European Commission

New Solutions in Energy Supply

Photovoltaic Solar Energy Best Practice Stories

Edition 2000

ENERGIE

ENERGIE

This ENERGIE publication is one of a series highlighting the potential for innovative non-nuclear energy technologies to become widely applied and contribute superior services to the citizen. European Commission strategies aim at influencing the scientific and engineering communities, policy makers and key market actors to create, encourage, acquire and apply cleaner, more efficient and more sustainable energy solutions for their own benefit and that of our wider society.

Funded under the European Union's Fifth Framework Programme for Research, Technological Development and Demonstration (RTD), ENERGIE's range of supports cover research, development, demonstration, dissemination, replication and market uptake - the full process of converting new ideas into practical solutions to real needs. Its publications, in print and electronic form, disseminate the results of actions carried out under this and previous Framework Programmes, including former JOULE-THERMIE actions. Jointly managed by Directorate-General Energy and Transport & Directorate-General Research , ENERGIE has a total budget of đ1042 million over the period 1999 to 2002.

Delivery is organised principally around two Key Actions, *Cleaner Energy Systems, including Renewable Energies, and Economic and Efficient Energy for a Competitive Europe,* within the theme "Energy, Environment and Sustainable Development", supplemented by coordination and cooperative activities of a sectoral and cross-sectoral nature. With targets guided by the Kyoto Protocol and associated policies, ENERGIE's integrated activities are focussed on new solutions which yield direct economic and environmental benefits to the energy user, and strengthen European competitive advantage by helping to achieve a position of leadership in the energy technologies of tomorrow. The resulting balanced improvements in energy, environmental and economic performance will help to ensure a sustainable future for Europe's citizens.

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Table of Contents

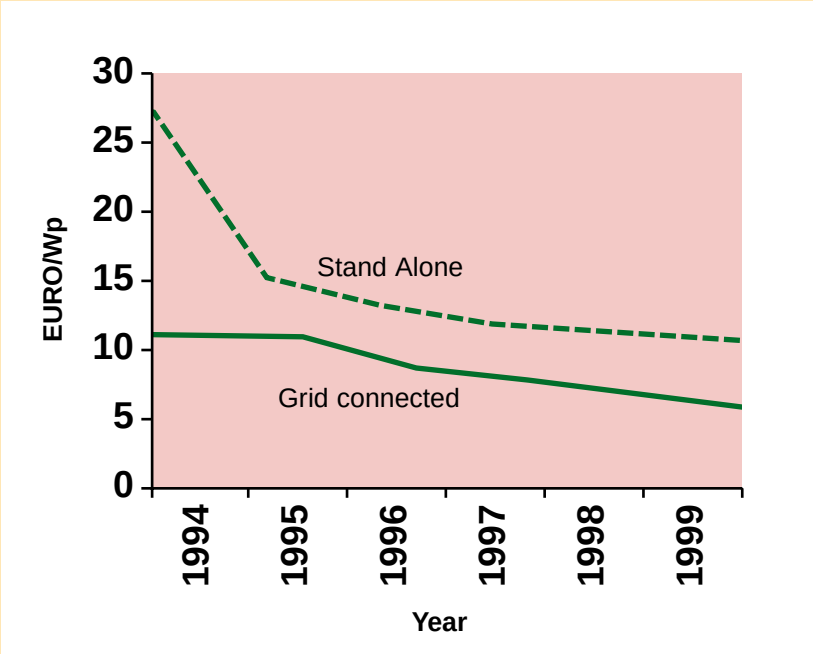
Foreword

The THERMIE programme, which ran up to 1998, and the demonstration element of ENERGIE, its successor, working within the Fifth Framework Programme for Research and Technological Development (5 FP, 1998-2002), form a major part of the European Union's implementation of renewable energy technologies, including solar photovoltaics. These programmes have offered support to more than 190 PV projects throughout Europe.

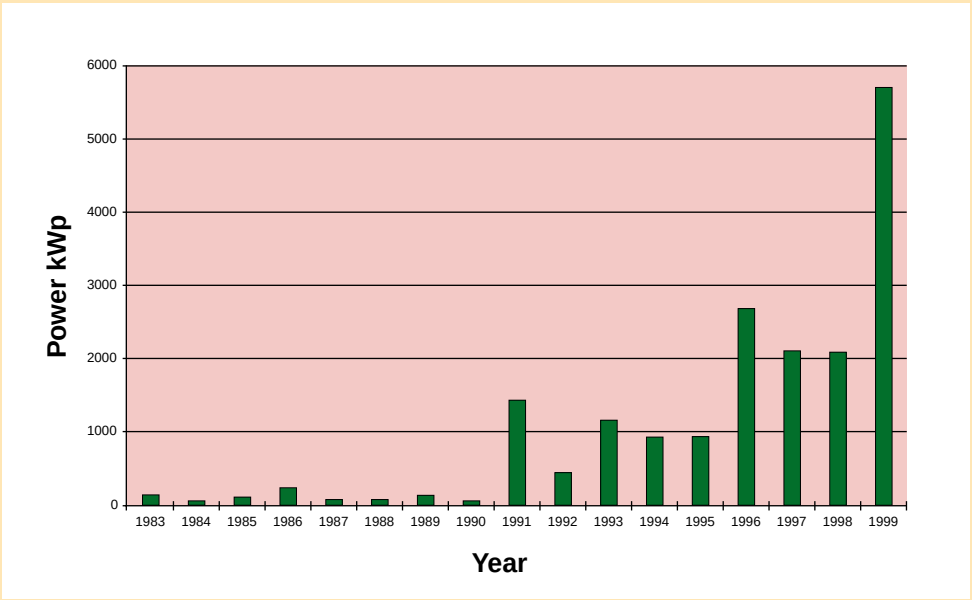
This booklet provides a synopsis of the wide range of photovoltaics projects launched throughout Europe with the support of the THERMIE programme. A broad spectrum of project partners, encompassing utilities, municipalities, transport authorities, PV manufacturers, installers, architects and end-users, have formed themselves into international consortia to pool the expertise required to undertake leading-edge and often highly innovative installations which will continue to serve as a showcase for European know-how. The diverse end-users active in the THERMIE programme include companies outside the energy sector whose motivation is to exploit PV as the most effective power source for their particular application. Although THERMIE is a European initiative, its impact is in a global context.

The photovoltaic sector is moving fast. The past few years have witnessed a dramatic increase in both the manufacturing capacity and the actual production of solar photovoltaic modules. The record shows a 78% increase in PV module production between 1995 and 1997 in the reporting countries of the International Energy Agency (IEA). This growth has had knock-on effects on revenue turnover, with a current annual growth rate of 29%, and in employment in the PV sector which grew by 16% in the period 1995-97. The factory prices of modules, was reduced by over 25%, during the 4 years up to 1997. The global PV industry is becoming increasingly competitive, and is gearing up to exploit the opportunities offered by growth in the world PV market.

Europe has played a major role in the expansion of the PV market. As of the end of 1999, 133 MWp of PV was operating in Europe (EU and EEA Member States). The THERMIE programme alone was responsible for 16 MWp of the PV systems installed since 1979, this represents 12% of the European total. During the past 5 years the average for installed power per project increased from 30 kWp to 700 kWp. This reflects the growing confidence of EU investors in PV technology. At the same time, this greater willingness



Evolution of THERMIE PV Demonstration Project Costs (including a 2 year monitoring period)



Total PV Power Installed per Year within Projects supported by THERMIE + 5 FP

to invest in PV has allowed the level of financial support per project offered by THERMIE to be reduced, hence facilitating the installation of more PV capacity per unit of EU support.

The European Commission's White Paper on Energy for the Future called: Renewable Sources of Energy (COM 97, 599) has a target of 3 GWp of installed PV capacity in the European Union by 2010. Innovative technologies are an important element of this ambitious but feasible target.
The market trends in PV applications are best seen in the history of the demonstration projects supported by THERMIE. The share of grid-connected applications has grown from less than 20% of the supported projects to more than 85% over the 5-year period leading up to 2000. However, the European Commission's support for photovoltaics not only embraces demonstration and research activities, but also covers dissemination actions and the provision of platforms to promote the exchange of information between industry, research institutes and end users. The web site of the Directorate General for Energy and Transport, europa.eu.int/en/comm/dg17/dg17home.htm, contains information on proposals, energy legislation and energy policy, as well as reviews of many of the projects supported under the Fourth and Fifth Framework Programmes. In addition, the Community Research and Development Information Service (CORDIS), www.cordis.lu, maintains extensive databases for facilitating partner searches and identifying support opportunities for innovative technologies such as PV.

It is hoped that the work illustrated here will motivate others to consider incorporating photovoltaics in future infrastructure investments in whatever sector they are involved. As the THERMIE programme makes way for its successor within ENERGIE, may these examples of European best practice inspire decision makers, planners, engineers and architects to incorporate PV in their everyday work both within and outside of the context of the Fifth Framework Programme.

Brussels, March 2000

PV Systems in Noise Barriers – Transforming Motorways into Solar Roads

The transport sector is one of the fastest growing in Europe. This increase is predicted to continue especially in respect to a possible expansion of the European Union toward Eastern Europe. This development will be accompanied by a brisk economy, a lively exchange of products and more personal mobility. On the other hand there are some negative side effects to this expansion process.

Together with the increase in traffic the traffic noise is increased. There are areas in Europe that are very densely populated. The people in these areas often live close to heavily frequented motor and railways. For a long time the danger that noise represents for a human being's health was underestimated. Today, the efforts for protecting people against noise have increased. Noise barriers along motor and railways are the more common and the more cost-effective method, compared to alternatives such as tunnels to protect humans from transport noise.

Assuming that a motor or railway equipped with a noise barrier has an east-west orientation these barriers offer very good opportunities for the installation of large PV systems. The PV modules not only generate electricity without polluting the environment but they also provide a visual upgrade for the often grey and monotone looking barriers.

Electricity production through photovoltaics on a large scale needs fairly large areas since the energy density with PV systems is relatively low. Therefore the noise barriers along Europe's motor and railways, often stretching over many kilometres, offer huge possibilities for the production of electricity through photovoltaics.

A short-term potential of 1,100 MWp was acknowledged within the European Union for PV integration in noise barriers along roads and rails. Short-term potential refers to the noise barriers that were planned in 1998 for construction and that are suitable for the integration of PV modules.

Penetration of Photovoltaics into a Traditional Coal Mining Region

This project resulted in the installation of 70 kWp of photovoltaic systems integrated into a noise barrier in the north of France. The region, traditionally associated with coal mining, is now embracing renewable energy technologies in its energy mix.

This project is the second PV sound barrier project developed under the Thermie programme. It represents a pioneering project in France.

The project has three basic aims relating to technical, economic and social issues. They are:

- to undertake a real case comparative study of the differences between amorphous and mono-crystalline silicon modules in a PV sound barrier and validate the application of a new generation of inverter technology.

- to decrease the cost of PV systems for use in sound barriers.

- to provide effective protection for sites currently suffering from high noise levels while simultaneously offering a high profile location for the use of PV.

A whole range of technical innovations characterise this project, including the merging of two separate technologies; sound barriers and photovoltaics. The project benefited from the experience gained at another Thermie-supported sound barrier project in the Netherlands.

In France a short-term potential of 67.3 MWp was identified for PV integrated in noise barriers along motorways. The short term potential refers to all noise barriers that were planned during 1998 for future implementation that are suitable for the integration of PV modules.

In order to get the message about photovoltaics across to the general public in this region, traditionally dominated by coal mining, an extensive dissemination campaign focused on the project has been launched.

Project title PV Sound Barrier
Project number SE/004/95
Contractors Region Nord – Pas de Calais, FR Sunwatt France, FR
Location Lille, France

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PV Integration in Noise Barriers – Catching the Sun While Reflecting the Noise

In order to further increase the public's awareness of PV technologies it is best to install PV systems at places whereas many people as possible can see them. For this reason, noise barriers along motorways are excellent installation sites.

More than 40,000 cars use the A9 motorway near Amsterdam and the international airport Schiphol daily. This is also the site of a 1650 meter long integrated PV noise barrier system with a total capacity of 220 kWp. Since the motorway runs in an east-west direction the PV modules face south so the maximum energy yield is assured.

While producing energy, the 5 m high barrier simultaneously reduces the noise impact on an area containing 700 houses. Since the barrier was new the integration of the PV system could be planned from the beginning. Prefabrication techniques were used wherever possible. The PV modules are integrated into the upper part of the barrier. This led to optimised construction and very fast installation of the components.

The achievements of this project are not confined to technical advances, but also cover architectural and economic aspects. In regard to the latter, the experience derived from this project has resulted in an overall reduction in system costs for such installations and for new projects using AC-modules on a large scale.

Project title
PV integration along highway (noise barrier)

Project number
SE/068/97

Contractors
ENW, NL
Energie Onderzoek centrum Nederland, NL
TNC Energy Consulting GmbH, CH
Fraunhofer-ISE, DE

Location
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PV Power Stations – Quality Power from the Sun

The vast majority of households in Europe are connected to the public electrical grid. Therefore most people are accustomed to a centralised power supply in which electricity is generated at a central power station and then delivered through a distribution system to the end users.

The early days of photovoltaics were characterised by PV systems with limited capacity, they represented exclusively decentralised power supplies. Parallel with technological development, the capacity of PV systems steadily increased. This led to the installation of the first PV power stations generating electricity on a larger scale (up to 1 MWp) increasing the range of possible applications for photovoltaic technology. High capacity systems allow the use of PV systems in many new areas.

This breakthrough into a new dimension of PV systems facilitates electricity supply to larger end users or to many small end users, e.g. the population of an island.

A PV power plant offers the application of techniques that cannot be realised in small PV systems for economic reasons. Examples of these techniques are tracking and concentrator systems.

With a tracking system the PV panel automatically follows the orbit of the sun and as a consequence optimises the energy yield.

With concentrator systems the incoming sunlight is bundled and therefore concentrated onto the solar cells. More sunlight on the solar cells means a higher energy output.

These techniques, used and tested in larger PV power stations can then be transferred to smaller systems in the future. One more step on the way to the solar age.

Tracking the Sun – Optimising the Energy Yield from PV Systems

Quality standards are a major concern in regard to renewable energy technology; they must play a very important role if PV is to become one of the major power sources in the future.

This project aims at investigating and comparing the electrical performance of a 330 kWp PV system which incorporates an active single axis tracking system versus a PV plant with the same capacity but with a fixed supporting structure. The tracking system optimises the orientation of the PV modules with reference to the sun and as a consequence increases the energy yield when compared to a conventional system.

At the same time, the real installation and maintenance costs for a PV system with tracking technique can be evaluated.

In this project technical solutions are applied that have reached the demonstration stage. This project provides technical experience in designing, managing and maintaining of grid-connected tracking systems. It also generates practical experience for the establishment of standards in the field of photovoltaics.

This project is a benchmark installation and helps to promote the implementation of similar projects.

Project title 330 kWp traking sub-field at the 3.3 MWp Serre PV power station
Project number SE/521/94
Contractors ENEL, IT
Location Serre (Salerno), Italy

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A One MWp PV Power Plant in Toledo Using State-of-the-Art Technology

Complementary seasonal peaks in energy yield are one of the characteristic features, and the advantages, of renewable energy which plays an important role in this project.

In La Puebla de Montalbán in the province of Toledo, south of Madrid, a 1MWp grid-connected PV power plant was designed and installed close to a hydroelectric plant.

The Toledo plant was designed as a PV power plant with optimised kWh costs using the most recent advanced technology in the photovoltaic field. Two new types of cells were installed in this big power plant.

A one axis tracking system of 100 kWp ensures that the PV panels follow the movement of the sun during the day optimising the energy yield.

New, advanced inverters were designed and tested in this plant.

The location of the Toledo PV power plant offers very high solar irradiation, and as a consequence, optimal conditions for operation.

An extensive performance monitoring system ensures that all necessary data are collected in order to control the systems performance and to record valuable information that can lead to improvements in future PV plants.

Project title
Design and installation of a 1MWp PV power plant in Spain (Toledo).

Project number
SE/109/91

Contractors
Toledo PV (AEIE), ES
Unión Fenosa, ES
Endesa, ES
RWE Energie AG, DE

Location
La Puebla de Montalbán, Toledo, Spain

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Building Integration of PV Systems – A New Tool for Planners and Architects

The architectural integration of PV systems and their acceptance and use as a natural construction material for buildings is an ultimate challenge for PV technology.

Integrating PV systems in an early stage of construction planning offers a wide range of application possibilities that reach far beyond pure electricity generation.

Two major side aspects of PV modules are their ability to improve the room climate of buildings and appealing optical properties that qualifies them as design materials for architects.

Especially in the southern countries the heating up of a buildings interior during the summer represents a severe problem that can be solved using appropriate shading materials. PV modules are excellent shading materials. Integrated in an suitable part of the building, they protect the interior against the sun, prevent the over heating of the building, while at the same time, converting the sunlight into electricity.

Another important aspect of PV modules is their quality as design elements for architects. Coloured PV cells are a fairly new development that opens up a new field of design possibilities. Especially integrated in facades these coloured cells offer a wide range of new design applications adding aesthetic value to the building. Coloured PV cells, transparent and opaque cells as well as solar roof tiles offer various application opportunities.

The number of available PV cells is steadily increasing. Parallel with the growing variety of PV cells themselves, the range of possibilities in regard to building integration is also improving.

The integration of PV modules into buildings is no longer only interesting from the energy point of view. It is also an important step towards the use of PV as a beautiful, and protective and a functional part of buildings.

Solar Power at the Heart of Europe

This project represents an important signal to the public that PV technology has developed to a stage where it can be incorporated in a complex environment like the vaulted roof of the Lehrter Bahnhof railway station in Berlin. The main hall of this train station was constructed in a modern transparent style. PV modules form an important element of this innovative structure.

In total 3,300 m^2 of semi-transparent PV modules were directly integrated into the slightly curved and vaulted roof that runs in an east to west direction. The installed capacity totals 325 kWp, the electricity generated meets part of the power needs of the train station.

The Lehrter Bahnhof is located in the vicinity of the governmental district in Berlin and represents a very prominent site in the German capital. Approximately 220,000 people pass through this train station every day making this location one of the most frequented places in Berlin and therefore an outstanding location to showcase state-of-the-art architectural integration of PV systems.

Project title
PV Facade Integration at Lerther Station Berlin

Project title
SE/220/96

Contractors
Deutsche Bahn AG, DE
Pilkington Solar International, DE
BP Solar, UK

Location
Berlin, Germany

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DB Station Service Deutsche Bahn Gruppe
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The World's First Large-Scale Integration of Photovoltaics into an Urban Development

A large percentage of Europeans are either tenants or the owners of flats in housing blocks with no exclusive access to the roofs of the building. They often face difficulties involving the property's owners and/or roof warranty issues when attempting to install a PV system.

However, a Thermie supported PV demonstration action in the Netherlands has adopted an innovative approach to overcoming these problems: the local utility is responsible for all issues and costs relating to the PV installation in a newly constructed housing project.

This project, in the area of Nieuw Sloten in Amsterdam, has demonstrated that photovoltaics are a feasible option as a source for domestic energy. The project equipped a number of houses in the district with PV modules that were integrated into the roof and provide energy to the grid. In this way, solar energy has also been integrated into the everyday life of the residents. The project constitutes a major tool for enhancing the general public's acceptance of renewable energy and especially of photovoltaics.

The Nieuw Sloten project also helped to develop a series of recommendations for the future. New projects will benefit enormously from the practical experience gained through the first grid-linked PV project of this magnitude in an urban area.

Project title
250 kWp PV systems on roofs in Nieuw Sloten

Project number
SE/168/93

Contractors
Energiebedrijf Amsterdam (presently NUON), NL
Miljøkontrolen, DK
Sermasa, ES

Location
Amsterdam, The Netherlands

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NUON Renewable Energy
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PV Power for the Financial World

The financial sector plays an important role in the development of photovoltaic markets since the up front costs for PV systems are often financed by bank loans.

In this case a bank was actively involved in a PV project. A 101 kWp PV system was installed on the roof of the new Berlin Bank building. Part of the energy used by the employees in this new building is generated by the in-house plant.

The power plant on its roof did not interfere with the buildings architectural design.

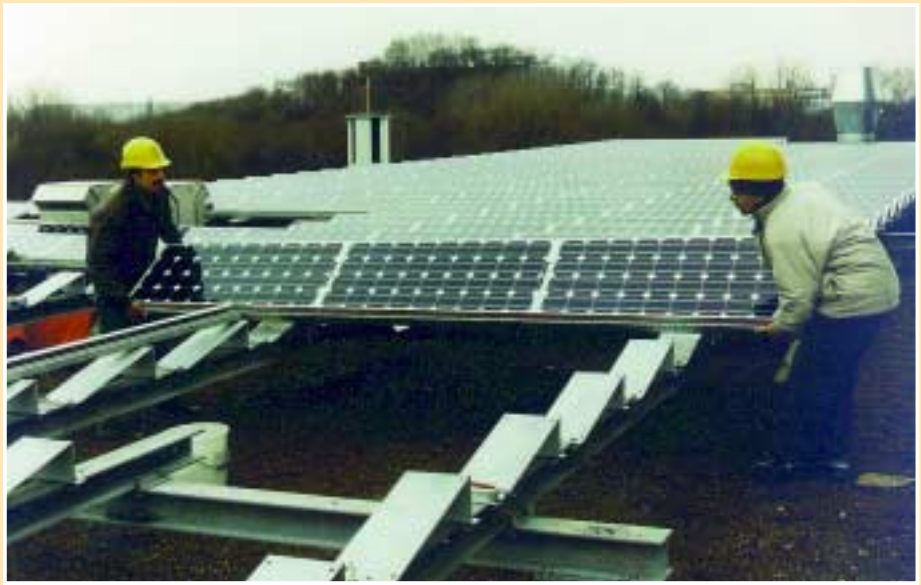
Not only does this PV plant replace electricity produced by conventional power stations — reducing the yearly production of CO2 emissions by 75 tons – it is also sets an important signal that a PV system was installed in Berlin, the German capital, and a focal point of public awareness in Germany.

Project title
PV service centre for the Berlin Bank

Project number
SE/154/95

Contractors
Bankgesellschaft Berlin AG, DE

Location
Berlin, Germany



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PV Power as an Element in an Ecological Renovation Concept for Buildings

How can an old building be renovated by integrating materials and technologies that do not damage the environment?

This was the challenge facing the international organisation Greenpeace when it started upgrading its new headquarters on the river Elbe in Hamburg.

Environmentally friendly solutions, such as a mixture of jute and recycled paper for walls, rain-water collectors and no PVC protecting

cables, also include electricity generation through photovoltaics.

A 51 kWp grid-connected PV system was installed on the roof of the building meeting about 25% of the buildings electricity demand on a yearly average.

Project title PV power station at Elbspeicher Hamburg
Project number SE/313/95
Contractors Rasmussen & Schiotz Holding A/S, DK Greenpeace, DE Siemens Solar, DE
Location Hamburg, Germany

As this project demonstrates, alternative and environmentally friendly solutions in large projects require significant commitment and investment in time to identify viable options, but that they, in the end, need not impose a large financial burden on the renovation.

This Elbspeicher building demonstrates the vast potential for the integration of photovoltaics in old and historic buildings.

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Photovoltaics in a Car Production Plant

Car production factories were one of the most far-reaching examples of the implementation of Taylor's theories, which basically aimed at increasing the productivity of the workforce without considering social aspects or the working environment.

Times have changed significantly since then and this project demonstrates that some car manufacturers are committed to improving both the internal and external environment.

26 photovoltaic roof lights have been installed in the Ford-Bridgend engine plant (South Wales). Opaque, large-area PV laminates have been incorporated into the south-facing side of the roof-light. The side facing north, incorporates double-glazing, providing natural daylight in the building.

The implementation of photovoltaic modules in factories represents a step forward, toward the factory of the future.

The natural sunlight provided by the PV roof lights enhances the working environment and thus improves productivity.

Project title
Architecturally integrated grid-connected PV rooflights for the Jaguar/Zetec SEII plant of Ford UK

Project number
SE/112/96

Contractors
Ford Motor Company, DE
BP Solar, UK
OVE ARUP & Partners, UK

Location
Bridgend, United Kingdom

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IMPACT– A New Concept on the Road to Cost Optimised PV Systems

Cost efficiency for high quality grid-connected PV systems was the main target of this project that was realised in France and Germany.

Within the IMPACT project 100 grid-connected PV systems, each with 2 kWp capacity, were installed totalling 204 kWp. The installation sites are located in Hamburg, Schleswig-Holstein, the most northern state in Germany, and in 5 areas in France.

A price advantage over other PV systems with a similar quality standard was achieved through a new approach to marketing and installation.

The essential pillars of this innovative concept are the central and superimposed project management structure combined with decentralised installation. The work was carried out by local companies that are experts in PV installation. An optimised project structure with low general overheads was created. Central purchasing and storage of the components combined with "just in time" delivery and reduction of installation time through the use of new techniques for fastening the modules on the roof contributed significantly to cost savings.

An additional impulse for optimising costs came from the standardisation of the systems and the strategy to purchase a minimum of 100 systems.

For the first time in the European PV market the Internet was used for promotion and training activities. Information about the project including the installation techniques and handling of the components is available under www.setwedel.de.

Project title
Impact project for new generation of PV grid-connected systems with advanced technologies and market strategy

Project number
SE/014/97

Contractors
SET, DE
Quénéa, FR

Location
Germany, France

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Multifunctional PV Facades – PV Systems that Go Beyond Emission Free Electricity Generation

The increasing versatility of PV systems offers new fields of application and supports the development of the PV market. PV offers new possibilities for designers and architects, especially in the urban environment.

In the 3 European countries of Germany, the Netherlands and Spain multi-functional grid-connected PV facades were installed in commercial and industrial buildings, one of them, in the office building of a company involved in the realisation of the PV systems and component.

All systems feature innovative facade elements and offer value above and beyond the pollution free generation of electricity and aesthetic aspects.

The system in the southwest part of Germany with a capacity of 53.1 kWp is integrated in the facade of the Solarfabrik. The modules offer shading services and day lighting of the atrium in addition to electricity production for this low energy building in Freiburg.

Two systems are installed in the Netherlands. One of them with a capacity of 13.7 kWp is integrated in the facade of the electrical installation company Hollander in Apeldoorn it features shading and has excellent demonstration aspects for clients that are interested in PV systems.

The 6.9 kWp VAR (Veluwse Waste Recycling) system consisting of AC-modules is the second Dutch installation for this project. AC-modules offer various advantages especially if they are not uniformly oriented as it is the case with this system. The modules are used as shading elements facing the directions from east over south to west.

The main achievements of this project are the demonstration of the variety of added values that PV systems can offer besides their role as a generator of pollution free electricity. Especially this project has contributed to:
- serious interest and increased professional involvement of electrical installation companies in PV technology,
- improved recognition of PV by building industry, property developers, architects and the general public.

Project title
Multifunctional PV façades in Spain, Germany and The Netherlands

Project number
SE/100/97

Contractors
ECOFYS, NL
IST EnergieCom, DE
TEULADES I FAÇADES, ES
Bauherrengemeinschaft Solar-Fabrik, DE

Location
Spain, Germany and The Netherlands

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Photovoltaics – An Element of a Utility's Portfolio

A crucial step towards the further dissemination of PV technologies is when companies involved in electricity production and electricity services include PV systems in their portfolios.

In this project the Spanish electricity producer EHN located in Navarra northern Spain, installed 2 grid connected PV systems with a total capacity of 50.4 kWp.

One PV system with a capacity of 21.9 kWp was integrated in a bio climatically designed building where all of EHN's production activities are telecontrolled. This building is designed to combine the use of passive, thermal and PV solar energy.

The second system with a capacity of 28.8 kWp is integrated in a sub-station of the „La Gerinda" wind farm that is also operated by EHN. This second installation represents a good example of the possible symbiosis of wind and PV solar energy. It underlines that wind energy and PV solar energy do not exclude each other. On the contrary, they offer excellent opportunities for mutual work in a larger system. Possible standardisations for such combinations were also investigated in the project.

This project represents a first step towards a comprehensive electricity supply through renewable energies in a European region whose goal is to cover 53% of its electricity generation by wind power.

Project title
Integration of a grid connected 50 kWp PV generator in the production telecontrol building „Energia Building"

Project number
SE/122/97

Contractors
Albasolar, ES
Energía Hidroeléctrica de Navarra, ES
GAPI, ES
BP Solar, UK
Centre for Renewable Energy Sources, UK

Location
Tafalla and Leoz, Navarra, Spain

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Cost Optimisation of PV Systems through Standardisation and Minimising Installation Costs

Decreasing costs for electricity produced by PV systems is still a major aim in order to increase the market for PV. One promising possibility for cost optimising PV systems is a combination of standardised PV systems and decreasing the installation costs by making it possible for individuals to take over some of the installation work themselves.

In this project 150 small, grid-connected PV plants in the power range from 0.5 up to 11 kWp were put in totalling 200 kWp of installed capacity. Ten of these systems were equipped with analytical monitoring.

The basic aim is to reduce costs through system standardisation and the participation of the PV system owners in the installation process.

Training programmes teach individuals how to install a PV system. In order to simplify the installation process, a new standard lightweight frame is used. Assistance from a professional technician who can also approve the installation is offered.

Project title
151 Small grid-connected PV station for a total of 200 kWp

Project number
SE/190/97

Contractors
Association Phebus, Les Sauvages, FR

Location
France

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Coloured Cells in Buildings

Coloured PV solar cells significantly increase the versatility of PV systems in buildings and represent a new possibility for architects to integrate photovoltaics into a facade in an aesthetically appealing way.

In the City of Terrassa, close to Barcelona, a building next to the Museu Nacional De La Ciència I La Técnica de Catalunya (mNACTEC) represents an appropriate location for a showcase of the new possibilities created by a combination of coloured opaque and semi-transparent solar cells.

The 34 kWp grid-connected PV system installed on a tilted facade consists of a patchwork of coloured opaque and semi-transparent mono- and polycrystalline solar cells. The colour sequence from bottom to top is blue, magenta and gold. The semi-transparent element in the PV systems allows the sunlight to pass through the cells and illuminate the central patio of the neighbouring building.

Another aspect of the project is the ventilation implemented between the solar cells and the facade. This has the effect of decreasing the cell temperature and, as a consequence, increasing the energy yield while simultaneously improving the insulation characteristics of the facade.

This innovative PV facade demonstrates that there is a wealth of aesthetically appealing solutions offered to architects by PV systems.

Project title
A grid connected coloured façade in the urban area of the Technique and Science Museum of Catalunya

Project number
SE/206/97

Contractors
Museu National de la Ciència i de la Tècnica de Catalunya, ES
Laboratoire Analyse et Architecture de Systémes du CNRS, FR
Teulades i Façanes Multifuncionals SA (TFM), ES
BP Solarex, UK

Location
Terrasa, Spain

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AC Modules Providing Grid-Quality Power

The purpose of this project was to gain experience with alternating current (AC) modules in countries with varying climates and to assess their yield and reliability. In addition, a new and cheaper mounting method, based on recycable plastic, for flat roof and ground based systems was implemented.

The test countries were Portugal, Italy and the Netherlands.

The significance of AC-modules is that they provide the same type of power that is available from the electrical utility grid. This greatly simplifies the system from the customer point of view, since the end-user can regard an AC-module as a "plug and play" device. Less complexity makes it more likely that customers interested in installing systems themselves will make a "buy decision" for photovoltaics.

AC-modules have significant advantages in terms of system efficiency at installations with non-uniform PV module orientation or shadowing of individual modules during the day.

Grid-connected AC-modules must be able to disconnect themselves from the electrical utility network when problems arise in the grid. All of the systems developed within this project proved to be suitable for safe grid-connected operation, switching off in cases where grid parameters were out of the specified window.

This project showed that, from a technical point of view, AC-modules are ready for the market.

Project Title
AC Module PV Systems in Italy, Portugal and the Netherlands

Project Number
SE/226/95

Contractors
ECOFYS, NL
ENEL, IT
INETI, PT
EDP, PT

Location
Adrano, Italy
Faro, Portugal
Amersfoort; Utrecht, The Netherlands

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Photovoltaics Powering Pavilions

This project clearly demonstrates the versatility of photovoltaics. The modular structure of PV systems allows them to be exactly tailored to the user's electricity needs as well as to their environment. 9 PV systems with a capacity range of 1 kWp to 5.8 kWp were installed totalling 33.6 kWp.

The systems were integrated in 9 pavilions or similar constructions along the coast line of the Baltic and the North sea. With the already existing pavilions the PV systems had to be adapted to the building structure, while in case of newly constructed pavilions the system could be integrated in the design of the building from the beginning. 7 of the systems are grid connected and two of them are for stand-alone applications.

Installation sites include pavilions at a camping site and at the heart of a newly designed public market place in Hamburg-Wilhelmsburg. Two systems with 5.1 kWp and 4.8 kWp were installed in the 'Technik- und Ökologie Zentrum' (TÖZ) a centre that belongs to the city of Eckernförde and is used by new and innovative small companies. The building, one of the most interesting ones in the area, became an EXPO 2000 building in 1998.

For the UNESCO Institute for Education a transportable container pavilion was equipped with a 2.8 kWp PV system that can be dismantled for transport or set up for operation within one hour. The container is used for various UNESCO projects outside Europe.

Project title PERLAS
Project number SE/357/91
Contractors SET, DE BP Solar, ES
Location Baltic and North Sea coast, Germany

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Solar Energy on the Move
Photovoltaics in Transport

Transport is responsible for 30% of the final energy consumption in the European Union, it accounts for 26% of the CO2 emissions arising from fossil fuels. While the levels of CO2 emissions from industry and household sectors have fallen since 1985, those from the transport sector have increased by 40% during the same period.

As one plank of the European Union's policy to demonstrate the role of renewable energy technologies in transport, the Thermie programme supported the integration of photovoltaics in a number of sectors. Municipal railway, public transport systems and boats were a particular target of the Thermie programme since they represent some of the most cost-effective applications for PV in the transport sector.

Photovoltaics in Europe is on Track!

Since photovoltaic generators produce electricity in the form of direct current (DC) they are optimally matched to applications that can use this form of power directly, without the need to convert it first to the more widespread alternating current (AC). In this sense, PV systems are simpler than those connected to an electrical grid and are therefore potentially more cost-effective and certainly more reliable.

Light railway and tram networks, which generally operate with up to 1100 volt direct current, are a good example of a near perfect application for photovoltaics, especially since they often consume all the power produced by the PV system, hence avoiding the need for expensive energy storage technologies.

The large number of passengers carried by such public transport is also an opportunity for getting the message across that photovoltaics has a role to play in everyday life – after all it's powering my train!

Even Away From Dry Land, Photovoltaics is Gaining Ground...

Ships and boats represent a very promising application for photovoltaics since they must generate all their energy on-board. Such high visibility PV systems can easily be integrated into many of the exposed surfaces on boats and can take over both traction or non-traction energy supply tasks from the diesel engine. This offers significant advantages particularly on in-land waterways as it would no longer be necessary to, for example, keep the engine running to provide cabin power when the boat is moored. Such PV installations simultaneously reduce pollution from both emissions and noise.

Photovoltaics on Electric Car Shelters Provide Fuel and Protection against Overheating

Inhabitants of Mediterranean countries experience sun power as soon as they get into their cars. The heat in the interior, makes the search for a shaded parking space part of the daily routine — especially during the summer months.

Therefore, the mounting of PV modules on a parking shelter for electric cars offers two advantages at the same time. The modules use the sunlight to provide the electric car with pollution free power and simultaneously provides a shady spot to park.

This project was realised in the Reggio Emilia in northern Italy. The total installed capacity of the 1,917 PV modules is 94 kWp, and is able to power three car-charging points. The electric cars, which belong to the city services, are charged by solar energy produced on the roof of the shelters.

This project has an additional and pleasing symbolic value. Photovoltaics, providing clean energy for cars that are otherwise a threat to the environment.

Project title Autosole
Project number SE/454/92
Contractors ANIT, IT
Location Reggio Emilia, Italy

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Solar Power for the Tramway from the Roof of a Media & Arts Centre

In this project innovation goes hand in hand with building refurbishment, electricity generation and sustainable transport.

In this Thermie supported project in Karlsruhe, Germany, a 100 kWp photovoltaic plant was installed on the roof of the new Centre for Arts and Media (ZKM). This recently renovated historical building –which was previously a munitions and armaments factory– has offered both engineers and architects much scope for demonstrating technical innovations as well as the many options that exist for aesthetically integrating PV into buildings.

Rather than using the power for the Centre's own needs or feeding it into the local electrical utility grid, the solar-generated energy from this project will be injected into the local tram network.

This so-called "directly coupled PV system" provides for greater technical simplicity than would be possible if the building used the power itself. It may prove to be more cost-effective than conventional systems that require devices to convert the voltage.

In addition, the architectural integration of the PV modules into the Centre's roof allow supplementary daylight to enter the building while providing valuable shading during sunny days. Approximately 100,000 people are expected to visit the Centre each year – the vast majority of them will use the tramway to get there – this will ensure that this prominent PV demonstration project receives the recognition it deserves.

Complete details of this PV system together with up-to-the-minute information on the power output are available on the internet at: www.zkmsolar.Karlsruhe.de

Project title
ZKM Karlsruhe - Tramway system with direct coupled photovoltaic power supply

Project number
SE/034/94

Contractors
Stadtwerke Karlsruhe, DE
Gesamthochschule Kassel, DE
Fraunhofer-ISE, Freiburg, DE

Location
Karlsruhe, Germany

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Solar Powered Trains – Photovoltaic Energy for Municipal Light Rail Transit Systems

Hanover is the host of the EXPO 2000 World Exhibition. The Hanover light railway system will play a major role in transporting participants around the municipal region. Since the theme of EXPO 2000 is "Man – Nature – Technology", the City of Hanover has decided to demonstrate its commitment to promoting more environmentally-friendly energy production at the local level by installing a 250 kWp photovoltaics system which will feed exclusively solar-generated electricity into the light railway network.

Simultaneously, and with the financial support of the Swiss Federal Government, the Hanover project will result in the installation of up to 250 kWp in Geneva and Lausanne to help power the public transport systems in these two cities. The applications in Germany and Switzerland will synergistically benefit from each other's experience in developing and optimising such PV applications.

The large number of passengers carried every day by the public transport networks in Hanover, Geneva and Lausanne, supplemented by national and international visitors to these cities, represents a vast audience who will actually experience the power of photovoltaics.

Project title
500 kWp PV power plant for direct injection in light train low voltage dc networks

Project number
SE/146/96

Contractors
ÜSTRA, Hanover, DE
SUNWATT, Gaillard, FR
SUNWATT Bio, Chêne-Bourg, CH

Locations
Hanover, Germany
Geneva & Lausanne, Switzerland

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Photovoltaics – the Rural Population's Hope for Electricity

There was a time when it seemed that some day every individual everywhere in the world would have access to a public electrical grid. Today, it is clear that this is not realistic nor does it represent an economically viable option. This is not only the case in developing countries, but also applies to isolated and/or sparsely populated regions in Europe.

One third of the world's population still have no access to electrical power, even though its availability is a prerequisite for improving living conditions and fostering economic development.

In the developed world remote locations without a reliable and sufficient electricity supply are not attractive living areas, and as a consequence, are in danger of being abandoned by the young local population. This situation threatens cultural heritage that was established over centuries.

Photovoltaic continues to demonstrate its suitability in rural areas because of its cost-effectiveness, its standalone nature and its ability to be tailored to the exact energy needs of the end-user. Over 300,000 non-grid connected houses have been identified in southern Europe alone. If equipped with PV, they would represent an installed capacity of over 175 MWp.

Non electrified areas in developing countries represent major markets for rural electrification activities. European Industry, with its experience, the quality of its products, and its cost levels should be able to play a key role in this huge market.

By helping to meet the electricity demands of rising populations in rural areas in both developed and developing countries, photovoltaics can reduce some of the more pressing problems affecting these regions. Supplying rural populations with electricity means offering the inhabitants a perspective for the future that can reduce migration to urban areas and simultaneously help the environment.

Photovoltaics – Powering Agriculture in Southern Areas of the European Union

Access to a reliable and efficient form of electrical power is a prerequisite for the economic sustainability of rural regions in the European Union. Particularly remote regions that suffer from under-development or are undergoing economic restructuring must have access to sufficient energy otherwise their recovery will not be effective and local employment opportunities will simply disperse. This project demonstrates the role of photovoltaics in helping the economic development of depressed farming communities. The aim was to install photovoltaic systems on farms in order to provide power for machinery.

Seven farms (one of which was converted into a rural tourist hostel) in the Jaén region of Andalusia, southern Spain, were selected as the sites for the PV systems. The aim was to provide innovative clean energy. The Services range from water pumping to lighting.

Project title
Electrification of farms using PV in Jaén (Spain)

Project Number
SE/113/93

Contractors
Solar Jiennense SL, ES
Asociación Agraria Jóvenes Agricultores, ES

Location
Jaén, Spain

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Improved Living Conditions in Remote Mountain Areas through Photovoltaics

In this project 72 PV systems were installed in France and Italy, in the Department Alpes-Maritimes, the Provence-Alpes-Côte d'Azur Region and the Italian Maritime Alps. All these areas are characterised by high levels of solar irradiance.

The goal is to demonstrate that PV systems provide economically viable, reliable and environmentally friendly electricity and, as a consequence, significantly raise the standard of living in areas where they are installed.

The selected installation locations are homes, mountain refuges, sheep shelters, and fire-fighting equipment stations in areas that are not connected to the public electrical grid. The installed capacity totals 27.7 kWp, the range of system capacity is from 50 Wp to 1,600 Wp. On-site or remote monitoring was incorporated in installations with more than 300 Wp capacity .

Many remote mountain areas in Europe face the problem of decreasing populations, and as a consequence, the threat of cultural heritage loss.

This project clearly demonstrates that PV systems can make remote areas more attractive for the local population by enhancing the quality of life.

Project title
Photovoltaic electrification of isolated sites in the French and Italian Maritime Alps

Project number
SE/181/93

Contractors
ARENE, FR
Transénergie, FR
Total Energie, FR

Location
France, Italy

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PV Electrification of Remote Sites in France, Spain and Italy

Ninety-three sites in France, Spain and Italy where the connection to the public grid is not economically viable have been electrified by PV systems with a total installed capacity of 92 kWp.

Innovative systems were installed that provide advanced energy service such as:
- lighting
- refrigeration
- pumping
- telecommunications

Two different concepts were compared with respect to technical and economic aspects. Some of the systems produce only direct current (DC) while others include an inverter, to transform the direct current to alternating current (AC).

The installations are equipped with a data acquisition device for monitoring the systems and controlling their performance. The project has allowed the validation of the „guarantee of service" concept in connection with electricity utilities.

Project title
TRANSEUROPEO

Project number
SE/405/94

Contractor
Groupement Européende Recherches Technologiques sur les Hydrocarbures, FR
Transenergie, FR
EDF, FR
ENEL, IT
ATERSA, ES

Location
France, Italy, Spain

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PV User Association – Full Electricity Service for Isolated Dwellings

The objective of this project is to provide rural populations with a degree of electrification that is adequate for their needs, while simultaneously offering services that are enjoyed by urban dwellers. This means that remote customers should be able to use standard electrical appliances without having to adapt them to a different electrical system.
This project recognised that one of the major difficulties of large-scale PV standalone projects, as opposed to providing the same power through a conventional grid, is the micro management, installation, commissioning, financing and – most important of all – the system's maintenance.

These challenges have been met by adopting a system whereby the installations are commissioned and owned by a users association (SEBA) which rents them to the users and carries out maintenance and repairs.

The advantages of this scheme are:
- Cost savings through collective purchase.
- Establishing a local critical mass of installations to facilitate the creation of sustainable specialised jobs.
- The option to update and expand power and services as the need arises.
- Grouped procurement of high-efficiency appliances.

Project title
PV standalone and hybrid systems with solar directly water heating in natural parks of Catalonia (Spain) & Aude (France)

Project number
SE/354/95

Contractors
Asociación SEBA, ES
CEA-GENEC, FR
Trama Tecnoambiental, ES

Location
Spain and France

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PV Power for Islands – Realising Independent Electricity Supply

Islands are very often not connected to the electrical grid of the main land and as a consequence have to build up there own electricity generation capacity. Especially on smaller island the costs for this set up are prohibitively high compared to the income generated by the relatively small amount of power that can be sold.

In these cases, photovoltaics offer significant advantages over the other main options like coal, gas, oil or diesel. PV is simply cleaner, more reliable and often more cost-effective. And – most importantly – in terms of fuel supply logistics, the sun's radiation doesn't need to be regularly shipped to the island as it is the case with the conventional fuel!
The shipment of conventional fuel always carries a potential risk for environmental catastrophes in case of a shipping accident.

Besides these logistics aspects there are also other reasons why photovoltaic is a first choice source of energy for islands. Islands often represent ecological sensitive areas very specific flora and fauna that needs special protection. Pollution free electricity generation is one way to preserve the living conditions of theses species.

Concentrating Sun Power

Concentrating sunlight onto a reduced area of solar cells is a potentially feasible way of reducing the cost of PV plants.

However, too little experience has been gained so far on PV concentrators. This fact can mainly be explained by the lack of availability of concentration cells, which are more complex than standard solar photovoltaic cells. In addition, a concentrating system needs substantially fewer and smaller cells than the flat module technology. As a consequence, concentration cells are not as profitable for PV manufacturers. The result is, that fewer concentration cells are produced and at a very high cost.

A new initiative was undertaken by the EUCLIDES project that led to the development of a comprehensive technology for PV concentration and the design and installation of a 480-kWp demonstration plant in the southern part of Tenerife.

The new technology is based on four components: concentration modules, concentrator optics, heat sinks and structure. The combination of these four components led to a significant step forward in concentrator technology for PV in respect to costs. It is a realistic goal that EUCLIDES can contribute to a significant (up to 50 %) reduction in PV systems costs.

The evaluation of overall energy production and component performance at a relatively low latitude is important, because one of the most significant markets for the EUCLIDES technology is in developing countries.

Project title
Demonstration Power Plant based on the Euclides Photovoltaic Concentrator

Project number
SE/064/96

Contractors
ITER, ES
BP Solar, UK
Instituto de Energía Solar, UPM, ES

Location
Tenerife, Spain

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Photovoltaics Help to Meet the Seasonal Energy Demands on Mediterranean Islands

Leisure time is increasing in modern life. Therefore, the amount of energy devoted to activities during our free time is also on the rise.

Vulcano is a volcanic island situated in the Mediterranean. Its main economic resource is tourism.

In order to cope with increasing energy demands during the tourist season, a low-cost photovoltaic generating station has been installed on the island. The size of the plant is 100 kWp.

The Vulcano plant is an optimised solution to seasonally varying demands for clean energy. The output of a solar energy generator is generally at a maximum during the summer time, exactly when the demand is highest.

The alternative solution, conventional plants is particularly expensive on these islands sites due to the high cost of fuel transportation and maintenance.

Fossil fuel generators are also a source of pollution which tourists do not appreciate.

In addition to strengthening the distribution systems in an extensive electrical grid, this project also highlights the application potential of PV in important niche markets, such as isolated grids and for powering reverse osmosis water desalination plants.

Project title
Design and construction of a photovoltaic plant connected to the electric grid of small Sicilian islands

Project number
SE/026/91

Contractors
ENEA, IT

Location
Vulcano, Italy

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Sunny Islands in Greece – PV Competitive with Conventional Energy

The Greek islands, popular tourist areas, represent a strategic location for increasing awareness about photovoltaics amongst a large audience.

This project consists of the installation of a 60 kWp grid-connected PV system on the island of Sifnos, located in the Aegean Sea.

This project aims at demonstrating and gauging the utility of photovoltaic technology in terms of energy costs and environmental benefits in the Greek islands. At the same time this initiative will provide practical experience on the introduction of PV systems into the local electrical grid.

Advanced inverters and a centralised design minimise its technical complexity and make this project a feasible option for sustainable energy in Mediterranean countries.

Project title
Installation of 60 kWp of new type modular photovoltaic systems in the Greek Islands of Sifnos

Project number
SE/135/96

Contractors
CRES, GR
PPC, GR
ANIT, IT
SMA, DE

Location
Sifnos, Greece

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PV Systems on Islands off Germany's Northern Coast Demonstrate that PV is also Viable in Northern Europe

Electricity consumption on islands reaches a peak during the summer vacation times. Islands, are also often ecologically sensitive areas. This combination of characteristics offers an excellent opportunity for the use of renewable energy.

Each year thousands of people spend their vacation on the islands of Amrum and Sylt located off Germany's northern coast, increasing the local demand for electricity dramatically.

9 grid-connected PV systems with capacities ranging from 1 kWp to 5 kWp have been installed on the islands of Amrum and Sylt and in the city of Schleswig. The installed capacity totals 23 kWp.

Examples of the various applications are an aesthetically pleasing roof, modules integrated in a bicycle shelter, a roof integrated system in a hospital for children and a PV system at the train station in Westerland, which is the most northern city in Germany. Another system was installed at a public swimming pool. All of these places are locations visited by large numbers of people.

The link between photovoltaics and the aspects of environmental protection is emphasised by a PV system installed in a building in the natural reserve centre on Sylt.

Project title SEN-AILÖN
Project number SE/487/94
Contractors SET, DE
Location Sylt Islands, Germany

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Solar Power for Guadeloupe

Water shortage is a severe problem in many areas of the world.

In Guadeloupe, a French overseas territory, the northern part of 'Grande Terre' and the island of Marie Galante are frequently confronted with droughts that are a severe problem for the cattle ranchers. During dry periods water normally has to be hauled in to the cattle with vehicles.

To solve these problems 12 PV powered pumps were installed, 7 on the island of Marie Galante and 5 on the main island Grande Terre. These solar pumps can supply between 50 and 300 cattle with water and are equipped with a telemetering system, which allows remote control of the pumps.

These installations were the starting point for a growing network of PV powered watering troughs, now totalling 60 solar pumping systems.

The positive results of this project created a snowball effect. PV pumping systems are now also used on Tahiti and in the Dominican Republic.

Project title
Water supply through telemetered solar pumps for the cattle rearing regions of Marie Galante and Guadeloupe

Project number
SE/178/93

Contractors
Solelec Caraibes, FR

Location
Marie Galante and Grande Terre (Guadeloupe)

Another PV project on Guadeloupe proved the reliability of PV systems even under extreme conditions. When a massive cyclone devastated the island of La Désirade (Guadeloupe) the PV generators demonstrated their worth. Most other infrastructure was destroyed, but the PV modules helped to secure the performance of vital services on the island.

The project was made up of autonomous 21,5 kWp shared by 18 generators located at vital distribution centres on the island of la Désirade.

The PV systems installed in this project were deployed for two distinct purposes –to backup the grid electricity supply for critical applications, and to act as a demonstration installation for non-grid connected applications such as playgrounds and schools.

This project served to enhance the perception of solar energy as a reliable and secure source of energy in areas where grid-energy may have severe problems due to natural phenomena.

Project title
Photovoltaic Generators at the Service of Security on the Island of „La Désirade"

Project number
SE/167/94

Contractors
VERGNET S.A., FR
VERGNET Caraibes, FR

Location
Island of la Désirade (Guadeloupe)

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PV Power Boosting the Environmental Experience in Galicia, Spain

The Cies Islands Natural Park is situated at the mouth of the Ria de Vigo in the Galicia region of Spain. It consists of an archipelago of three main islands and various small islets. The park is home to the world's largest colony of yellow-legged seagulls. The magnificent natural richness of the park attracts large numbers of visitors, reaching 2,200 daily during the summer period.

Within the context of this project a PV plant with a capacity of 12kWp has been installed in the park. The advantage of this location is that demonstration and dissemination of PV systems reaches an audience of thousands of visitors each year.

The aim of this project is to transform the natural park into an information and education centre on renewable energy where visitors can see, in practice, that it is possible to cope with human energy needs without destroying the environment.

The PV plant meets the electricity needs of the installations devoted to information and security surveillance.

Project title
PV electric power supply for the Cies islands natural park

Project number
SE/232/95

Contractors
Universidade de Vigo, ES
Fundación Empresa Universidad Gallega, ES
Conselleria de Medioambiente Xunta de Galicia, ES
Instituto de Energia Solar, ES
BP Solar, UK

Location
Cies Islands, Galicia, Spain

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Other Uses – Photovoltaics Covering a Broad Range of Applications

Besides the various fields of applications presented in the preceding 6 chapters photovoltaics offers many more application possibilities. A few of these are presented in the following chapter.

These projects demonstrate versatility as one of the great advantages offered by PV. The areas telecommunications, waste water treatment, improvement of water quality and integration of a PV system on a parking shelter are some examples for the increasing importance of PV in very different areas of everyday life.

For the future development of Photovoltaics it will be essential to continue the expansion of application areas for PV technologies and to implement them in areas that were so far not considered as typical PV application fields.

The development of new products by the PV industry will significantly support this expansion process and will help to implement photovoltaic technologies in the public's mind as a reliable, environmentally friendly and cost-effective source of electricity.

PV on a Parking Structure

A modern university education not only provides students with a solid theoretical background, it also raises their awareness concerning today's global challenges. Finding alternative sources of energy to power sustainable growth and development is certainly one of the biggest challenges facing new generations.

This project aims at installing PV arrays in several buildings at Jaén University in the Spanish region of Andalusia. A facade, a pergola and car-park shelters of the university have photovoltaic modules integrated into their roofing structures. The sunlight conditions of the region, together with the location in the university buildings provide an ideal means to get the message across to the student community that solar energy is a feasible, viable and environmentally friendly alternative to conventional sources of energy.

Space considerations used to be a critical point for solar energy. Now, advanced techniques can integrate modules into buildings. Parking structures offer good opportunities to install PV systems without blocking an area that is valuable for other purposes.

Project title
Universidad Verde (UNIVER)

Project number
SE/383/95

Contractors
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University of Northumbria, UK
Instituto de Energía Solar, ES
Solar Jiennense, ES
Isofotón, ES

Location
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Combining Innovative and Rapidly Expanding Technologies – PV and Mobile Telecommunications

Access to sources of information is one of the keys to economic development. Telecommunications is the door to that information.

Parallel to the rapidly growing number of mobile phones the number of transmitter stations that are installed in remote areas is also increasing. During their initial operation phase there is often no grid connection possible.

This project aims at bridging the time span from the start of the transmitter operation, to the time when a stationery PV system is installed, or a connection to the grid is possible.

The achievement of this project is the design and construction of three mobile hybrid power stations consisting of a 4.4 kWp PV system and a diesel back-up generator. The systems are mounted on trailers for mobility so that they can meet the electricity demand of transmitter stations in Portugal in their initial operation phase.

As soon as a permanent electricity supply is available the mobile hybrid power supply system can easily be moved to another location. The quick and easy set-up of the hybrid system is an important feature of this development.

This project demonstrates that PV systems are highly reliable power sources as required by the operators of transmitters. Since transmitter stations are also often installed in ecologically sensitive areas a practically noise and pollution free source of power plays a very crucial role.

Project title
Mobile PV supply for telecommunications

Project number
SE/096/95

Contractors
ARES Energiesysteme GmbH, DE
ATERSA, ES
TELECEL, PT

Location
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Photovoltaics for Water Treatment and Improving Water Quality (1)

The regions in the southern part of Europe are, even today, characterised by high levels of waste water that is not processed in any treatment chain. One of the most significant reasons for this are the high running costs caused by heavy energy consumption.

The objective of the project in France was to install two photovoltaic systems which will allow the optimisation of water treatment in natural lagoons.

The project in France exploits PV as a clean source of energy for the treatment of used water. This innovative combination represents a major tool to preserve the ecosystem of the region and to raise the environmental awareness of its inhabitants.

Given that the Southern regions of Europe are subjected to severe water restrictions during the warmer period in the summer, this project provides fresh water for farmers fields, as well as for other purposes. In this way, the photovoltaic systems help alleviate water scarcity during dry periods.

A total of 181 PV modules with a power rating of over 11 kWp were installed in two locations.
Particular care was taken that the PV systems were optimally integrated into the landscape.

Project title
Water Treatment Optimisation

Project number
SE/058/95

Contractors
APEX Ingénerie, FR
Inmedio Ambiente, ES
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Location
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Photovoltaics for Water Treatment and Improving Water Quality (2)

The second project located in the protected area 'La Albufera' in Valencia (Spain) uses PV to increase the level of oxygen in a lake in order to diminish the eutrophication of the lake. The oxygen content of the water is low due to pollution which has negative consequences on the flora and fauna of the area. The PV modules are mounted on a floating structure on the lake and deliver the electricity for the compressor that supplies the water with oxygen through a submerged diffuser.

The main achievement of this project lies not in the installation of a large PV capacity but in a innovative application of PV technology in a ecologically sensitive area.

Project Title Water Oxygenation with Photovoltaic Energy
Project Number SE/179/95
Contractors Aplicaciones Técnicas de la Energía, ES Shurflo LTD, UK
Location La Albufera de Valencia, Spain

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The network of Organisations for the Promotion of Energy Technologies (OPET), supported by the European Commission, helps to disseminate new, clean and efficient energy technology solutions emerging from the research, development and demonstration activities of ENERGIE and its predecessor programmes. The activities of OPET Members across all member states, and of OPET Associates covering key world regions, include conferences, seminars, workshops, exhibitions, publications and other information and promotional actions aimed at stimulating the transfer and exploitation of improved energy technologies. Full details can be obtained through the OPET internet website address http://www.cordis.lu/opet/home.html

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Notice to the reader

Extensive information on the European Union is available through the EUROPA service at internet website address http://europa.eu.int

The overall objective of the European Union's energy policy is to help ensure a sustainable energy system for Europe's citizens and businesses, by supporting and promoting secure energy supplies of high service quality at competitive prices and in an environmentally compatible way. DG for Energy and Transport initiates, coordinates and manages energy policy actions at, transnational level in the fields of solid fuels, oil & gas, electricity, nuclear energy, renewable energy sources and the efficient use of energy. The most important actions concern maintaining and enhancing security of energy supply and international cooperation, strengthening the integrity of energy markets and promoting sustainable development in the energy field.

A central policy instrument is its support and promotion of energy research, technological development and demonstration (RTD), principally through the ENERGIE sub-programme (jointly managed with DG Research) within the theme "Energy, Environment & Sustainable Development" under the European Union's Fifth Framework Programme for RTD. This contributes to sustainable development by focusing on key activities crucial for social well-being and economic competitiveness in Europe.

Other DG for Energy and Transport managed programmes such as SAVE, ALTENER and SYNERGY focus on accelerating the market uptake of cleaner and more efficient energy systems through legal, administrative, promotional and structural change measures on a trans-regional basis. As part of the wider Energy Framework Programme, they logically complement and reinforce the impacts of ENERGIE.

The internet website address for the Fifth Framework Programme is
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Further information on DG for Energy and Transport activities is available
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