for solar electricity technologies	around 3 MEUR
Website	All running programmes: http://www.tekes.fi/en/community/Ongoing_programmes/554/Ongoing_programmes/1425 Funding principles for projects under programmeumbrella, or bottom-up projects: http://www.tekes.fi/en/community/Funding_principles/551/Funding_principles/1422

* Programmes listed provide Solar Energy funding. Industrial applicants may also apply for bottom-up funding outside programme frame.

France

Update September 2014 – Authors: Céline Coulaud, Yvonnick Durand

Organisations involved in SOLAR-ERA.NET and solar electricity RTD&I programmes

The Agency for Environment and Energy Management (ADEME) represents France in SOLAR-ERA.NET.

There are three national agencies funding Solar Electricity technology RTD projects: ADEME, the National Research Agency (ANR) and the industrial development agency Bpifrance (formerly OSEO):

- ADEME is a governmental organisation in charge of promoting the use of renewable energy sources including solar PV electricity and CSP. ADEME depends upon two different ministries: Ministry of Ecology, Sustainable Development and Energy (MEDDE) and Ministry of Higher Education and Research. ADEME manages a Solar Electricity-specific programme. The agency must report to its supervising ministries the results of its policy within the framework of a Government/ADEME multiannual contract.
- Under the programme initiated by the government in late 2009, known as "Investissements d'avenir" (IA), ADEME launched in 2011 two calls for expressions of interest, known as "AMI PV" and "AMI Solaire", in order to accelerate to the technology transfer to the industry. At the beginning of 2014, ADEME issued a new call for expressions of interest (AMI). The first AMI on 'Renewable Energies' is intended to back up the development of new projects. The photovoltaic part of this AMI covers innovative processes and equipment for manufacturing materials, cells and modules. It also refers to the experimentation and validation of original photovoltaic systems and building integration technologies.
- ANR, the National Agency for Research is a public organization created in February 2005. ANR is in charge of promoting research projects on all science disciplines.
- Bpifrance is a public organization created in 2013 which mission is to provide innovation support and funding to French SMEs and VSEs.

The three agencies fund solar electricity technologies R&D projects undertaken by industry and public research organizations (CNRS, CEA), as well as other research institutions (INES, the Institute for Solar Energy, Universities, Engineering schools, etc.).

Context and trends

At the Environment Conference held in September 2012, the new government (which took office in June 2012 following France's presidential and parliamentary elections) proposed a roadmap for transition to environmentally friendly energy production, as part of its preparations for a major public debate on energy transition. The government has set a target of reducing the proportion of electricity produced using nuclear power from 75% to 50% by 2025, focusing efforts on two aspects: energy efficiency and renewable energy. In 2013, during the preparatory phase of the new Energy Transition Act the Government acknowledged the contribution of renewable energy. The law will be passed in 2014 and will determine the new attitude of government support for renewable energy. ADEME was involved in producing France's long-term energy plans for 2030-2050. ADEME, meanwhile, has conducted an outlook study to assess the potential of the photovoltaic sector, with estimated capacity of 33 GW by 2030 under reasonable technical and economic conditions.

Concerning the CSP in France, the potential of development is quite low due to the DNI resource. Indeed, the price of the electricity and the direct solar resource are too low in France to achieve the break-even point.

The definition of the strategy of the development of solar electricity technology in France is based on the technological roadmaps produced by ADEME in 2010 for CSP and PV, which allows to identify the needs for demonstrators. In the field of PV, focus remain on cost optimisation and increase of performances related to materials, cells and modules, system design and BOS. In the field of CSP, the objective is to fund demonstrators in order to develop a French offer for international market.

Set-up and strategy of the programme involved

PV and CSP come under the research section of the Law similarly to hydrogen and carbon dioxide sequestration (these three topics are selected by the National Agency for Research).

The solar photovoltaic research programme of ANR focuses on PV materials, cells and modules. ADEME's PV programme is mainly targeting industrial RTD and PV system issues. ADEME is also focusing on measures essential (quality, reliability, performance, etc.) for market uptake.

ADEME's CSP programme is focusing on demonstrators as a proof of concept. French companies working on CSP made the choice to develop the Fresnel technology. Now, those companies are all ready for becoming active in a short period of time. But they need to acquire industrial references and to install industrials demonstrators so as to make credible the French offer.

ADEME has two roles in R&D support namely:

- It plays a coordinating and funding role for R&D through its demonstrator and technology platform programme, the objective of which is to carry out operations on a virtually life-size scale and demonstrate their technological effectiveness. The fund is managed by a committee on which the Ministry of Ecology and Sustainable Development, the Ministry of the Economy, and the Ministry of Education and Research all sit, through road maps which call for demonstrations of interest.
- Furthermore, the ADEME supports the emergence of start-ups, in particular in the field of thin films for PV and new motors for CSP.

The task-sharing between ADEME and ANR means that ANR deals with upstream research and development, on a pre-manufacturing level, while ADEME is entrusted with the role of supporting technological development in industry targeted at placing new commercial products on the market.

Objectives

The main photovoltaic programmes are those of ADEME and ANR.

Their main objectives are the development of:

- Advanced solutions for electricity generation in the building sector with a particular emphasis on fully integrated components;
- Competitive industries in the field of manufacturing of components and PV systems;
- Close cooperation between business community and researchers strengthening international research and the national industry position;
- As a consequence, job creations.

ADEME's PV programme also consists in implementing objectives fixed by the "Grenelle of Environment".

The PV RTD programmes of ADEME and ANR aim at:

- Increasing the cost effectiveness of PV components and systems (manufacturing cost reduction, operation and maintenance cost reduction, long term reliability of PV systems);
- Increasing the overall quality and performance of PV systems;

- Facilitating the integration of PV modules into the building envelope;
- Easing the homologation and standardisation of components and system

In the field of CSP, the fund of research demonstrators will fulfill these decisive criteria:

- Contribute to the emergence of critical technological components (in particular reflectors, receivers, heat storage components, heat/electricity conversion machinery, new coolants);
- Test technological components under real use conditions;
- Integrate a CSP component for producing heat and/or electricity (by hybridisation and/or co-generation) in turnkey power systems that are either prototypes or already available on the market;
- Lead to experiments on new business models for export.

Since 2005, the two agencies ANR and Bpifrance have complemented ADEME's work and have contributed to leveraging more money for the R&D on solar electricity.

In parallel, ANR launched a new research programme called "PROGELEC" (2011-2013) which aims to accelerate French research into the use of renewable energies on a massive scale and for the integration of innovative systems, allowing optimised electricity management. The 2013 call for proposals is structured around photovoltaic electricity production, thermoelectricity, hydrogen production and its use in fuel cells, electricity storage, management and hybridisation of components and centralised and decentralised electricity management.

Priorities

The PV RTD programmes, undertaken by ADEME, ANR and Bpifrance, are geared towards the development of materials and production processes leading to high yield/low cost processes, high conversion efficiency of cells/modules and low cost components and applications. Cooperation between industry and public research institutions is essential to promote innovation and make successful technology transfers.

The thematic priorities of the PV RTD programme are:

- Industrial and pre-industrial materials (wafer-based silicon and thin film Cu-In-Se and amorphous silicon) and high yield/low cost processes (feedstock silicon, multicrystalline silicon, thin film Cu-In-Se electrodeposited, tandem cells based on amorphous silicon thin films, low environment impact processes);
- Materials such as organic materials (polymers and molecules) and new PV cell structures;
- Building integration of PV modules;
- Reliability, quality assurance, standardisation of products, homologation, installation monitoring, etc.;
- Institutional cooperation (EC, IEA, IEC).

The ADEME PV programme also includes:

- Training: researcher training through PhD research grants and training of installers and field project managers;
- Communication and dissemination of information (general public information brochure, technical guides for professionals, seminar and workshop proceedings, etc.).

Concerning the CSP technology, the challenge is to work on all the new and critical fields:

- Thermal storage and coolants: implementing new materials,
- Solar field: mirrors and receivers
- Systems integration: find the best compromise to produce electricity at reduced costs,
- Solar thermal-electric conversion: develop new concept of thermodynamic motors

The ANR goals are to develop academic and application-oriented research and promote public-private partnership and technological transfer through the funding of research projects selected by a peer review process.

Bpifrance does not hold a PV programme identified as such but answers to industrial solicitations. Bpifrance has a long tradition of supporting EUREKA projects. Bpifrance works mainly with reimbursable subsidies.

Table 6: France - General Information on Solar Electricity RTD&I Programming

Programme	ADEME's Solar Electricity Programme	ANR's R&D Programme: PROGELEC R&D Programme (2011-2013)	Bpifrance PV R&D Activity
Ownership	Agency for Environment and Energy Management (ADEME)	National Agency for Research (ANR)	Industrial Development public organisation Bpifrance
Management	Renewable Energy Department of Agency for Environment and Energy Management (ADEME/SRER)	ANR	Bifrance
Focus	PV and CSP	Renewable production and electricity management	PV
Time Frame	New R&D two years programme since 2012. New calls in 2014 for demonstration and preindustrial projects.	New three years programme since 2011.	New organisation since 2013. Formerly OSEO
Budget (average)	Around 150 MEUR on PV RTD and 20 MEUR on CSP (including demonstration projects)	Around 4 MEUR per year	
Finance resources	Government budget, Ministry of Research, Ministry of Ecology, Sustainable Development and Energy	Government budget, Ministry of research	
Number of solar electricity technology projects currently running with public support (out of total number of projects running)	PV: 10 CSP: 5	PV: approx. 15	
Programme-specific RTD spend for Solar Electricity out of global spend 2013	PV+CSP: approx. 0,5 MEUR + Demonstration and preindustrial projects (programme investment for the future): approx. 170 MEUR	PV+CSP: approx. 4 MEUR	
Total public RTD spend 2013 for solar electricity technologies			
Website	www.ademe.fr	www.agence-nationale-recherche.fr	www.oseo.fr

Germany

Update September 2014 – Author: Martina Biedrawa

Organisations involved in SOLAR-ERA.NET and solar electricity RTD&I programmes

In Germany, the responsibility for the renewable energies has been with the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) until end of 2013. In order to streamline the German energy policies the new federal government decided to concentrate all energy related activities within the Federal Ministry for Economic Affairs and Energy (BMWi).

Research and Development (R&D) is currently conducted under the 6th Energy Research Programme of the Federal Government called “Research for an environmentally sound, reliable and affordable energy supply” which was published in September 2011. Under this framework the BMU and BMWi, respectively, as well as the Federal Ministry of Education and Research (BMBF) support R&D on different aspects of PV and CSP. Main parts of this programme are administrated by the Project Management Organisation PtJ in Jülich.

PtJ is an independent unit in the Research Centre Jülich and benefits from the excellent infrastructure as well as from close contact with topical research. Since 1974, the PtJ has been supporting the Federal Government.

PtJ is, on the one hand, an authorised funding agency for the government and some Federal States and, on the other hand, a partner for the scientific and industrial community and the public in general.

In addition to national tasks, PtJ is responsible for a number of international activities: For the Seventh Framework Programme of the European Union PtJ has been nominated by the German Ministries in agreement with the EU-Commission as the National Contact Point (NCP) for a number of thematic fields. Aiming at the coordination of Member States programmes and promoting the European Research Area (ERA), PtJ is participating in 17 EU projects, being the consortium leader in 6 ERA-Net projects.

Context and trends

The transformation of the energy system is a core task for Germany’s environmental and economic policy. The overall objective is an environmental friendly, reliable and economical feasible energy supply. The German Federal Government paved the way for this target when announcing the German Energy Concept in autumn 2010. Moreover, it was decided in 2011 to terminate the production of nuclear power until 2022.

The goals are to be reached firstly by efficient energy use and secondly by the use of renewable energies. The German Energy Concept states that this energy source will contribute the major share to the energy mix of the future. With respect to the electricity supply, the share for renewable energies has reached approx. 22% already in 2012. It is expected to reach 35% in 2020 and 80% in 2050. It can be expected that the medium term goal of 35 % renewables by 2020 will be exceeded.

Photovoltaic (PV) is a major part of this development driven by the Renewable Energy Sources Act (EEG) on the one hand and a noticeable decrease of system prices on the other hand. A capacity of 3,4 GW PV power has been newly installed in Germany in 2013. This results into a total installed PV capacity of 35,3 GW connected to the electricity grid. Subsequently, PV contributed 29,7 TWh (approx. 5%) to the annual gross electricity generation.

Set-up and strategy of the programme involved

The 6th Energy Research Programme is valid for the period from 2011 to 2014. The Programme covers research on renewable energies, energy efficiency and the institutional funding for research on energy technologies at the national research centres.

In December 2011, the BMU released a new open call for tender which is open until end of 2014, funding applied research projects that are expected to lead to an implementation of the results within a short time frame. Thus the focus is on collaboration of universities and research centres with industry.

Concerning PV, main goals are a further increase of the efficiency, especially closing the gap between records and (mass) production, and of the lifetime of all components. Apart from that, significant cost reductions should be achieved by using more efficient processes.

Relating to CSP, the call aims at applied research projects focussing on pre-commercial development and establishing the technology in the market. The call is administrated by PtJ.

In Summer 2010, BMU and BMBF initiated the Innovation Alliance PV in order to enhance the competitiveness of Germany's industry. Therefore projects under industrial leadership will be funded, which support a significant reduction of PV production costs. Together, BMU and BMBF will support this initiative with 100 MEUR while the German PV industry agreed to contribute additional 500 MEUR to accompany the Innovation Alliance. The approval procedure took place in 2011 and 2012. Currently 19 R&D projects are in progress.

As follow-up action, BMU and BMBF initiated another call for tender "RTD for Photovoltaics" in order to stabilize the competitiveness of Germany's industry in spring 2013. As in 2010, projects have to be lead by industry in order to receive funding. The topics focus on module technology, plant engineering and complex system technology. Together, BMU and BMBF will support this initiative with 50 MEUR. The approval procedure of 10 joint projects started in 2014.

In August 2011, the BMBF published a call on "Organic Electronics", containing especially organic LED and organic PV, which is funded in the frame of 2 different programmes. The call aims for an acceleration of the development of the organic PV technologies by using a combination of basic research, development of process technologies and devices. The call is jointly administrated by PtJ (OPV) and the VDI Technologiezentrum GmbH (OLED).

In April 2013, the BMBF published a call on "Materialforschung für die Energiewende" (Material research for the "energy turnaround"). This call addresses very different technologies. Within the PV sector, main topics are improved materials for thin film solar cells and silicon wafer cells are. The call is administrated by PtJ.

Priorities

The thematic priorities of the open call for tender (December 2011) in the field of PV are:

- Silicon wafer technology, especially the production of solar material, cells and modules exploiting the efficiency potential and the development of new cell processes and module concepts for future industrial productions.
- Thin film technologies based on CIS/CIGS, especially the establishment and optimization of processes and investigation of long term stable structures.
- Transfer of concepts and processes into an industrial environment System technology, especially for decentralised grids and standardisation of island systems for global applications.

- Concentrated Solar PV and other alternative concepts which are both suitable for power application and feasible for industrial production.
- Cross-cutting issues like building integration, avoidance of materials which are harmful to the environment, reduction of energy usage in the production, recycling and accompanying environmental research.

Concerning CSP the following focal points are addressed:

- Parabolic Trough Plants, especially concepts for O&M and monitoring as well as alternative heat transfer fluids (HTF).
- Fresnel Plants with improved processes (super heating)
- Solar Tower concepts with open and pressurized volumetric air receivers and the development of heliostats and their controlling.
- Integrated Storage Systems which are cost-efficient and adapted to the power plant
- Cross-cutting issues like measurement and qualification methods, formulation of standards

Table 7: Germany – General Information on Solar Electricity RTD&I Programming

Programme	6 th Federal Programme on Energy Research - “Research for an environmentally sound, reliable and affordable energy supply” Sub-programme on renewable energies	
Ownership	Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU)	Federal Ministry of Education and Research (BMBF)
Management	Project Management Organisation PtJ	PtJ, VDI Technologiezentrum GmbH
Focus	Renewable energies, energy efficiency and energy related institutional funding Sub-programme on renewable energies: photovoltaic, wind energy, low temperature solar thermal applications, concentrating solar power, geothermal energy, biomass	Renewable energies, energy efficiency and energy related institutional funding Sub-programme “Basic Energy Research 2020+”: Development of organic solar cells
Time Frame	2011 – 2014	
Budget (average)	Around 60 MEUR	
Finance resources	Government budget PV and CSP, 6th Federal Programme on Energy Research - “Research for an environmentally sound, reliable and affordable energy supply”	
Number of solar electricity technology projects currently running with public support (out of total number of projects running)	approx. 310 (out of 900)	approx. 140 (out of >300)
Programme-specific RTD spend for Solar Electricity out of global spend 2013	53,8 MEUR (out of > 160 MEUR)	23,6 MEUR
Total public RTD spend 2013 for solar electricity technologies	n.a.	n.a.
Website	http://www.erneuerbare-energien.de http://www.fz-juelich.de/ptj/	

Germany - North Rhine Westphalia

Update September 2014 – Author: Dr. Melanie Schulte

Organisations involved in SOLAR-ERA.NET and solar electricity RTD&I programmes

As a regional representation of North Rhine Westphalia in Germany, two organisations are formally involved in SOLAR-ERA.NET: The “Ministry of Innovation, Science, and Research” (MIWF) of NRW is responsible and owner of the relevant MIWF research programmes, networking and technology transfer in the field Solar Energy, but not beneficiary of SOLAR-ERA.NET. “Projektträger Energie, Technologie und Nachhaltigkeit” (ETN) manages the MIWF research programme in the field Solar Energy. In the SOLAR-ERA.NET, the work of ETN will be supported by Cluster EnergieForschung.NRW (CEF). CEF is not a beneficiary of SOLAR-ERA.NET but consulted for relevant matters.

Context and trends

North Rhine-Westphalia (NRW) is Germany's leading energy location and the most important energy region in Europe. Around 30% of Germany's electricity is produced here – more than in any other federal state, and 90% of German coal and 53% of German lignite is produced here. Nearly 35% of the total energy needed in Germany is consumed in NRW.

As a consequence of the energy and climate protection strategy from 2008, the NRW parliament has released on 23th of January 2013 a law for climate protection. This law focuses the reduction of CO₂ emission, resource and energy efficiency, energy saving and the enhancement of renewable energies.

Set-up and strategy of the programme involved

The strategy of NRW funding activities to realize its goals is based on competition. Funding shall be provided mainly by the performance of regular calls. The best proposals are selected by independent experts and in the following invited to hand in full proposals for funding. 16 different clusters have been setup in NRW, within these clusters calls for proposals are released at least once a year. Two cluster concerning PV exist: Cluster EnergieWirtschaft.NRW and Cluster EnergieForschung.NRW. Both clusters are of more general character but comprise PV as important parts.

Within the Cluster EnergieWirtschaft.NRW, the programme for efficient use of energy, of renewable energy sources and energy efficiency (progres.NRW) addresses enterprises for technical development and demonstration of new energy technologies. Progres.NRW also includes a non-innovative market implementation part.

The programme owner provides for exchange in terms of cooperation and coordination of objectives and activities and use synergies in having a common programme manager (ETN) and a common communication agency.

Objectives

The main general objectives of the progres.NRW programme are:

- The reduction of barriers against, and the enhancement of, efficient energy use and the use of RE
- Proving the technical and economic viability of technical research results and transferring them into applications

- The reduction of investment risks in the context of development and use of innovative energy technologies
- Facilitating the integration of innovative energy solutions into energy supply
- Achieving considerable effects on employment and contributing to a sustainable change of the regional industry structure
- Contributing to primary energy savings and to the reduction of CO2 emissions

Priorities

The progres.NRW programme scope ranges from technical development to demonstration projects. Current priority topics are:

- Fuel cells and hydrogen technology
- Electromobility
- Use of renewable energy sources (biomass, solar, geothermal, water, wind)
- Clean coal technologies
- Products and processes promoting the efficient use of energy and resources
- Concepts and studies promoting the use and implementation of efficient energy use and RE

PV-related priorities: Due to the adaptation of funding activities to the existing regional PV RTD and industry structure, the PV activities are mainly focussed on crystalline silicon cell and module technology. Another important area until recently has been the demonstration of building-integrated PV.

The Cluster EnergieForschung.NRW comprehends the research in the whole range of energy technologies. The cluster is split into three sectors:

- Centralized energy production (power station technology on the basis of fossil fuel, nuclear energy and solar thermal energy)
- Decentralized energy production (fuel cell and hydrogen, photovoltaic, storage of electricity and heat)
- Biological production of energy carrier (bio refinery as keyword).

As cross-sectional issues energy grids and energy economics integrate these three sectors.

Table 8: North-Rhine-Westphalia - General Information on PV RTD&I Programming

Programme	Efficient use of energy, of renewable energy sources and energy efficiency (progres.NRW)
Ownership	Ministry of Economic Affairs and Energy (MWME)
Management	Project management organisation Energy – Technology – Sustainability (Projekttraeger ETN)
Focus	Energy efficiency, renewable energies and electromobility
Time Frame	Since 2007
Budget	n.a.
Finance resources	n.a.
Public PV RTD spend	n.a.
Website	www.progres.NRW.de

Greece

Update September 2014 – Author: Stathis Tselepis

Organisations involved in SOLAR-ERA.NET and solar electricity RTD&I programmes

Two organisations are formally involved in SOLAR-ERA.NET: The Centre for renewable Energy Sources and Saving (CRES) who is the programme manager and the General Secretariat of Research and Technology (GSRT) from the Ministry of Education Life Long Learning and Religious Affairs is an associate and is providing the funding for SOLAR-ERA.NET calls.

When a joint call will be discussed CRES will contact GSRT to receive the commitment from their side and later GSRT may participate in the evaluation of the proposals and finally GSRT will be responsible for the national funding procedure. CRES will also have the right to participate in the calls.

Context and trends

In view of the Law 3851/2010 an ambitious goal was taken up by the government of at least 40% of the electricity consumed by 2020 to be provided by RES. The main renewables to contribute to this goal are Wind and Solar energy. The NATIONAL RENEWABLE ENERGY ACTION PLAN of Greece was issued in 2010, in the scope of the DIRECTIVE 2009/28/EC. In this report the targeted installed capacity for Photovoltaics and Concentrated Solar Power were 2200 MWp and 250 MW respectively, to meet the binding target of 2020. Already this year and month the installed PV capacity has surpassed the goal for 2020 and measures are taken by the government to “cool” the PV market by reducing significantly the feed-in tariffs and applying a special tax to the existing PV systems on the revenues, until July 2015, under the pressure of the burgeoning RES Fund deficit. Regarding the CSP installations, at the moment there are no systems connected to the grid but it is expected that some Production licenses may go ahead. Furthermore, two CSP systems, of total capacity of 125 MW, were approved recently for financing through the NER300 programme.

The research and development work for the Photovoltaic and CSP sector in Greece is going in the universities and research institutes funded through European and national programmes. An industrial base was developed 7 years ago with national investment subsidies through the acquisition of ready to operate PV wafer, cell and module production lines and also at the same time the balance of system market for PV systems was developed through the development with existing knowhow or by acquisition for aluminium and galvanized steel support structures, sun tracking systems, cables, readymade electrical boards for PV systems, transformers, performance monitoring and security systems for PV parks, etc. The industrial PV wafer, cell and module activities have come to a standstill in the last two years as the Chinese PV module prices have dropped significantly, to the point that the PV industry in Greece cannot compete and have suspended its operation. At the end of April 2013, the PV installed capacity in Greece reached 2270 MWp, already surpassing the 2020 goal for PV system capacity. The measures taken by the government through significantly reduced feed-in tariffs and special taxation for PV plants are expected to significantly shrink the PV installations from 2014 and on. Therefore, new high value and cost effective PV products and systems have to be developed in order to keep the PV sector going.

Set-up and strategy of the programme involved

The strategy is to manage national and structural funds to promote R&D activities by supporting the stakeholders in the country through information dissemination, the launch of calls for proposals and evaluation. In GSRT there is a Direction responsible for International Scientific and Technological Cooperation under which

there are three departments, for European, bilateral and international collaborations. At this time, there is no specific national programme supporting PV and CSP, but rather broader programmes in R&D encompassing all energy systems and RES.

Objectives

The main objectives of the GSRT is to support R&D in the fields of Photovoltaics and Concentrated Solar Power are broad and general and accept to fund projects that are dealing from basic research of materials to the development of components and systems and demonstration.

In February 2013 in the framework of a national call on "Creating Innovative Clusters - A Greek product one Market: The Planet - Pilot Phase Operation", of the supported clusters titled: "Chorus Cluster for Green Energy", coordinated by the Centre for Research and Technology Hellas, will deal to a certain extent with Photovoltaics. The objective of the Action is to develop in Greece innovative business clusters in thematic areas or sectors of the economy that have competitive advantage for the country in order to stimulate innovative activity through the development of innovative products and services and achieve economies of scale and scope by specialization of production and development of close cooperation between members of the cluster. Specifically, the aim of the innovation cluster is the development and use of innovative products and services with high added value, good reputation and competitiveness.

Priorities

The priorities of GSRT programmes for Photovoltaics and CSP are aiming at reaching the objectives of the Solar Europe Industrial Initiative and accelerate the development and deployment of the concerned solar electricity technologies.

Table 9: Greece – General Information on Solar Electricity RTD&I Programming

Programme	GSRT research and innovation programme
Ownership	General Secretariat of Research & Technology (GSRT)
Management	General Secretariat of Research & Technology (GSRT)
Focus	Energy, RES
Time Frame	
Budget (average)	For Solar Electricity, approx. 1 MEUR per year
Finance resources	National government RTD funds and European Union
Number of solar electricity technology projects currently running with public support (out of total number of projects running)	approx. 5 (out of 100)
Programme-specific RTD spend for Solar Electricity out of global spend 2013	<1 MEUR
Total public RTD spend 2013 for solar electricity technologies	<1 MEUR
Website	www.gsrt.gr

Italy - Puglia

Update September 2014 – Author: Carlo Gadaleta Caldarola

Organisations involved in SOLAR-ERA.NET and solar electricity RTD&I programmes

The Puglia Region's Research and Competitiveness Service is part of the Puglia Region's Department "Policies for Economic Development, Jobs and Innovation" that governs the regional policies concerning energy and the solar sector. It is directly involved in programming and implementing the regional innovation policies. The Research and Competitiveness Service is located in Puglia's main town, Bari. This Service is directed by Adriana Agrimi and has an internal staff of 5 qualified employees. The Service is supported by the Regional Agency for Technology and Innovation (ARTI), whose primary mission is promoting and consolidating the regional innovation system. ARTI is also involved in different international projects regarding solar energy.

The Puglia Operational Programme for the European Regional Development Fund (ERDF) 2007-2013 has programmed 1,762 MEUR for the Research & Innovation supporting policies. The regional co-financing is guaranteed by the Regional Law for State Aid "RL 10/2004."

Context and trends

Italy started offering concrete support to Renewable Energy Sources (RES) deployment in 1999, by granting priority grid access to electricity produced by renewable means and introducing a quota system. In response to an EU directive, Italy enacted a feed-in tariff (FIT) system specifically designed to support photovoltaic (PV) installations in 2005.

Since 2005, Puglia began specializing in the production of wind and solar energies and now outperforms the other Italian regions in terms of installed PV capacity, accounting about one quarter of the entire Italian data. In fact, the combination of relatively high FITs for PV energy set by the national government, with a simplified regional authorisation process in Puglia (Regional Law nr. 31 of 21 October 2008), combined with the plummeting cost of PV panels and a solar radiation above the national average, created the conditions for a very large deployment of PV installations.

More recently Italian FIT incentives have been reduced to control costs and better integrate RE deployment in the national energy and economic framework (OECD, 2012). On one hand, a new FIT system to support small solar thermal installations has been set up in the latter part of 2012 (www.gse.it). On the other hand, there are several problems and challenges which face the Region concerning the development of the PV sector.

First of all, local PV installations mostly relied on imported technologies. Consequently, the economic impact was diffused far beyond the borders of the region and deployment was disconnected from a local supply chain. This problem is shared by the rest of Italy, in which 25% of all PV modules come from Germany, 21% from Japan, 19% from China and only 15% from local production. The local production of inverters is in a bit better condition and covers 31% of the local market, while Germany has produced 41% of the inverters used in Italian PV installations (SMR, 2012). Some positive economic impacts of PV can nevertheless be identified at the Puglia local level, including an increase in investment in the region; in tax revenues for small communities, employment opportunities for small and medium local installers and SME developing inverters and components for PV systems.

A second key issue is the use of land and landscape and the connected social acceptance of large-scale PV plants. By the end of 2011, 3 375 hectares were devoted to PV installations (GSE, 2011). Both PV fields and large wind farms have “redesigned” part of Puglia’s rural landscape, while potentially undermining sectors such as tourism (OECD, 2012). This situation has changed since Puglia adopted new guidelines connected to the RES plants (Regional Regulation nr. 24 of 30/12/2010) and the national incentive system has been reformed.

The last major issue is with electric grid management. Both of the regional transmission and distribution networks were poorly prepared to absorb the high number of RES projects and there are congestion problems, especially in the north of the Region.

Through a questionnaire sent to about 500 Puglia actors operating in the energy sector in 2008, ARTI could show that the regional research activities on the solar topic were carried out by 3 Public Universities (the University of Bari, the Polytechnic of Bari and the University of Salento), the local offices of two public research centres, namely ENEA (Italian National Agency for New Technologies, Energy and Sustainable Economic Development) and CNR (National Research Council) and 25 private companies (ARTI 2008).

Below, are some of the main projects on solar energy that the main key public research centers are carrying out:

- ENEA - National Agency for New Technologies, Energy and Sustainable Economic Development (www.enea.it): High efficiency photovoltaic cells based upon both the nano-structured and nano-hybrid composite semiconductor materials; optical and thermal designing of both solar concentrators and receivers.
- CNR - National Research Council (www.irsa.cnr.it): High efficiency photovoltaic cells based upon both the nano-structured and nano-hybrid composite semiconductor materials; arrays of nano-antennas for the direct conversion of light into current; photovoltaic panels CIGS (copper indium gallium selenide), elements integrated in architecture, solar thermodynamic.
- Polytechnic of Bari (<http://www.poliba.it/>): Solar heat for indoor climate (solar heating & cooling).
- University of Bari (www.uniba.it): Integration of photovoltaics in the structures of greenhouses for vegetable crops, flora and nursery.
- University of Salento (www.unisalento.it): High-temperature solar thermal systems based on the use of nanofluids, concentrating solar systems based on the use of rectenna, solar power (ARTI 2012).

There also are two districts in Puglia that group companies, universities, associations and research centres operating in the field of renewable energy and solar energy: The National Energy Technology District “DITNE” and the Puglia’s productive District “The New Energy.” The DITNE was founded in August 2008, is located in the Puglia region but has nationwide coverage. Its main activities consist of strengthening research infrastructure and supporting technology transfer.

The Productive District “The New Energy,” was established in December 2008 and includes 263 actors operating in the regional energy sector. The main objectives of the productive district are increasing regional actors’ international openness and enhancing the innovation level of manufacturing firms belonging to the District, in order to broaden the range of products and services.

Set-up and strategy of the programme involved

The Puglia's regional government shares responsibility for energy with the central government. The regional government is responsible for implementing the EU Cohesion Policy which affects RES deployment at the regional level for the RES plants authorizing procedures, for the management of the Regional ERDF and for local energy planning.

There is no specific programme aimed at financing solar energy technologies but some initiatives are targeted at financing solar installations.

Concerning the Cohesion Policy related to the energy sector, the Interregional Operating Programme for Energy, aims to support the RES and generate manufacturing supply chains linked to RES production with 1500 MEUR.

The Puglia Region set up the guidelines for public buildings renovation with the Regional Deliberation nr. 2155 of 23/9/2011; committing about 160 MEUR relating to the action 2.4.1 of the ERDF OP. These resources are devoted in part to the financing of solar appliances.

The Puglia regional government programmed 1762 MEUR for the Research & Innovation supporting policies during the 2007-2013 period. The Puglia Region's initiatives and programmes noted below are not directed to solar R&S. Moreover, there are no available estimates on the value of the investments supported by regional policies, specifically directed to this sector.

The main Puglia Regional programmes and calls aimed at supporting innovation and R&S are:

- "Programme Contracts": These concern investments sponsored by large companies in association with SMEs with eligible costs between 10 and 100 MEUR (eligible investments are expenses in tangible assets and/or research and development). At the end of June 2012, 30 of the total submitted projects were eligible for a public granting of 246 MEUR (of which 49,5 MEUR in R&D). (for more information: www.sistema.puglia.it/portal/page/portal/SistemaPuglia/ContrattiProgramma?home=1)
- "Aid to Small Innovative Enterprises Already Operating and Newly Established": This call for innovative companies was published in 2010 with a budget of 15 MEUR (of which 5 MEUR was destined for new enterprises and 10 MEUR for operating enterprises). The call was republished in September 2011, with an additional budget of 15 MEUR. (www.sistema.puglia.it/portal/page/portal/SistemaPuglia/BandoNuoveImpreseInnovative)
- "Integrated Facilitation Programs for Medium-Sized Enterprises": This covers investment programs promoted by medium-sized enterprises with costs comprised between 1 and 20 MEUR. Investments may refer not only to 'material assets' expenditures, but also to research (industrial research or experimental development), consulting services, the development of e-business and investments related to energy-saving. See: (www.sistema.puglia.it/portal/page/portal/SistemaPuglia/AiutilImprese?home=2)
- "Start up of Micro-enterprises Promoted by Disadvantages": This instrument, comprised in the Action 6.1.5 of the ERDF OP 2007–2013, supports the creation of new micro-enterprises promoted by some categories of disadvantaged persons. The financing provided amounted to 25,58 MEUR in June 2012.
- "Aid for Starting Investments of Micro and Small Enterprises": Action 6.1.4 of ERDF OP 2007–2013 provides aid for investment for micro and small enterprises. It is intended to facilitate access to finance and the development of economic activities of micro and small businesses. 2102 instances were presented from April 2009 to July 2012, of which 1396 were financed with 46,3 MEUR.
- "Aid for Investment in Research in SMEs": Allocates 48 MEUR aimed at supporting investments in Puglia's small and medium-sized enterprises for research and technological development. The call was

carried out in the first quarter of 2009 and funded 148 projects.

See: (www.sistema.puglia.it/portal/page/portal/SistemaPuglia/AiutiRicerca)

- Other calls dedicated to support R&S and innovation are: “Integrated Facilitation Programmes for small enterprises” ([/www.sistema.puglia.it/portal/page/portal/SistemaPuglia/PIAPiccoleImprese](http://www.sistema.puglia.it/portal/page/portal/SistemaPuglia/PIAPiccoleImprese)), “Aid for Consultancy Services for Technological Innovation of SMEs.”

See: (www.sistema.puglia.it/portal/page/portal/SistemaPuglia/aiutiservizi), “Aid for small innovative operating companies” (www.sistema.puglia.it/portal/page/portal/PianoLavoro/InnovativeOperative_2011)

Sources:

Sistema Puglia (2013), www.sistema.puglia.it

SVIMEZ (2012), Rapporto SVIMEZ 2012 sull'economia del mezzogiorno, il Mulino

Objectives

In 2007 the regional government enacted the Regional Environmental Energy Plan (PEAR) that set the general objectives for RES deployment. In particular, the PEAR define a target of 400 MW of PV to be installed by 2016, but this objectives has been overwhelmed by the PV installations booming of the last years: at the end of 2011 the Regional PV installed capacity was about 2184 MW. The Regional PEAR is currently under revision. The Regional policy concerning innovation has not specific objectives in terms of research and development in the solar sector.

Priorities

On the basis of the results of a working groups with some of the above mentioned key regional actors (ARTI, 2012), the main innovative Puglia projects and competences in PV systems regards: photovoltaic systems for greenhouses and agricultural sector, photovoltaic with hybrid organic / inorganic materials, development of organic semiconductors, third-generation photovoltaic with nano-structured materials, second generation photovoltaic with thin film (thus saving material), photovoltaic concentration systems.

With regard to solar thermal, the main themes are solar thermodynamic plants using nano-fluids / or salts and low and medium temperature applications both in residential and industrial sector, such as solar cooling. These priorities, as specified before, doesn't represent the regional policies nor can be considered representative of all the regional entities.

Recent updates – PEAR 2014-2020

In 2012 the total power of PV plants in Apulia was about 2.5 GW, of which more than 1.8 GW were large-scale plants installed in the countryside. For this reason, the mitigation of the impact on landscape of these large RES plants became a priority for the Regional Government. Moreover, the total Apulia's energy production overpass its energy demand of about 50%, generating overloading problems in the distribution and in the transmission grids in some areas. Finally, the decrease of the prices in PV plants construction beside the diffusion of such technology led the Italian government to the change of the FIT system of the Conto Energia.

In the light of these recent changes, the new Regional Environment and Energy Plan (PEAR) of 2014 (currently in a draft stage) encourages only small and integrated PV installations. Moreover, innovative technologies such as storage system are seen as a possible solution to the problem of the grid overload.

Table 10: Puglia – General Information on Solar Electricity RTD&I Programming

Programme	research programme
Ownership	Puglia Region
Management	Region Puglia Department “Policies for economic development, jobs and innovation
Focus	Research and Innovation
Time Frame	2007-13
Budget (average)	1762 MEUR
Finance resources	European Union, Italy, Puglia Region
Number of solar electricity technology projects currently running with public support (out of total number of projects running)	n.a.
Programme-specific RTD spend for Solar Electricity out of global spend 2013	n.a.
Total public RTD spend 2013 for solar electricity technologies	n.a.
Website	www.sistema.puglia.it

Italy - Sicily

Update December 2013 – Author: Fabio Maria Montagnino

Organisations involved in SOLAR-ERA.NET and solar electricity RTD&I programmes

The Regional Council for Productive Activities of the Sicilian Region is in charge for participating in ERA NET programme, notably through the Unit 2 which carries out institutional tasks for applied research and innovation in productive processes, participate s in Joint Technical Committees with the national governmental offices and other regions, promotes and manages productive districts and technology clusters. The Council supports the industrial system focusing on research and innovation, highlighting the regional priorities, with the aim to foster growth and competitiveness of small businesses that is the target of tailored incentives for research, innovation and networking. Energy, as an industrial branch, is strategic for the regional economy.

The Regional Council for Productive Activities manages several ERDF funding schemes supporting projects on boosting innovative systems and tools for energy production from renewables. These funds are leveraging PV and CSP/ST innovation, financing partnerships between RTD performers and private companies operating in Sicily. Main funding measures are:

- M 4.1.1.1 (with a financial capacity of approx. 113 MEUR) funds actions to support industrial research and experimental development activities in connection with supply chains, technology and manufacturing districts in areas of potential excellence that experience a high degree of integration between universities, research centers, SMEs and large enterprises.
- M 4.1.1.2 (approx. 31 MEUR) provides support for experimental applications and process innovation and organization in different policy areas.
- M 5.1.1 (approx. 142 MEUR) supports among others measures of eco-innovation in production processes (energy and water savings, reduced air emissions, reduction of waste generation), within industrial clusters.
- M 4.1.2a (approx. 76 MEUR) aims at qualifying the research offer in the areas of strategic regional relevance, encouraging the networking of universities and research institutions and promoting public/private management of the network and better finalization of research activities to enhance the transfer of innovation to the productive sector.

The overall allocation of funds for projects in the theme addressed by SOLAR-ERA.NET (PV and CSP) amounts so far to over 20 MEUR.

The main project on solar energy that key public research centers are carrying out are:

- ENEA - National Agency for New Technologies, Energy and Sustainable Economic Development (www.enea.it) running CSP projects involving molten salts as HTF.
- CNR - National Research Council: research on solar cooling systems, inverters, actuators for tracking, energy storage
- University of Palermo: solar cooling systems, HCPV technologies, solar chemistry, hybrid biomass/solar plants, BIPV.
- University of Catania: innovative PV materials, thermodynamic cycles.
- University of Messina: solar chemistry, energy storage.

In Sicily, three districts are grouping companies and research centres operating in the field solar energy: the Machatronic District, the Etna Valley District, both grouping industrial SMEs and the Advanced Manufacturing District, that's going to start a large (>10M) project on small scale solar plants.

Context and trends

The Italian legislation in the past few years has produced several acts and decrees, both at national and regional level, to govern the adoption of renewable energy sources. The recent (2012) introduction of “Quinto Conto Energia” has deeply changed the rules of the game in the Italian photovoltaic system. On the one hand, it has greatly reduced the incentives and, on the other hand, has clearly indicated the end of the incentive mechanism for the near future. Therefore the operators have to be ready to face the new challenge of grid parity. The cost effectiveness of investments cannot be guaranteed directly by public incentives any more, but should be based on the ability of photovoltaic technology to be cost effective itself, rather taking advantage of alternative mechanisms such as tax concessions for investment or on-site exchange.

The incentive system envisaged in the last “Conto Energia” pays back also the solar thermodynamic system (CS), which in recent years is achieving such a good maturity as to represent a potential competitor for the traditional photovoltaic.

A constraint to the diffusion of this breakthrough technology in Italy depends on the issue of restrictions to legal persons and public administrations as the only beneficiaries of these incentives.

In addition to rules and incentive policies for the photovoltaic systems, the Italian legislative framework on the incentives to other RES has been updated with the Decree 6 July 2012 (implementing Law Decree n.28, 3 March 2011), with the provision of incentives to the generation of electric energy from renewable sources other than photovoltaic systems.

The incentives for solar thermal power plants vary according to:

- the integration, that is the electric energy percentage produced yearly by a different source than sun;
- the absorbing surface, or the sum of the areas of solar collectors of the solar thermal plant, also hybrid.

In case of hybrid plants, powered both by solar sources and others, only the percentage of electric energy coming from the solar source is covered by the incentives envisaged in the Conto Energia tariffs.

The incentives will be assigned over a maximum period of 25 years. They are in addition to the revenues from the sale of produced electricity and fed into the national grid. These incentives are the highest in the world for CSP.

In case of hybrid CSP power plant, REN-REN is guaranteed the maximum FIT independently from the solar fraction.

In order to benefit from the incentive, the following two conditions have to be observed:

- it is mandatory to use a non-polluting heat transfer system (unless the system is implemented in industrial areas)
- installations must show the minimum accumulation capacity established by the Decree.

Incentives are available up to a maximum of 2,5 million m² of mirror surface.

The FIT will be reduced of 5% for the power plants connected to the grid on 2016 and 10% on 2017.

Incentives for solar cooling in Italy are also envisaged. Solar cooling allows to produce cooling from solar energy, exploiting the combination between the high solar radiation in the summer and the need for cooling within the buildings; this system has a huge impact on the reduction of energy consumption, thus improving the environmental sustainability of buildings.

On 28 December 2012 the so-called “Conto Energia Termico”, providing incentives to the production of thermal energy from renewable sources and to small scale energy efficiency actions, has been issued. “Conto Termico” provides financial support to energy efficiency improvement of existing buildings and to small scale plant installations for the production of thermal energy from renewable sources. The first area of action concerns initiatives promoted by public boards, whereas the second area is extended also to private beneficiaries.

As a rule, it is not allowed to combine financial incentives with tax deductions.

There are also incentive policies on the cogeneration plants and on the valorization of reduced CO₂ emissions, but so far there is no devoted incentive tool to multigenerative systems from renewable sources that might only be reconducted to the different incentivisation schemes. It is self-evident that such a complex legislative framework on one hand allows users to choose among different incentive schemes, on the other hand has a negative impact on the whole system integrated growth.

Objectives

Due to the average duration of the authorization process, Sicily has been characterized by a delay in the uptake of renewables, but further to the adoption of the national guidelines that introduce different types of simplified procedures for small plants, the region is now able to catch this opportunity of development.

Through the complementarity between regional planning for solar energy, incentives for R&D and EC programs, in line with the strategic plan for technologies in the energy sector (SET plan), Sicily could host in the near future experimental fields and research facilities for advanced PV, CPV and CSP.

Priorities

The main priority of the regional planning for energy in the years from 2014 to 2020 is addressed to the reduction of energy consumption through increased energy efficiency of built heritage, both public and private, and of production system:

- a) realising small scale production plants mainly tailored to individual energy consumption in rural areas
- b) integrating energy generation components in the urban environment in the framework of energy efficiency projects
- c) promoting the scientific research on energy storage from renewables and the realization of small scale pilot plants.

As a priority for the R&D sector the further development of low cost and efficient CSP systems has been identified. The application of MF and DSG approach, development of innovative storage systems, and research on mini-CSP systems have been envisaged, as CSP seems to have actual opportunities for further development in the medium term also in the Italian market. Hybridization of CS plans with other sources, i.e. biomass, could help the diffusion of such technology in the rural areas.

Improved solar cooling units, CHP and polygenerative systems are under investigation and the support for these activities will be further improved.

New materials for PV, new PV concepts, CPV and BIPV, storage of electricity to improve PV-grid connection, power electronics are of interest for the Sicilian manufacturing companies and RTD activities in these fields will be strongly considered.

Table 11: Sicily– General Information on Solar Electricity RTD&I Programming

Programme	ERDF 2007-2013
Ownership	Sicilian Region
Management	Regional Planning Department
Focus	Research and Innovation
Time Frame	2007-13
Budget (average)	6500 MEUR
Finance resources	European Union, Italy, Sicilian Region
Number of solar electricity technology projects currently running with public support (out of total number of projects running)	n.a.
Programme-specific RTD spend for Solar Electricity out of global spend 2013	n.a.
Total public RTD spend 2013 for solar electricity technologies	n.a.
Website	www.euroinfosicilia.it

The Netherlands

Update October 2014 – Authors: Otto Bernsen

Organisations involved in SOLAR-ERA.NET and solar electricity RTD&I programmes

Two organisations are formally involved in SOLAR-ERA.NET: The Dutch Ministry of Economic Affairs (MINEZ) is the government authority responsible for innovation, economy and all energy related matters (policy, legislation, research, action programmes, etc.) and programme owner of the R&D programmes for photovoltaic. RVO is part of the Ministry of Economic Affairs and executes the policies of the Ministry. RVO is a beneficiary of SOLAR-ERA.NET in the name of the Ministry.

Bouke Bussemaker represents the Ministry internationally for solar affairs including the SEII team. The NL Agency acts officially on behalf of the Ministry and Otto Bernsen is the official representative on behalf of NL Agency for international solar affairs including the SOLAR-ERA.NET, which is an instrument under the SEII team and SET plan.

Context and trends

As of 2011 the policy in the Netherlands is focused on so called “top sectors” of which the top sector Energy is one. In this top sector energy photovoltaic is one of the seven spear points and is organised in a Top Knowledge Institute (TKI) headed by prof. Wim Sinke. The TKI is a public-private partnership which guarantees the participation of industry in the R&D programs under its care. Photovoltaic is also expected to contribute to the renewable energy goal of 14% in 2020 set for the Netherlands. Traditionally R&D is strong in the Netherlands and in 2013 around 30 MEUR was allocated by the TKI Solar in national tenders. There is separate funding for fundamental research which goes to the universities and the FOM Institute for the fundamental research of matter). The latter research funds are not exclusively allocated to the top sector Energy but also span the top sectors Chemistry and High Tech Systems.

While PV still forms a relative minor part of the Dutch energy mix (currently 0,43% of the total electricity production, source CBS 2014) its share is fast growing and PV is a major driver for decentralised and renewable energy production. The installed capacity has doubled each year from 2009 onward and has in the summer of 2014 passed the 1 GW accumulated installed capacity. The goal set by the TKI Solar is to reach at least 3% of the total electricity production in 2020 which amounts roughly to 4 GW. This is still a modest amount in an international perspective but it shows a vibrant domestic market made up almost completely of household installations and a small but growing percentage of medium sized systems up to 1 MW. Only systems above 15 kWp are eligible for a subsidy (the SDE+ scheme). Net metering is under national debate but the limit which was set on 5 000 kWh has been removed.

Apart from this there are fiscal schemes and the so called “Green Deals” in which players in the sector can negotiate a deal with the government to lower the barriers for the implementation of renewable energy sources and reaching higher energy efficiencies.

The Dutch industry is present in most aspects of the value chain and has a strong position in manufacturing equipment and system integrators. There is virtually no PV module production left in the Netherlands itself.

Set-up and strategy of the programme involved

The TKI Solar organises innovation through a partnership between the private sector, knowledge institutes and government. It covers the entire value chain from materials and devices to large scale deployment of systems and services. Looking beyond PV modules and manufacturing equipment, it targets specifically integration into buildings (BIPV), grid integration and societal awareness, safeguarding public support and timely addressing non-technical barriers for large scale deployment. The brunt of the funding goes to industry-led research into wafer-based silicon PV technologies, advanced manufacturing equipment for very high efficiency modules, including nanotechnology, and thin-film PV advanced manufacturing equipment for low cost/high throughput and light-weight/flexible applications. The key research partnerships in these three focus areas are:

- SEAC (Solar Energy Application Centre) for systems and applications.
- Silicon Competence Centre for wafer-based silicon PV technologies.
- Solliance for thin-film technologies.

Pilot, demonstration, quality assurance and implementation projects are mostly placed within the IPZ (Innovation ProgrammeZon) executed by RVO.

For an integral approach and efficiencies the TKI Solar has to coordinate with other TKI's in the top sector Energy (like the TKI's for the built environment and smart grids) and with the other top sectors already mentioned for Chemistry and High Tech Systems.

Objectives

The main objectives of the TKI Solar are:

- Cost reduction / optimisation of PV systems (integral approach): the efforts undertaken in the individual research projects on the component level aim to reduce overall system costs, improve the efficiency, the reliability etc. of the whole PV system including engineering, material (modules, BOS), mounting, operation and quality assurance.
- Applicability (application oriented approach): transfer of the elaborated scientific results into practical solutions as well as industrial processes and products, where the collaboration with the industry is an important issue.

Priorities

In 2012, the 31 MEUR allocated in national tenders went to PV systems and applications, wafer based silicon technologies and, to a smaller extent, to thin-film technologies. The TKI Solar Energy focused on applied research in these three areas. The key research partnerships in these three focus areas are: SEAC, Silicon Competence Centre and Solliance. Alongside these national initiatives there are several active provinces with extensive applied research activities in solar energy, such as Energy Valley (the three Northern provinces) and Limburg with the BIHTS program on building integrated high tech systems. The total public – private investment (including innovation vouchers) for BIHTS over the coming years amounts to 19 MEUR. On the first of January 2012, FOM started a new research group called DIFFER for fundamental energy research, which will be based in the years to come on the high tech campus in Eindhoven. In 2013 this policy was prolonged along the same lines.

Table 12: The Netherlands – General Information on Solar Electricity RTD&I Programming

Programme	Top Sector Energy Sub-programme on solar power by TKI Solar	
Ownership	Ministry of Economic Affairs (EZ)	Ministry of Education and Sciences (OCW)
Management	Top knowledge Institute (TKI) Solar and NL Agency which is part of EZ	NWO (Dutch Foundation for Scientific Research)
Focus	Yearly tenders on subjects as wafer based crystalline Si cells, Thin Film and Systems/applications.	Scientific research from different scientific angles.
Time Frame	2011 – 2014	
Budget (average)	Around 30 MEUR in total yearly	
Finance resources	-	
Number of solar electricity technology projects currently running with public support (out of total number of projects running)		
Programme-specific RTD spend for Solar Electricity out of global spend 2013	28,8 MEUR (out of total 85,7 MEUR for renewable energy sources from budget EZ)	
Total public RTD spend 2013 for solar electricity technologies	Approx. 30 MEUR	
Website	http://www.tkisolarenergy.nl/ http://english.rvo.nl/	http://www.rvo.nl/subsidies-regelingen/tenders-tki-solar-energy

Poland

Update September 2014 – Author: Malgorzata Swiderska

Organisations involved in SOLAR-ERA.NET and solar electricity RTD&I programmes

There is one organisation in Poland involved in SOLAR-ERA.NET: The National Centre for Research and Development (NCRD), a Polish agency financing research, that is mostly applied research.

There is no special or strategic programme devoted to solar energy. Research projects in this area are financed on a project by project basis, within the frame of broadly formulated calls for proposals (programmes of applied research, demonstrating projects, technological initiatives, and so on). The strategic programme, “Advanced Technologies for Energy Generation,” coordinated by the NCRD, covers use of biomass, and agricultural wastes, but not solar energy. The projects and programme mentioned above are financed by the state resources.

In the frame of Norway Funds (the EEA Grants and Norway Grants represent the contribution of Iceland, Liechtenstein and Norway to reducing economic and social disparities and to strengthening bilateral relations with 16 EU countries in Central and Southern Europe), also managed – among others - by the NCRD, there was also the possibility of financing projects and solutions devoted to application of renewable sources of energy and increasing energy efficiency. This included solar energy as well, but the last call concerned only CCS (carbon capture and storage) projects. The Norwegian Funds budget for the period 2009 – 2014 amounts to about 18 MEUR.

The Polish Sustainable Energy Financing Facility (PoISEFF) is the programme focused on increasing the energy efficiency in the energy sector in Poland and also includes the use of solar energy. It is financed by the European Bank for Reconstruction and Development (the amount of 75 MEUR is foreseen for loans for SMEs located in Poland). The PoISEFF is not a research and innovation programme but an investment programme.

In 2010, Polish banks started offering credits co-financed by the Polish National Fund for Environmental Protection and Water Management. This financial instrument enables an applicant to receive a subvention equal to 45% of installation costs for solar collectors applied for water heating. The programme's budget is equivalent to approximately 50 MEUR.

Context and trends

In 2011, the Polish parliament passed the law act on energy efficiency, which implements many measures aimed at satisfying the need for rational energy use, especially in the industry sector. The so-called “White Certificates” are awarded for solutions leading to optimum energy use (less consumption, less losses in energy transmission and energy distribution). White Certificate beneficiaries are energy sector enterprises (energy production and distribution, energy operators).

Although the main energy sources in Poland are conventional ones (black and brown coal power plants), the share of renewable energy sources systematically increases: From 5% in 2001 to 9% in 2009 (more or less a half of the EU mean). This positive trend ensues not only from the necessity of fulfilling the EU directive 2009/28/WE, but also arises from the real interest in using this energy source along with suitable conditions, depending on the country's geographical position.

The surface of solar collectors installed in Poland has increased dynamically, from 21 000 m² in 2001 to 1,2 million m² in the end of 2012. About 200 enterprises (2013) are active in the solar market (production and distribution of PV panels and CSP elements). In 2012 the surface of solar collectors produced in Poland and exported was 62 000 m². Total installed capacity for PV/CSP (data for the end of 2012): on-grid: 1,4 MW (in 2012 increase of 0,1 MW), off-grid: 2,2 MW (in 2012 increase of 1,3 MW).

Set-up and strategy of the programme involved

Not applicable in Poland.

Objectives

Due to the lack of special projects or programmes on solar energy application in Poland, everything that remains is included under general statements on energy efficiency or energy savings and solutions; thus, fulfilling requirements resulting from Polish law and the EU directives (2009/28/WE). Although the use of solar energy in Poland becomes more and more visible, it is still rather a niche source of energy, in comparison to conventional sources.

Priorities

Not applicable in Poland.

Table 13: Poland – General Information on Solar Electricity RTD&I Programming

Programme	n.a.
Ownership	Ministry of Infrastructure and Development
Management	National Centre for Research and Development
Focus	Research and development of state-of-the-art technologies.
Time Frame	2007-2015
Budget (average)	325 MEUR
Finance resources	Structural EU funds plus state resources
Number of solar electricity technology projects currently running with public support (out of total number of projects running)	5 (out of 1388)
Programme-specific RTD spend for Solar Electricity out of global spend 2013	ca 10 MEUR (out of 1,675 BEUR)
Total public RTD spend 2013 for solar electricity technologies	ca 6,5 MEUR
Website	http://www.ncbir.pl/fundusze-europejskie/program-operacyjny-innowacyjna-gospodarka/aktualnosci/

Spain

Update November 2014 – Author: José Herrero Rueda

Organisations Involved in SOLAR-ERA.NET and Solar Electricity RTD&I Programmes

The Centre for Energy and Environmental Researches and Technology (CIEMAT) acts in SOLAR-ERA.NET on behalf of the Ministry of Economy and Competitiveness (MINECO), which is responsible for research development, innovation and demonstration programmes in Spain through the Secretary of Investigation (SEI). CIEMAT is a research public body (OPI) dependent on MINECO-SEI, and its contribution is made with the direct support of other MINECO bodies: General Directorates (International, Public-Private Collaboration, etc.) and the National Agency for Industrial and Technological Development (MINECO-CDTI); which are actually responsible for the management of the National RTD Programmes for Energy (including PV and CSP).

Both MINECO-SEI and MINECO-CDTI are involved in the preparation of calls, evaluation and follow-up of granted projects. They have complementary objectives relating to the support of universities groups, technological centres and industries. The fund mechanisms range from direct subvention to soft loans. Application of one or/and both tools is usually graded according the project's objectives, from fundamental research to industrial and commercial applications.

Context and trends

Spanish National Research Programmes are governed by 4-year plans. The new 4 Year Plan (2013-2016) began in 2013. "Energy and its Environmental Impacts" are one of the main strategic lines for this Plan's development. The Plan's activities refer to the principles of the European SET-Plan and the HORIZON 2020 Programme. These actions shall impact on research into industrial application, in order to achieve the SET-Plan targets and the objectives of the European and National Policy Actions, e.g. Lisbon.

The R&D&i Work Programme is drawn up on an annual basis and, once approved, functions as a tool for programming short-term science and technology policies, for coordinating the actions of the General State Administration and as a platform for presenting the integrated activities of the General State Administration and the Autonomous Community Administrations for Science, Technology and Innovation

The Work Programme mainly includes information on the planned calendar of public announcements, stating the terms for presenting and ruling on the different procedures, distributing the annual budget by priority area and programme, assigning the managing bodies for each of the activities and the types of beneficiaries and sectors eligible for grant aid.

It is considered that the solar energy sector (PV and CSP) in Spain is a key issue for the establishment of a safe and sustainable power supply. This capacity is based on the available solar resource, the existence of relevant RTD groups and centres, a competitive solar industry and a favourable social perception of the solar energy.

Over 50 centres (private companies, universities and technological non-profit organizations) are identified in Spain as potential developers in solar (PV and CSP) RTD activities. Most of them have participated in projects supported by national programmes during the last years; see Table 14a. Fund applications are split

into direct grants or soft loans, see above, depending on the participation of non-profit centres or private companies.

Table 14a: Spain – Budget Distribution for Solar Granted Projects in Spain during the 2012-2013 Period

Collaboration Public & Private Projects ¹ (INNPACTO)			
Topics	PV ²	CSP ³	Total
Number Projects	26	12	38
Total Budget ⁴ (EUR)	56 607 440	17 529 360	74 136 800
Granted Soft Loans ⁵ (EUR)	29 514 278	8 654 453	38 168 731
Granted Subventions ⁶ (EUR)	11 814 447	2 330 831	14 145 278
Granted Advanced Payments ⁷ (EUR)	2 302 591	529 972	2 832 564
TOTAL Grant Support (EUR)	43 631 316	11 515 256	55 146 573

¹Corresponding to calls 2010/2011/2012.

²Photovoltaic Solar Energy.

³Concentrated Solar Power

⁴Total budget of the projects, including contribution of public bodies and companies.

⁵Soft loans granted by public bodies, according to previously established advantageous conditions.

⁶Direct subvention granted by public bodies.

⁷Advanced free payment for reimbursing to the public bodies according to previously established conditions

Major strengths of the Solar RTD in Spain are: Extremely important solar resource for testing and demonstration of solar systems, important industry leaders in the solar sector, and highly qualified RTD groups in both fields, e.g, Institute of Solar Energy (IES) or CIEMAT+Almeria Solar Platform (PSA).

Weaknesses are identified by Spain's own solar community as:

- Instability of the regulatory framework, which leads to difficulty in the real establishment of investment in RTD.
- Poor implication of the society and administration in RTD activities.
- Lack of or poor connection of the solar RTD community. Poor mid- to long-term vision of most of the national companies for investment in solar RTD activities.

Set-up and Strategy of the Programme Involved

The MINECO-SEI research programme deals in solar RTD, covering activities on photovoltaic and solar thermal (CSP and heating for industrial and household use). The objectives arise from basic research, (new materials, preliminary studies) to applied research, as well as with the INNOVA and INPACTO industrial application programmes. These activities are supported by direct subvention for mostly fundamental research to soft loans and/or subvention when joint projects are proposed from the public-private initiative, technological centres and companies. MINECO-CDTI support activities are focussed where solar power industrial development can improve technological capability for Spanish companies and their international competitiveness; and the application of Spanish know-how. It makes use of Spain's own national funds or the European Commission's grants and funds. CDTI is also responsible for international programmes management, such as ESA or EUREKA, where solar RTD can be included.

The determination of projects is based on open-calls, taking into account the equality and transparency terms where the funding is determined by scientific and technical quality, coordination issues, affective attribution of funds and expected deliverables. The projects' effective follow up is realised by MINECO in terms of the technical targets' costs and accomplishments. Also, bottom-up actuations are welcome when

the initiatives have special relevance for general objectives and strong industrial implication (CDTI), where the aim is strengthening the Spanish position in solar energy. The philosophy is open opportunities and transparent processes.

Demonstration and deployment projects are usually carried out by the Ministry of Industry and its respective agencies, such as the IDAE (Institute for Saving Energy and Diversification Energy), with pilot PV and CSP systems demonstrations, where the objective is to advance the technology to the market place. Accompanying measures for standards, reliability and quality are also available.

All MINECO supported projects, either as individual actions or broad programmes, can be carried out with the additional support and in the framework of other regional, national and international funding agencies; always within the applicable rules of maximum public support. MINECO highly recommends collaboration among the research community and private organisations, while offering its contribution in an advisory or coordination capacity. In any case, MINECO's objective is to support the entire solar technologies value chain in order to identify and resolve scientific and technological gaps, while opening new windows for science, technology and industrial implementation development.

Objectives

The main objectives of the MINECO solar research programmes are:

- Reduction of the levelized cost of electricity (LCOE) according to the guidelines of the European Solar Industrial Initiative (SEII). This objective involves the participation of technological groups and industry. Actions are taken within the entire value chain in both areas (PV and CSP).
- To improve industrial products quality on the basis of high quality technological developments, that can improve the position of the Spanish companies in the global solar market. This action is directly related and comprises public-private collaboration.

Priorities

The thematic priorities usually selected for research in Photovoltaics are:

- Metallurgical silicon grade and feedstock.
- New materials including novel and emergent technologies, organic photovoltaic, quantum technologies, etc.
- High efficiency solar cells including crystalline solar cells and III-V cells for high concentration.
- New modules and better products for the balance of the system (BoS).
- Thin film solar cells, production systems and up-scaling.
- BIPV including new modules, products and energetic quality of the integration.
- Concepts and products for grid integration, including approaches for self-consumption.
- Optical technologies for concentrated photovoltaics (CPV).

The thematic priorities for concentrated solar power (CSP) are:

- Relevant concepts for improving dispatchability including thermal storage.
- New fluids for heat transfer.
- New materials for CSP reactors.
- Solar chemistry, including production of new fuels and detoxification of waste.

Table 14b: Spain – General Information on Solar Electricity RTD&I Programming

Programme	-
Ownership	Ministry of Economy (MINECO)
Management	Spanish State Secretary of Investigation, and National Agency for Industrial and Technological Development. Including: General Secretary for Science Technology and Innovation; Directorate General of Innovation and Competitiveness.
Focus	Photovoltaics (PV) and Concentrated Solar Power (CSP)
Time Frame	Presently, State RTD Plan during 2013-2016 Since 1988, executed by 4-year national plans
Budget (average)	Over 17 MEUR per year ¹
Finance resources	MINECO energy research, other national and regional government RTD funds, European Union programmes
Number of solar electricity technology projects currently running with public support (out of total number of projects running)	Over 30 ¹
Programme-specific RTD spend for Solar Electricity out of global spend 2013	n.a.
Total public RTD spend 2013 for solar electricity technologies	n.a.
Website	www.idi.mineco.gob.es ; www.cdti.es

¹Based on information Table 14a. Direction General of Public-Private Collaboration (MINECO-SEI).

Sweden

Update June 2014 – Authors: Tobias Walla, Susanne Karlsson,

Organisations involved in SOLAR-ERA.NET and solar electricity RTD&I programmes

The Swedish organisation formally involved in SOLAR-ERA.NET is the Swedish Energy Agency (Energimyndigheten). This is a governmental agency under the Swedish Ministry of Environment, with the overall objective to implement the Swedish energy policy, including energy supply and renewable energy.

The Swedish Energy Agency owns and manages the Swedish Energy Research Programme, with a budget of about 150 MEUR annually. The Energy Research Programme covers the whole spectrum from basic and applied research to demonstration projects in renewable energy and energy efficiency applications. Within this programme, the Swedish Energy Agency defines initiates and finances a diverse set of RTD instruments (e.g. sub-programmes, competence centres, projects, etc.). Yearly a total of about 5.5 MEUR are channelled to PV and CSP related research. Additional resources to solar electricity research and innovation come from several national research councils, universities and private institutions.

Context and trends

The installed PV capacity in Sweden in 2013 was 43,2 MW, with a slight majority of grid-connected installations. These 43,2 MW produced 39 GWh in 2013, which leaves a large potential for growth: it has been estimated that the potential for electricity produced by roof-mounted solar cells in Sweden amounts to several tens of TWh per year.

There is solid public support for PV technology in Sweden, and about 80% of the population think that efforts towards implementation should increase. Since a capital subsidy was introduced in 2009, the number of grid-connected PV installations has increased rapidly. There is strong support among stakeholders for net metering, and the government has announced the intention of introducing such a system.

A growing number of small to medium-sized enterprises exist, that design, market and sell PV products and systems. Many of these companies depend almost exclusively on the Swedish market. The capital subsidy programme has resulted in more activity among these companies and since there has been a lot of interest from private households there are several companies that market products specified for this market segment. Recently several utilities have begun selling turn-key PV systems, often working together with companies installing the systems.

For the concentrating solar power technologies, a small number of Swedish companies develop steam turbine and Stirling engine technologies.

There are strong academic environments doing research on new types of solar cells, such as CIGS thin film, dye sensitized and polymer solar cells, nanowire solar cells and more. There is also research on enhancement techniques for conventional silicon solar cells.

Set-up and strategy of the programme involved

The Energy Research Programme covers the whole spectrum from basic and applied research to demonstration projects. Both renewable energy technologies and energy efficiency applications are included in the programme. Within this programme, the Swedish Energy Agency defines, initiates and finances a diverse set of RTD instruments (e.g. sub-programmes, competence centres, projects, etc.).

For PV, there has historically been public funding of several long-term research projects focusing on CIGS, dye-sensitized and polymer solar cells. The strategy has been to maintain a high level of competence and scientific excellence, while also supporting the spin-offs that have resulted from these projects.

In 2012, the Swedish Energy Agency formulated a new strategy for energy research. It states that PV research in Sweden should continue to cover several different subjects. The research should aim for new innovations that increase the system performance of PV and give better utilisation of the values from PV installations. Some areas that should be included in the research programmes are building integration, electricity storage, information and communication technology, automation and power electronics.

On-going activities focusing on solar electricity technology research and innovation within the Swedish Energy Research Programme in parallel to SOLAR-ERA.NET are:

- *El och bränsle från solen*, a national sub-programme formed in 2012, covering PV, concentrated solar power and solar fuels.
- *SolEl-programmet*, a national sub-programme formed in 1997, which aims on research that facilitates an increasing amount of PV solar power in the Swedish energy system.
- Projects financed in collaboration with the Swedish Research Council
- Singular projects in PV and CSP, typically pilot- and demonstration projects

Objectives

Overall objectives for the Swedish Energy Research Programme are:

- To establish scientific and technological knowledge and expertise needed to enable the transition to a sustainable energy system in Sweden at universities, institutes, agencies and industry, and
- To develop products and services that can be commercialized by Swedish enterprise, thereby contributing to sustainable economic growth both in Sweden and abroad.

Priorities

The priorities for solar energy technologies within the Swedish Energy Research Programme are stipulated by the Swedish Energy Research Development Board, composed by government appointed experts in the energy field. They decide which projects and programmes that should be supported. The board members have five different Development Platforms as guidance in their strategic decisions. Solar electricity technologies fall within the Development Platform for the Power System. This Platform has come up with the following thematic priorities for solar electricity technologies:

- System components for PV (Balance Of System or BOS) and CSP
- BIPV
- Information Technology
- Electricity storage
- More effective solar electricity components
- Environmental Technology, such as eco-friendly materials and recycling
- More effective production of emerging PV technologies

Table 15: Sweden – General Information on Solar Electricity RTD&I Programming

Programme	Long-term energy research programme	El och bränsle från solen (national sub-programme covering PV, CSP and solar fuels)	SoIEI-programmet (Swedish national co-financed programme for PV systems and applications)
Ownership	Ministry of Enterprise, Energy and Communications	Swedish Energy Agency	Swedish Energy Agency and Swedish industry
Management	Swedish Energy Agency	Swedish Energy Agency	Swedish Energy Agency and Elforsk AB
Focus	Energy research towards a long-term sustainable energy system	PV, CSP and solar fuels	Research to facilitate the implementation of PV in Sweden
Time Frame	continuous	2013 – 2016	2013-2017
Budget (average)	2 MEUR	3,7 (4,7) MEUR	0,5 MEUR
Finance resources	Swedish Energy Agency	Co-funded by the Swedish Energy Agency (80%) and Swedish industry (20%).	Co-funded by the Swedish Energy Agency (40%) and Swedish industry (60%).
Number of solar electricity technology projects currently running with public support (out of total number of projects running)	n/a	10 (11)	5 (5)
Programme-specific RTD spend for Solar Electricity out of global spend 2013			
Total public RTD spend 2013 for solar electricity technologies	2 MEUR	2,9 (3,8) MEUR (year 2013)	0,2 MEUR (year 2014)
Website	www.swedishenergyagency.se	http://www.energimyndigheten.se/Forskning/Kraftforskning/Solkraft/El-och-bransle-fran-solen/	www.solelprogrammet.se

Switzerland

Update November 2014 – Authors: Stefan Nowak, Stefan Oberholzer

Organisations involved in SOLAR-ERA.NET and solar electricity RTD&I programmes

Two organisations are formally involved in SOLAR-ERA.NET: The Swiss Federal Office of Energy (SFOE) is responsible and owner of the SFOE research programmes Photovoltaics as well as High-Temperature Solar Energy whereas NET Nowak Energy & Technology Ltd (NET) manages the SFOE research programme Photovoltaics (the company Planair being responsible for the management of the SFOE research programme Industrial Use of Solar Energy is not a beneficiary of SOLAR-ERA.NET but consulted for relevant matters).

The Swiss Federal Office of Energy is part of the Federal Department of Environment, Transport, Energy and Communications (Ministry) and is the government authority responsible for all energy related matters (policy, legislation, research, action programmes, etc.). Stefan Oberholzer represents SFOE as head of Solar Energy Research Unit. The SFOE uses a decentralised management structure whereby the management is under the responsibility of qualified institutions (disregarding the type of institution – be it a university, agency or private company) acting officially and on behalf of the SFOE. With respect to the SFOE research programme Photovoltaics, Stefan Nowak / NET is the official manager on behalf of SFOE.

Context and trends

In the year 2014, on the levels of Swiss policy and administration, work continued regarding the preparation of the various measures in conjunction with Switzerland's phase-out of nuclear energy decided in 2011 in the framework of the new energy strategy 2050. These measures will have impacts on all levels from research to implementation and use as well as regarding legislative and normative issues. Before coming into force, there will likely be a public vote on the new energy strategy, expected for 2016. According to the present scenarios, in absolute terms, some 10 - 12 TWh could come from photovoltaics by 2050, representing some 20% of the present national electricity consumption.

The development of the photovoltaic sector in Switzerland builds on a strong research and technology base, an increasing industrial activity and, more recently, an acceleration of the market deployment efforts. A comprehensive research programme covers R&D in solar cells, modules and system aspects. The Swiss energy research strategy is defined by an energy RTD master plan updated every four years. The support of the national PV RTD programme can be expected to continue with a focus on innovative research activities, rapid technology transfer, industrial developments, new products for niche markets, increased pilot and demonstration activities as well as ongoing international involvement.

Set-up and strategy of the programme involved

The SFOE research programme Photovoltaics deals specifically with PV RTD activities whereas the SFOE research programme High-Temperature Solar Energy covers different areas including solar thermal power plants (CSP), high temperature solar energy for industrial purposes (CST) as well as solar thermochemistry for the solar thermal production of hydrogen and syngas (solar fuels). Both programmes combine the specific funding possibilities through SFOE as well as European, national and regional funding agencies. Important developments of industrially oriented research are supported by the Commission for Technology and Innovation (CTI) whereas pilot and demonstration activities are under the responsibility of SFOE. This broad

definition of a RTD programme follows the Swiss Energy Research Master Plan and is part of the terms of reference for the programme management.

Based on strategic national policy targets (energy & environment, science & education, industry & society), the Federal Commission for Energy Research (CORE) in cooperation with SFOE develops 4 years' RTD energy research master plans (present period 2013–2016), split up in programmes and sub-programmes. These energy technology specific programmes are supported by different national and regional government agencies, the research community and the private sector with an overall coordination by SFOE. The individual RTD programmes develop their own 4 years' research master plans including implementation plans, which detail the research to be carried out.

The SFOE research programme Photovoltaics focuses on R&D in a system and market oriented approach, from basic research, over applied research, product development, pilot and demonstration projects all the way to accompanying measures for market stimulation. On the technical level, silicon heterojunction and different thin film solar cells, their variations and building integration continue to be the topics of highest priority. New concepts such as perovskite solar cells and tandem cells with these are increasingly being investigated. The programme is organised along the entire value chain and addresses the critical gaps from research over technology to the market place. Thorough component and system analysis, as well as testing, aim at increasing efficiency and performance. Accompanying measures to raise the quality and reliability of photovoltaic power systems include work on standards and design tools.

The SFOE research programme High-Temperature Solar Energy aims at the promotion and development of technologies for the use of high-temperature solar heat for electricity generation and process heat. The programme supports private and public sector research projects with the aim of strengthening Switzerland's position as an exporter of know-how and technology in this field. Additionally to basic and applied research in the field of CSP-technology and solar thermochemistry, demonstration activities for the application of concentrated solar thermal plants to produce industrial process heat are promoted within Switzerland.

The comprehensive approach followed in the Swiss energy RTD Programmes has benefits for the funding institutions involved on the one hand (e.g. coordination, transparency, effective attribution of funds, avoiding duplication, etc.) and for the research community on the other hand (e.g. one central contact, one stop shop, efficient support and guidance, etc.). At the same time, such an approach requires an important networking effort and good communication channels. Furthermore, confidence and impartiality are key aspects relevant for a successful programme management. Considerable effort and time is required until these "soft" but important factors are established and recognised by the RTD community.

Objectives

The main objectives of the SFOE research programme Photovoltaics are:

- Cost reduction / optimisation of PV systems (integral approach): the efforts undertaken in the individual research projects on the component level aim to reduce overall system costs, improve the efficiency, the reliability etc. of the whole PV system including engineering, material (modules, BOS), mounting, operation and quality assurance.
- Applicability (application oriented approach): transfer of the elaborated scientific results into practical solutions as well as industrial processes and products, where the collaboration with the industry is an important issue.

The main objectives of the SFOE research programme Industrial Use of Solar Energy are:

- Development of innovative CSP technologies: research and development covers various topics ranging from more basic material science up to the system level. The focus lies on cost reduction

with new innovative and cost-efficient CSP concepts as well as the dispatchability and the hybridization of CSP-systems.

- Development and demonstration of CST technologies: the application of medium temperature solar concentrators bears a huge potential for the decarbonisation of process heat for industry. The objective here is to develop cost-effective CST technologies and foster the market introduction via the demonstration in different applications. This includes also the study of potential implementation in regions with moderate insolation.
- Demonstration of solar fuels: converting concentrated solar energy into chemical energy carriers deals with the challenge to store and transport the energy contained in highly diluted solar radiation. The objectives comprise the fundamental development of concentrating solar systems for industrial applications in solar thermochemistry combined with first demonstrations for the production of synthetic fuels such as hydrogen and syngas.

Priorities

The thematic priorities of the SFOE research programme Photovoltaics are:

- Development of high efficiency solar cells (e.g. heterojunction solar cells, photon management)
- Manufacturing processes for new solar cell technologies (e.g. CIGS)
- Further development of thin film solar cells (efficiency, processes, cost)
- Material options for new solar cell technologies (e.g. organic solar cells)
- New multifunctional products for building integrated PV
- Integration and high penetration of PV in electrical grids
- Optimized system approaches involving several technologies for electricity as well as heat production and storage

The thematic priorities of the SFOE research programme Industrial Use of Solar Energy are:

- Optimization and further development of solar thermal reactors on a large scale for the thermal dissociation of metal-oxide complexes
- Cost reductions for CSP technologies via new approaches, including new thermal storage concepts
- Development, testing as well as codes and standards for new CST-technologies for industrial process heat
- Packed bed solar reactors for direct use of solar energy (gasification, waste treatment etc.)

Table 16: Switzerland – General Information on Solar Electricity RTD&I Programming

Programme	SFOE research programme Photovoltaics	SFOE research programme Industrial Use of Solar Energy
Ownership	Swiss Federal Office of Energy (SFOE)	Swiss Federal Office of Energy (SFOE)
Management	NET Nowak Energy & Technology Ltd	Planair SA
Focus	PV	CSP, CST and Solar thermochemistry
Time Frame	since 1985, executed in subsequent 4 year terms	since the 1980s, executed in subsequent 4 year terms
Budget (average)	approx.18 MEUR of which 1,5 MEUR is funded by SFOE	approx.4 MEUR of which 0,6 MEUR is funded by SFOE
Finance resources	SFOE energy research and pilot budget, other national and regional government RTD funds, European Union	SFOE energy research and pilot budget, other national and regional government RTD funds, European Union
Number of solar electricity technology projects currently running with public support (out of total number of projects running)	approx. 75 (out of 75)	approx. 15 (out of 35)
Programme-specific RTD spend for Solar Electricity out of global spend 2013	1,5 MEUR	approx. 0,5 MEUR (out of 1 MEUR)
Total public RTD spend 2013 for solar electricity technologies	18 MEUR	approx. 3 MEUR (out of 5 MEUR)
Website	www.bfe.admin.ch/forschungphotovoltaik www.photovoltaic.ch	www.bfe.admin.ch/forschungindustriesolar

Turkey

Update December 2014 – Authors: Dr. İsmail Doğan, Kaan Karaöz

Organisations involved in SOLAR-ERA.NET and solar electricity RTD&I programmes

One organisation is formally involved in SOLAR-ERA.NET: The Scientific and Technological Research Council of Turkey (TUBITAK), the leading agency for the management, funding and conduct of research in Turkey. It was established in 1963 with the mission to advance science and technology, to conduct research and to support Turkish researchers and industry. TUBITAK funds research projects carried out in universities, other public and private organisations, conducts research on strategic areas, and develops support programmes for public and private sectors.

Context and trends

With respect to the importance given to the solar energy topic, the subject would be effective in order to create organisations or specific programmes.

Set-up and strategy of the programme involved

The “1509 – International Industrial R&D Projects Funding Program” is designed to encourage Turkish companies to carry out international projects such as EUREKA, EUROSTARS and European Union Framework Programmes (EU FPs). Any Turkish company with one or more partners from participating countries can apply for funding. There is no restriction in terms of project support duration. Payments are made twice a year after the company spends. SMEs receive 75% of all eligible R&D costs and big companies receive up to 60% of all eligible R&D costs. Pre-payment is available on condition that the company can establish a letter of guarantee. There is no specific application period defined, project proposals can be submitted at any time of the year by PRODIS (Project Evaluation and Monitoring System). Project application should be made simultaneously with the application to the international joint programme or at the latest, one month after.

Objectives

Within the frame of the “1509 – International Industrial R&D Projects Funding Program,” industrial research and the experimental development phase of R&D is funded. The following sub-phases of these activities are targeted for support:

- Conceptual development,
- Technological/technical and economic feasibility studies,
- Laboratory studies to be conducted in the process of transition from conceptual development to design,
- Design and development,
- Prototype production,
- Establishment of pilot plant,
- Demonstration,
- Test run.

Priorities

There does not exist any thematic priorities for “1509 – International Industrial R&D Projects Funding Program”.

Table 17: Turkey – General Information on Solar Electricity RTD&I Programming

Programme	“1509 – International Industrial R&D Projects Funding Program”
Ownership	The Scientific and Technological Research Council of Turkey (TUBITAK)
Management	The Scientific and Technological Research Council of Turkey (TUBITAK)
Focus	-
Time Frame	-
Budget (average)	-
Finance resources	Government RTD funds
Number of solar electricity technology projects currently running with public support (out of total number of projects running)	1 (out of 45)
Programme-specific RTD spend for Solar Electricity out of global spend 2013	-
Total public RTD spend 2013 for solar electricity technologies	-
Website	http://www.tubitak.gov.tr/

United Kingdom

Update September 2014 – Author: Christian Inglis

Organisations involved in SOLAR-ERA.NET and solar electricity RTD&I programmes

Innovate UK is the UK organisation involved in SOLAR-ERA.NET. Innovate UK is the UK's innovation agency focussed on business innovation, working closely with central government in energy through the cross government Low Carbon Innovation Coordination Group (LCICG) (www.lowcarboninnovation.co.uk/)

Context and trends

Through Innovate UK's energy programme we believe the following UK domestic policy and legal requirements offer real opportunities to develop innovative new products and services in the UK:

- The legally binding obligation that in the UK, 15% of total energy must come from renewable sources by 2020
- The statutory requirement that UK greenhouse gas emissions must be reduced by 34% by 2020 and 80% by 2050 (on 1990 levels)
- The four Carbon Budgets covering five-year periods from 2008-2027
- The security of an estimated 85GW indigenous supply requirement in the UK by 2020
- The need to provide affordable energy for all.

We believe the priority for our programme should be in innovations that can have a business impact in the next 10 to 20 years and that we should use UK policy and government action as key drivers for a programme that develops test beds for demonstration, new supply chains, knowledge transfer and expertise. Next generation solar technologies play a part in this in with many other generation opportunities both for the home and export market.

The UK is now considered to be a top 10 player in the global PV market where in the second quarter of 2013 installed capacity was 2,4 GW growing to 3 GW by June 2013. The Department of Energy and Climate Change (DECC) now estimates 7-20 GW of UK based solar PV by 2020 (UK PV Roadmap, December 2013, ESP KTN).

DECC published its Solar PV strategy in April 2014 (<https://www.gov.uk/government/news/the-uks-rooftops-to-become-power-stations>) highlighting the need for innovation in technology, manufacturing and installation to help reduce costs and see the sector cost-competitive with other major low-carbon routes.

Set-up and strategy of the programme involved

Our energy supply strategy at the Technology Strategy Board has three key strands;

- To develop affordable and secure sources of energy supply which also reduce greenhouse gas (GHG) emissions
- To integrate future demand and energy supply into a flexible, secure and resilient energy system
- To reduce GHG emissions at point of use.

As part of this, our activities in next generation solar technologies will look to:

- Enhance the UK supply chain by bringing together innovative SMEs with early-stage research and existing large companies, to develop underpinning technologies that focus on cost reduction and efficiency improvement
- Assess where the UK can best engage with Europe to develop and exploit new technologies
- Analyse our current portfolio of investment and work with Research Councils UK and other Innovate UK programmes such as materials and photonics, to address how we can continue to support this area. We are currently setting up a special interest group in solar energy systems

Objectives

The Challenges being addressed by our energy supply strategy are:

Cost reduction - New technologies are costly. Energy is a commodity and to compete, new technologies must ensure they add value in terms of security, sustainability and affordability. Offshore renewables are a good illustration of this balance. In the UK we have prodigious offshore wind, tidal stream and wave energy resource, more than any other European country. Although this offers a sustainable and indigenous source of supply, the cost is currently prohibitive without significant government subsidy and is a major challenge to the industry.

Supply chain development - To be competitive, new energy technologies must have capable and innovative supply chains. There is an opportunity for the UK to develop goods and services in those parts of the supply chain where maximum value can be created and captured.

Expert workforce - A skilled and well-trained workforce is needed to deliver often very technical and safety-critical innovations. In a number of energy sectors, there is considerable concern regarding skills gaps and human capital depreciation. Equally, there is a challenge regarding how to transfer knowledge and innovation from the research base into industry.

Infrastructure development - Innovation needs a capable infrastructure to manage, transmit and distribute new energy technologies, both in terms of supply but also on the demand side. Above all, the future energy system has to be flexible and be able to handle a mix of generating technologies, deal with intermittency of renewable supply, automate the management of energy demand and inform consumer response and behaviour.

Stable policies - Stable and consistent energy policies are needed to give industry the confidence to invest in innovation. Policy and regulation are fundamental in determining the pace of market development. To invest in new infrastructure, new generating capacity and demand side measures, new supply chains and new skills, industry needs certainty with regards to regulation, planning and capacity targets.

Priorities

The thematic priorities for next generation photovoltaics from an Innovate UK perspective focus around

- Cost reduction, efficiency improvements and packaging
- Material options for new solar cell technologies (e.g. organic solar cells)
- New multifunctional products for building integrated PV
- Optimized system integration approaches involving several technologies for electricity as well as heat production and storage (e.g. localised energy systems)

Table 18: Innovate UK, United Kingdom – General Information on Solar Electricity RTD&I Programming

Programme	Energy supply strategy
Ownership	Innovate UK
Management	Innovate UK
Focus	Next generation solar technologies
Time Frame	2007, new strategy launched in 2012 running to 2015
Budget (average)	approx. £28.5 million in solar projects since 2007
Finance resources	Technology Strategy Board programmes in energy, materials, manufacturing and photonics
Number of solar electricity technology projects currently running with public support (out of total number of projects running)	approx. 25 (out of 36) solar related projects
Programme-specific RTD spend for Solar Electricity out of global spend 2013	n.a.
Total public RTD spend 2013 for solar electricity technologies	n.a.
Website	www.innovateuk.org