

**SOLAR BUILDINGS  
RESEARCH NETWORK**



**RÉSEAU DE RECHERCHE SUR  
LES BÂTIMENTS SOLAIRES**

## **Solar Buildings Web Links**

**Technology Transfer Research Project**

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November 27, 2006

## Project Overview

This research project is the first directive of the Technology Transfer Committee of the Solar Buildings Research Network. It is aimed to provide a useful collection of solar buildings related Web links for use by researchers, students and the general public. The document which follows provides convenient access to nearly 400 sites related to solar buildings, and can be personally customized and continually updated by individual users. It is expected to be periodically updated by the Solar Buildings Research Network as its research efforts continue.

While reasonable effort has been made to ensure a comprehensive document, it is normally expected that many valuable resources may have been overlooked in the compilation process. Users of this document are encouraged to forward suggestions for inclusion and updating to:

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For users interested in updating their own solar buildings Web links, the following keywords were used to generate this document:

Keywords: solar buildings, solar design heuristics, solar building design, solar building research, solar links, photovoltaics, PV system, PV panel, PV/T, solar thermal systems, solar thermal, solar organizations, solar research, solar institute

Search engines: Google, IXquick

### Acknowledgements

The authors of this document wish to gratefully acknowledge the financial support of the Natural Sciences and Engineering Research Council of Canada through its funding of the the Solar Buildings Research Network, and to all of our colleagues who have provided their time, interest and support in launching this compendium of solar buildings Web links.

### Disclaimer

This document is for information purposes only. Neither the authors nor the Solar Buildings Research Network endorse or promote any organization, product, or service listed in this document, and users are solely responsible for ensuring the accuracy and reliability of any information obtained through the use of this document.

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# General

## Resources/General Documents

### [The SolarServer](#)

A forum for solar energy.

### [Solar Design](#)

This is a guide to selected resources on Solar Design issues with strategies for locating materials at the University of California, Berkeley libraries and on the internet.

### [Survey of Active Solar Thermal Collectors, Industry and Markets in Canada](#)

Final Report of a Survey of Active Solar Thermal Collectors, Industry and Markets in Canada, conducted by Science Applications International Corporation (SAIC Canada) for Natural Resources Canada.

### [CLIMASOL](#)

It is the objective of the CLIMASOL project to use an integrated approach to cooling demand in tertiary buildings (new and to be renovated). The search for comfort and the recent design of buildings lead to an increase in needs for air conditioning in tertiary buildings. A more energy vision of the buildings design and a relatively new technique for solar cooling could answer to this request.

### [ColoradoENERGY.org](#)

ColoradoENERGY.org is your one-stop shop for energy efficiency and renewable energy information in Colorado. There is something for everyone at ColoradoENERGY.org. You will find how-to's, information about green building, energy-efficient applications, wind power in Colorado, government actions, new technologies, important events and much more.

### [C.R.E.S.T.](#)

Renewable Energy Policy Project's goal is to accelerate the use of renewable energy in the US by providing credible information, insightful policy analysis, and innovative strategies amid changing energy markets and mounting environmental needs by researching, publishing, and disseminating information, creating policy tools, and hosting highly active, on-line, renewable energy discussion groups.

### [DEMOSITE](#)

DEMOSITE is the international demonstration center for photovoltaic building elements. DEMOSITE provides comprehensive information on photovoltaics for architects, builders, authorities and other interested parties. The site has an EXHIBITION section that displays photovoltaic systems; PRACTICE EXAMPLES where one can view PV systems integrated into various buildings; and LEARNING which has information on the basics of PV building integration, as well as downloads and links.

### [Energy Center of Wisconsin](#)

The Energy Center of Wisconsin is a private, non-profit organization dedicated to improving energy sustainability including support of energy efficiency, renewable energy, and environmental protection.

### [Energy Design Resources](#)

Energy Design Resources offers a valuable palette of energy design tools and resources that help make it easier to design and build energy-efficient commercial and industrial buildings in California. The goal of this effort is to educate architects, engineers, lighting designers, and developers about techniques and technologies that contribute to energy efficient nonresidential new construction.

### [Energy Server](#)

This site lists renewable energy and energy-efficient construction fairs and conferences.

### [Focus on Energy](#)

Focus on Energy is a public-private partnership offering energy information and services to residential, business, and industrial customers throughout Wisconsin. These services are delivered by a group of firms contracted by the Wisconsin Department of Administration's Division of Energy. The goals of this program are to encourage energy efficiency and use of renewable energy, enhance the environment, and ensure the future supply of energy for Wisconsin.

### [GreenPrices](#)

GreenPrices aims at stimulating renewable energy by giving clear information about the market for green energy.

### [PVpower](#)

This is a site for the coordination and dissemination of information of global photovoltaic (PV) technologies, applications, history, and resources.

### [PVresources](#)

Welcome to the web site devoted to perspective possibilities of solar energy use. History, technologies and applications of photovoltaic systems are presented here.

### [Renewable Energy Access](#)

RenewableEnergyAccess.com was started in 1998 by a group of Renewable Energy professionals who wanted their work to relate to their passion for renewable energy. With this passion and the desire to create a long term sustainable business, we have created perhaps the single most recognized and trusted source for Renewable Energy News and Information on the Internet.

### [Renewable Energy Certificate System](#)

The RECS International Association is a group of market players that trade in renewable energy certificates through whole of Europe.

### [Renewable Resource Data Center](#)

Welcome to the Renewable Resource Data Center (RReDC). The RReDC is supported by the National Center for Photovoltaics (NCPV) and managed by the Department of Energy's Office of Energy Efficiency and Renewable Energy. The RReDC is maintained by the Electric and Hydrogen Systems Center at the National Renewable Energy Laboratory.

### [RISE Information Portal](#)

The RISE Information Portal will provide a valuable information resource in the area of sustainable energy. Information will include: renewable resources, technologies, applications, renewable energy systems and professional development and training.

### [Solarbuzz](#)

Connect to solar energy companies worldwide, follow solar energy developments. or access our solarbuzz research and consultancy services

### [Solar Energy](#)

SEI offers hands-on workshops in solar, wind and water power and natural building technologies in 17 locations. SEI also offers internet based online courses.

### [Solarplaza](#)

www.SolarPlaza.com is the independent global solar energy (photovoltaic) marketplace for PV trade and information. We offer a wide range of products and services to empower your Solar PV business.

### [The Solar Building Library](#)

The Solar Building Library (also known as the 'Buildings' Module in WIRE) is a freely accessible central repository for information about renewable energy technologies for buildings, energy efficiency and other aspects relating to solar or bioclimatic architecture and sustainable buildings.

### [Solar Glossary of Terms](#)

Are you interested in solar electricity, but not sure what "photovoltaic conversion efficiency" means? You're not alone.

### [SWISSOLAR](#)

(En français) Centre d'informations sur l'énergie solaire.

### [Thai Net Metering Project](#)

The Thai Net Metering Project project builds on the momentum that was generated with the passing of Thailand's net metering laws -- also known as Very Small Power Producer (VSPP) laws.

### [Border Green Energy Team \(BGET\)](#)

The Border Green Energy Team (BGET) provides hands-on appropriate technology training and financial support to village innovators in ethnic minority areas on both sides of the Thai/Burma border. Documents can be found at <http://www.palangthai.org/docs/>.

## **Organizations**

### [Alliance to Save Energy](#)

The Alliance to Save Energy is a nonprofit coalition of prominent business, government, environmental and consumer leaders who promote the efficient and clean use of energy worldwide to benefit the environment, the economy and national security.

### [American Council for an Energy Efficient Economy \(ACEEE\)](#)

The American Council for an Energy-Efficient Economy is a nonprofit organization dedicated to advancing energy efficiency as a means of promoting both economic prosperity and environmental protection.

### [American Solar Energy Society](#)

The American Solar Energy Society (ASES) is a national organization dedicated to advancing the use of solar energy for the benefit of U.S. citizens and the global environment. ASES promotes the widespread near-term and long-term use of solar energy.

### [CADDET](#)

CADDET Renewable Energy is an International Energy Agency agreement for the exchange of information on commercial renewable energy projects and has been operating since 1993. CADDET stands for Centre for the Analysis and Dissemination of Demonstrated Energy Technologies.

### [CANSIA](#)

The Canadian Solar Industries Association is a national organization supported by industry members, the public and government agencies. For more than 25 years, CanSIA members from all segments of the solar industry have joined together to support, promote and advance all forms of solar energy for the benefit of Canadians and the environment.

### [Chartered Institution of Building Services Engineers \(CIBSE\)](#)

With a membership of 15,000, one-fifth of which is overseas, CIBSE (The Chartered Institution of Building Services Engineers) is an international body which represents and provides services to the building services profession.

### [ColoradoEnergy.org](#)

ColoradoENERGY.org is your one-stop shop for energy efficiency and renewable energy information in Colorado. There is something for everyone at ColoradoEnergy.org. You will find how-to's, information about green building, energy-efficient applications, wind power in Colorado, government actions, new technologies, important events and much more.

### [Daylighting Collaborative](#)

The Daylighting Collaborative is a program started by utilities and the State of Wisconsin to incorporate daylighting into mainstream design and construction. The Collaborative brings together utilities, product manufacturers, state agencies, design and construction professionals, and other organizations dedicated to promoting the human, environmental and economic benefits of cool daylighting.

### [Earth Energy Society of Canada](#)

The Earth Energy Society of Canada was incorporated to represent the domestic earth energy (ground-source / geothermal heat pump) industry, with a mission to promote quality installations and to promote earth energy technology as a viable economic and environmental option in Canada's energy scenario. It is responsible for developing and delivering adequate and relevant training for practitioners, and promoting the applications on economic and environmental bases.

### [Energy and Environmental Building Association](#)

The Energy & Environmental Building Association promotes the awareness, education and development of energy efficient, environmentally responsible buildings and communities. The strength of the organization lies in the diversity and talent of its membership, which includes: architects, builders, developers, manufacturers, engineers, utilities, code officials, researchers, educators and environmentalists.

### [Energy Center of Wisconsin](#)

We are a private nonprofit organization dedicated to improving energy efficiency in Wisconsin. The Center provides energy-efficiency programs, research, and education to residents, businesses, industry and government.

### [Florida Solar Energy Center](#)

The Florida Solar Energy Center (FSEC) is the largest and most active state-supported renewable energy and energy efficiency research, training and certification institute in the United States.

### [IBPSA - International Building Performance Simulation Association](#)

International Building Performance Simulation Association  
IBPSA (the International Building Performance Simulation Association) is a non-profit international society of building performance simulation researchers, developers and practitioners, dedicated to improving the built environment

### [IBPSA-Canada](#)

IBPSA-Canada is a regional affiliate of IBPSA (also known as IBPSA-World), a non-profit international society of building performance simulation researchers, developers and practitioners, dedicated to improving the built environment.

### [International Solar Energy Society](#)

The International Solar Energy Society (ISES) is a multi-faceted, global organisation. A long history and extensive technical and scientific expertise find expression in a modern, future-oriented Society. Clearly defined goals, extensive communication networks and practical, real-world projects are the hallmarks of ISES.

### [National Association of Home Builders](#)

The National Association of Home Builders (NAHB) is a federation of more than 800 state and local builders associations throughout the United States.

### [National Association of State Energy Officials](#)

National Association of State Energy Officials (NASEO) is a nonprofit corporation whose membership includes energy officials from the state and territory energy offices and affiliates from the private and public sectors.

### [Interstate Renewable Energy Council](#)

The Interstate Renewable Energy Council (IREC) is a non-profit organization committed to accelerating the sustainable utilization of renewable energy resources and technologies in and through state, local government and community activities.

### [My Solar](#)

MySolar is a site for all interested in solar energy. What is it, do you need it, how to get it and where? MySolar provides you with information and with answers via an easy step-by-step 'Straight to your solution' wizard.

### [North Carolina Solar Center](#)

The North Carolina Solar Center provides programs and resources that help people throughout North Carolina take advantage of solar energy.

### [PV Power Resource Site](#)

The PV Power Resource site is a site for the coordination and dissemination of information of global photovoltaic (PV) technologies, applications, history and resources.

### [RenewableEnergyAccess.com](#)

The Internet's Renewable Energy News and Marketplace for business members and individuals offering comprehensive news and marketplace services including: advertising, on-line education and distance learning, classifieds, job postings, events calendar, interactive news forum—plus extensive B2B direct marketing opportunities.

### [Residential Energy Services Network \(RESNET\)](#)

The Residential Energy Services Network's (RESNET) mission is to improve the energy efficiency of the nation's housing stock and to qualify more families for home ownership by expanding the national availability of mortgage financing options and home energy ratings.

### [Rocky Mountain Institute](#)

Rocky Mountain Institute is an entrepreneurial, nonprofit organization that fosters the efficient and restorative use of resources to create a more secure, prosperous and life-sustaining world.

### [Solar Rating & Certification Corporation](#)

The combined programs of the Solar Rating and Certification Corporation (SRCC) provide one-time certification, national recognition, product credibility and standardized comparisons of solar energy products.

### [Sustainable Buildings Industry Council](#)

Sustainable Buildings Industry Council (SBIC) is a nonprofit organization whose mission is to advance the design, affordability, energy performance and environmental soundness of residential, institutional and commercial buildings nationwide.

## **Building Supplies and Services**

### [American Ingenuity](#)

Housing technology has changed very little since framing replaced the log cabin. The modifications that have been made to improve the efficiency and strength, also increased the cost. We applied some American Ingenuity to the geodesic dome, designed an all new component building system and developed a superior home without increasing the cost.

### [Environmental Building News](#)

Environmental Building News is a monthly newsletter (combined July/August issue) on environmentally responsible design and construction, featuring comprehensive, practical information on a wide range of topics related to sustainable building - from renewable energy and recycled-content materials to land-use planning and indoor air quality.

### [Solar Energy International](#)

Your one stop shopping site for all your solar and alternative energy needs. Visit our "ON-LINE CATALOG" for great deals on Solar Electric, Solar Thermal, Wind Power and Micro-Hydro components, accessories and much more. . .

## **Publications/Guidelines**

### [Centre for Analysis and Dissemination of Demonstrated Energy Technologies \(CADET\)](#)

CADET is an international information source that helps managers, engineers, architects and researchers find out about renewable energy and energy-saving technologies that have worked in other countries. Along with its sister programme, GREENTIE, CADET ceased collecting new information at the end of March 2005. Nevertheless, the information will remain available through this web site's search facilities as it represents one of the World's most detailed repositories of such information.

### [Photovoltaics for Buildings: Opportunities for Canada](#)

This report was written to share information acquired by CEDRL in the process of managing the Canadian Photovoltaic Program and more specifically to help define the way ahead. It is the result of a lengthy consultation process with industry, associations, municipal, provincial and federal governments. Canada's participation in the International Energy Agency (IEA) Photovoltaic Power Systems Implementing Agreement also provided a good perspective on the photovoltaic programs of other countries. This report analyses these programs and trends, and proposes a course of action for Canada.

### [Daylighting Design](#)

Canadian Building Digest #17 – Daylighting Design.

### [Design Brief: Building Integrated Photovoltaics](#) Energy Design Resources

Designing with BIPVs requires a “whole building” approach that focuses on the interaction of all the energy systems in a building. By evaluating the interoperability of all systems, energy savings may be compounded, and full economic and environmental advantages may be realized.

### [A Vision for Photovoltaic Technology](#) European Commission, Community Research

The report identifies the major technical and non-technical barriers to the uptake of the technology and outlines a strategic research agenda designed to ensure a breakthrough of PV and an increase in deployment in the Union and worldwide. The Council proposes the use of a European Technology Platform as a mechanism to implement the strategy and achieve the wider goals defined in the vision.

### [EERE Online Catalog](#)

This links to a list of all downloadable Technical Reports published by the Solar Energy Technologies Program of the EERE.

### [Environmental Building News](#)

Environmental Building News is a monthly newsletter (combined July/August issue) on environmentally responsible design and construction, featuring comprehensive, practical information on a wide range of topics related to sustainable building - from renewable energy and recycled-content materials to land-use planning and indoor air quality.

### [Florida Solar Energy Center's Table of Publications](#)

The table of publications given provides access to many of the Florida Solar Energy Center's most recent technical articles and research publications on building energy performance.

### [Home Power](#)

Since 1987, we've dedicated more than 100 issues to home-scale renewable energy and sustainable living solutions. That means comprehensive coverage of solar, wind, and microhydro electricity, home energy efficiency, solar hot water systems, space heating and cooling, green building materials and home design, efficient transportation, and much, much more.

### [James & James \(Science Publishers\) Ltd.](#)

Leading provider of information for energy and environment professionals worldwide.

### [Potential for Building Integrated Photovoltaics](#)

Document entitled Potential for Building Integrated Photovoltaics. The objectives of this study are to assess and compared different approaches, potential estimates and case studies, to formulate an accepted and validated methodology, and to develop a comprehensive set of rules of thumb, with respect to (the determination of) the BIPV potential. In the end, the BIPV potential calculations and estimates lead to a number of general findings useful to incorporate in future photovoltaic roadmaps. (more documents can be found at <http://www.iea-pvps.org/products/index.htm>)

### [A Parametric Review of the Built Environment Sustainability](#)

This paper, through an evaluation of selected sources from the sustainability literature, takes a first step at systematically identifying what parameters of both the built environment and the concept of sustainability are emphasized in the existing literature on the topic. The outcome is a set of parameters that can be used in future research to begin to uniformly and comprehensively define sustainability as it applies to built facilities, using techniques such as concept mapping, content analysis, dendograms, and other established research methods.

### [Photovoltaics for Buildings: New Applications and Lessons Learned](#)

This paper discusses experiences with these PV systems on commercial buildings and presents energy performance and solutions to resolve design and operation issues.

### [Photon International](#)

The photovoltaic magazine. Contains in-depth coverage of the photovoltaic industry, from technology and markets to government programs around the world.

### [Renewable Energy World](#)

This is the webpage for Renewable Energy World, the periodical.

### [Solar Energy Lab \(SEL\) publications](#)

This page lists the University of Wisconsin-Madison College of Engineering's Solar Energy Lab (SEL) publications.

### [SOLAR TODAY](#)

SOLAR TODAY is the award-winning bimonthly magazine — published by the American Solar Energy Society, that covers all solar and renewable energy technologies, from photovoltaics to climate-responsive buildings to wind power and biomass. Regular topics include building case studies, energy policy and community-scale projects.

## **Design/Construction**

### **Architects**

#### [Bear Architechten](#)

Architects and engineers, design of bioclimatic building projects, project management, research & development in environmental building systems. Specialists sustainable building, and housing projects. Experience in the field of thermal, passive and photovoltaic solar energy (BIPV).

#### [Innovative Design](#)

From 1977 through 2004, Innovative Design has designed 700 buildings incorporating renewable energy solutions. Our solar home designs have been constructed over 4400 times and have saved over 1.3 trillion Btu's.

#### [Rountree Architects](#)

Rountree Architects is a design and consulting firm founded in 1990, dedicated to promoting the use of clean, renewable energy. Our goal is to foster a greater understanding of renewable energy sources and to promote their use in new and existing building projects. In addition to solar and residential architecture, we also offer solar consulting services for architects, building owners and developers on larger projects who wish to integrate renewable energy technologies into their projects.

#### [Solar Design Associates](#)

Solar Design Associates (SDA), is a group of architects and engineers dedicated to the design of sustainable buildings and the engineering and integration of renewable energy systems that incorporate the latest in innovative technology.

### **Consultants**

#### [AWS Scientific](#)

Established in 1983, AWS Scientific Inc. is an engineering and meteorological consulting firm specializing in renewable energy technologies and environmental services for the energy and government sectors.

### [BRE](#)

BRE is a trading name for Building Research Establishment Limited, a company providing independent research, consultancy and testing. BRE's mission is to build a better world and our vision is our unmistakable imprint on a highly regarded and sustainable built environment. Every working day around 650 research scientists, engineers, architects, surveyors, psychologists, administrators, managers and many others at BRE's two sites in Watford and East Kilbride, bring together their expertise, skills and knowledge to advise clients on Construction, Environment, Fire and risk, and Certification of products and services.

### [Ecofys](#)

Ecofys has a clear mission: a sustainable energy supply for everyone. This is the goal that everyone in our company believes in and strives for. In a company that is a leader in renewable energy and energy efficiency, knowledge and innovation are key factors in turning the ideas of today into the viable realities of tomorrow.

### [Edisun Power AG](#)

Edisun Power AG: Secure returns on capital from the Swiss solar power business. Invest in the future with Switzerland's leading solar power contractor.

### [Ellehaug & Kildemoes](#)

Ellehaug & Kildemoes are Energy Consultants within the field of sustainable energy technologies. The firm was set up by Klaus Ellehaug and Troels Kildemoes in April 2002 and are based in Jutland in Aarhus and Sydthy and undertake projects both individually and working as a team.

### [New Energy Options](#)

Engineering Consulting Focused on Emerging Technologies in the Renewable Energy and Distributed Generation Markets

### [Next Wave Energy](#)

NextWave Energy is a professional advisory services firm supporting private sector interests in emerging technologies and innovative product or service concepts related to the electricity sector. We can provide the expertise to help create valuable businesses that promise significant improvements in both the economic and environmental efficiency in the production and transmission of electric power.

### [PowerLight Corporation](#)

PowerLight is a manufacturer of complete kits of PV products, and is a bondable turn-key contractor for systems installation. PowerLight provides a menu of project development, management, design, construction, facilities management, and analysis services in support of its clients.

### [SolarAccess.com](#)

The Internet's Renewable Energy News and Marketplace for business members and individuals offering comprehensive news and marketplace services including: advertising, on-line education and distance learning, classifieds, job postings, events calendar, interactive news forum—plus extensive B2B direct marketing opportunities.

### [Solarstrom](#)

Engineering and Consulting on Photovoltaics, Energy Efficiency, R&D activities.

### [Solar Works](#)

Since 1980, Solar Works, Inc., has provided renewable energy services and equipment to government agencies, utilities, private businesses, homeowners, and not-for-profit organizations in the United States and overseas.

### [Solstis](#)

(En Français) Solstis est active depuis 1996 dans le domaine du développement durable et de l'utilisation rationnelle des ressources naturelles. Elle est au bénéfice d'une grande expérience en matière d'intégration de l'énergie solaire au bâti et travaille de concert avec les architectes du projet. Son équipe pluridisciplinaire ainsi que son réseau de partenaires vous propose une approche globale et des solutions à votre mesure.

### [Talmage Solar Engineering, Inc.](#)

Talmage Solar Engineering has been serving the independent living needs of our customers since 1975. During this time, many new products have come and gone. We have had direct experience with all types of systems and equipment and know what works and what will give you years of trouble-free service.

## **Design Guides/Guidelines/Tools**

### [Design Methodology for Passive Solar Architecture](#)

A Simple Design Methodology for Passive Solar Architecture, by Dennis Holloway, architect.

### [Architectural Expression and Low Energy Design](#)

M. Nicoletti, 1998.

### [Daylighting Information Clearinghouse](#)

Daylighting Information Clearinghouse brought to you by the Daylighting Collaborative, this site demystifies the why, how, who, and what of the cool daylighting philosophy.

### [Selecting an Active Solar Heating System](#)

From the EERE Building Toolbox on Active Solar Heating systems.

### [Passive Solar Design](#)

This Technology Fact Sheet on Passive Solar Design from EERE outlines ways to increase energy efficiency and comfort in homes by incorporating passive solar design features.

### [Whole Building Design Guide](#)

The WBDG is the only web-based portal providing government and industry practitioners with one-stop access to up-to-date information on a wide range of building-related guidance, criteria and technology from a 'whole buildings' perspective. Currently organized into two major categories—Design Guidance and Project Management—at the heart of the WBDG are Resource Pages, reductive summaries on particular topics.

## Case Studies

### [Drake Landing Solar Community \(DLSC\)](#)

The Drake Landing Solar Community (DLSC) is a master planned neighborhood in the Town of Okotoks, Alberta, Canada that has successfully integrated Canadian energy efficient technologies with a renewable, unlimited energy source - the Sun.

### [Bio-Solar House](#)

Article on the bio-solar house designed and occupied by Soontorn Boonyatikar, professor of architecture at Chulalongkorn University in Bangkok.

### [Bio-Solar House - ASHRAE Award](#)

Ashrae Technology award for Bio-solar home by Soontorn Boonyatikarn, professor of architecture at Chulalongkorn University in Bangkok.

### [Renewable Energy Systems for Urban ReGENERation in Cities of Europe \(RESURGENCE\)](#)

Renewable Energy Systems for Urban ReGENERation in Cities of Europe (RESURGENCE). RESURGENCE proposes to demonstrate the installation of 1.3MWp of photovoltaics in 5 countries as part of significant urban regeneration programmes. The four key project aims are Photovoltaic System Cost Reduction, Increased Socio-economic Acceptability and Social Sustainability, Exploitation of Liberalised Electricity Markets and Finance Innovation. The project targets the social housing / urban regeneration sector, which holds tremendous potential for achieving each of these aims. SITE CONTINUOUSLY UNDER DEVELOPMENT

### [European Passive Houses](#)

Promotion of European Passive Houses. The objective of the PEP project is to promote the potential of the European Passive House concept in Europe by the development of information packages and design tools for passive houses, the organization or (inter) national workshops, symposia and conferences and the set up of international passive house website.

### [CEPHEUS](#)

CEPHEUS has tested and proven the viability of the Passive House concept at the European level. In Germany, Sweden, Austria, Switzerland and France, a total of 221 housing units in 14 building projects have been built to Passive House standards and are now occupied. Measurement campaigns have commenced in all building projects; this final report presents measured consumption data for the first heating season for 11 of the 14 projects.

### [Passivhaus UK](#)

### [Passivehouse Belgium](#)

The passive house concept is an approved concept of very low-energy buildings, and already successfully applied on large scale in Scandinavia, Germany, Austria, Switzerland... We are introducing this concept, as we are now able to answer the frequently asked questions immediately. Not only theoretically, we can also show you number of projects of passive houses, either in construction or already finished.

### [Passiefhuis-Platform](#)

Passiefhuis-Platform, alias PHP, is a non-profit organization founded by leading actors and institutions from the building industry. They present, one after the other, commitment concerning energy saving and sustainable technological development. PHP is an independent organization that is neutral and not bound to suppliers or other groups.

## Reports

### [Communication Approaches to Marketing Solar Photovoltaic Homes in Japan](#)

This paper examines the selling of factory-built or industrialized homes equipped with solar photovoltaic (PV) electric power generating systems in Japan.

Masa Noguchi, Ph.D.

Source: <http://cetc-varenes.nrcan.gc.ca/>

### [Testing and Validation of a New Building Energy Simulation Program](#)

M. Witte, et. al., August 13-15, 2001.

Source: <http://www.ibpsa.org>

### [Design, Monitoring and Evaluation of a Low Energy Office Building with Passive Cooling by Night Ventilation](#)

S. Herkel, et. al., 2002.

Source: <http://www.ise.fhg.de>

### [An Architectural Understanding of Solar Power](#)

The paper presents an approach to regain the architectural viewpoint for understanding valuable solar radiation information as meaningful design support. In the author's previously published research work, a method of "solar profiling" was developed using parametric calculation models. The described methodology has since been further refined through continual educational application.

Margit H. Pfeiffer-Rudy, ISES Solar World Congress 2003.

Source: <http://www.iti.tuwien.ac.at>

### [The design and evaluation of integrated envelope and lighting control strategies for commercial buildings](#)

Eleanor S. Lee and Stephen E. Selkowitz.

Source: <http://www.osti.gov/bridge>

### [System Concept of a Passive Solar Office Building](#)

R. Waner, et. al., EuroSun 98.

Source : <http://wire0.ises.org/wire/>

## Other

### [Center for Maximum Potential Building Systems \(CMPBS\)](#)

The Center for Maximum Potential Building Systems's services reflect a multi-faceted, collaborative design approach and a commitment to move design and building professionals towards sustainable practices.

<http://www.ecobuilding-performance.com/en>

Ecobuilding Performance is the annual meeting place to exchange ideas between professionals and decision makers, promoting Energy Efficiency & Sustainable Development in Building and Construction.

<http://www.nrel.gov/ncpv/documents/japan.html>

Interest in building-integrated PV has been growing steadily in Japan over the past decade.

### Minergie

MINERGIE is a quality label for new and refurbished buildings. This trade name is mutually supported by the Swiss Confederation, the Swiss Cantons along with Trade and Industry and has been registered to prevent misuse.

### Solar Decathlon

The Solar Decathlon is a competition in which 20 teams of college and university students compete to design, build, and operate the most attractive, effective, and energy-efficient solar-powered house. The Solar Decathlon is also an event to which the public is invited to observe the powerful combination of solar energy, energy efficiency, and the best in home design.

## Research

### International Agencies

#### European Commission

Photovoltaic R&D activities receiving support from the European Commission can be divided into short to medium-term and medium to long-term, and are managed by DG TREN and DG RTD respectively. The following PV projects are currently ongoing in the Sixth Framework Programme (FP6):

#### FULLSPECTRUM

FULLSPECTRUM is a scientific project funded by the European Commission. The project started in November 2003 and will last five years. As an Integrated Project (IP) it is part of the 6th Framework Programme of the European Commission. The project pursues a better exploitation of the FULL solar SPECTRUM (as requested in the Work Programme) by further developing concepts already scientifically proven but not yet developed and by trying to prove new ones in the search of a breakthrough for the PV technology.

#### MOLYCELL

The MOLYCELL project is funded by the European Commission for 30 months in the framework of the 6th PCRD (January 2004 - June 2006). This project deals with "Molecular Orientation, Low band gap and new hYbrid device concepts for the improvement of flexible organic solar CELLS" Organic solar cells promise a strong cost reduction of photovoltaics (PV) if fast improvements of the power efficiency and the lifetime can be achieved. For these objectives, the 12 partners involved in MOLYCELL work in parallel on the development of new materials (organic materials and metal oxides) and the development of two device concepts to improve efficiencies: all-organic solar cells and nanocrystal/organic hybrid solar cells.

#### CRYSTALCLEAR

The main objectives of CRYSTALCLEAR are as follows: research, development, and integration of innovative manufacturing technologies which allow solar modules to be produced at a cost of 1 €/Wp in next generation plants; improvement of the environmental profile of solar modules by the reduction of materials consumption, replacement of materials and designing for recycling; and, enhancement of the applicability of modules and strengthening of the competitive position of photovoltaics by tailoring to customer needs and improving product lifetime and reliability.

### [BIPV-CIS](#)

The aim of this project is to improve the potential for fitting copper-indium-diselenide (CIS) photovoltaic technology to new and existing buildings. Photovoltaic roof tiles, overhead glazing and façade elements based on CIS materials will be developed, including innovative connection and mounting techniques. The building elements produced in the project will undergo characterisation and performance tests, including thermal behaviour, reliability and outdoor exposure. The project will also address the architectural and aesthetic aspects of building integrated photovoltaics, including a European market survey on PV roof tiles.

### [PV-CATAPULT](#)

PV-CATAPULT is a Coordinated Action consisting of 10 diverse work packages, centred on a common goal of accelerating the development of the photovoltaic technology (including hybrid solar) towards market deployment. The work in PV-CATAPULT includes studying the potential of PV in the emerging electricity markets of developing countries, engaging the construction industry on applications of PV in buildings (BIPV), producing a roadmap for the penetration of hybrid solar (PV and thermal), and comparing the measurement performance of different solar testing laboratories. Round-robin testing will lead to the publication of best-practise guidelines on measurement procedures and a better understanding of solar simulator performance. The project will organise meetings to discuss market development and will produce status reports on socio-economic issues.

### [PV-SEC](#)

The PV-SEC Coordination Action provides secretarial support to the European Photovoltaic Technology Platform. The tasks are carried out by a consortium of 4 partners: European Photovoltaic Industry Association, WIP, EUREC Agency and the European Commission DG JRC.

### [Flexcellence](#)

Roll-to-roll technology for the production of high-efficiency low cost thin film silicon photovoltaic modules. Flexcellence is a Specific Targeted Research or Innovation Project (STREP) financed by the Sixth Framework Programme of the EU. It began on October 1st 2005 and is set to last 3 years.

### [LARCIS](#)

The aim of the project is to improve the manufacturing potential of thin-film solar modules based on CIS (copper indium diselenide) technology. The project will work on the development of the molybdenum back contact, the buffer layer, the CIS absorber and process control. Special emphasis is placed on the development of cadmium-free large-area modules and electro-deposition methods for CIS absorbers. Results of the work will be transferred from the laboratory to the pilot production facilities of the project partners.

### [FOXY](#)

The growth of the photovoltaic industry has resulted in an increased demand for silicon feedstock, the price of which has risen significantly. The FOXY project will address this problem by developing refining, purification, and crystallisation processes for metallurgical solar-grade silicon feedstock, as well as for recycled electronic-grade silicon. The refined solar-grade silicon cost target is 15 €/kg, and the electronic quality of the feedstock material will be assessed by fabricating and analysing large area solar cells.

## PERFORMANCE

The rapid development of the photovoltaic market requires harmonised, high-quality testing and labelling of products, supported by a sound scientific base. The PERFORMANCE project covers pre-normative aspects of photovoltaic technology, from cell to system level. The limitations of current indoor and outdoor calibration and measurement practices will be investigated, and measurement precision will be improved for traditional technologies and for new and emerging photovoltaic concepts. The results of the project will be fed directly into standardisation processes at CENELEC and IEC level.

## ATHLET

By using cell thicknesses of only a few micrometers, thin-film technologies have significant potential to lower the cost of photovoltaic electricity due to reduced material consumption. In addition, high productivity and low-temperature processes offer further possibilities for cost reduction. The ATHLET integrated project will contribute to the development of 3 types of thin-film technologies: 1) CIGS (based on copper, indium and selenium) 2) microcrystalline / amorphous silicon 3) thin-film polycrystalline silicon. The project activities include increasing the performance of high-efficiency cells in the laboratory, developing module technology specifically for thin-films, improving the environmental-friendliness of certain processing steps, and adapting industrial equipment for large-scale deposition of thin-film solar modules. The work will be supported by material analysis, device modelling, and sustainability assessments.

## PV-MIPS

The aim of this project is to significantly reduce the cost of grid connected PV systems through the development and demonstration of PV modules with integrated inverters. The research has a strong focus on building-integrated PV, because the potential for this application is especially high in the densely populated areas of Europe. The cost targets for production are 0.3 €/Wp for the inverter and 3.0 €/Wp for the complete system.

## International Energy Agency (IEA)

### **IEA Implementing Agreements**

#### IEA Photovoltaic Power Systems Programme (PVPS)

#### **Tasks**

##### Task 7 - PV Database

Within PVPS, Task 7 is the international collaborative effort focusing on building integrated PV, linking developments in IEA countries worldwide. The overall objective of Task 7 is to enhance the architectural quality, technical quality and economic viability of photovoltaic power systems in the built environment and to assess and remove non-technical barriers for their introduction as an energy-significant option. This site has a project and product search feature.

## Renewable Energy Technology Deployment (RETD)

## Solar Heating and Cooling Programme (SHC)

### **Tasks**

[Task 27 - Performance, Durability and Sustainability of advanced windows and solar components for building envelopes](#)

[Task 31- Daylighting Buildings in the 21<sup>st</sup> Century](#)

[Task 32- Advanced Storage Concepts for Solar and Low Energy Buildings](#)

[Task 34 – Testing and Validation of Building Energy Simulation Tools](#)

[Task 35 - PV/Thermal Solar Systems](#)

### SolarPACES

Concentrated Solar Power (CSP) technologies use large, sun-tracking mirrors to concentrate solar radiation. However, the final steps of generating electricity using CSP systems is similar to conventional electricity generation - the ultimate energy conversion process depends on the use of steam or gas to rotate turbines, or move a piston in a Stirling engine. In a CSP system, however, steam or hot gas is produced by the concentrated solar radiation.

### **Government**

#### Natural Resources Canada - NRCan

Natural Resources Canada (NRCan) plays a pivotal role in helping shape the important contributions of the natural resources sector to the Canadian economy, society and environment.

#### Sustainable Buildings and Communities - NRCan

Experts in energy innovations for the built environment, the Sustainable Buildings and Communities (SBC) group is recognized nationally and internationally for its leadership role in the research, development, and deployment of leading-edge energy efficient and renewable energy technologies for new and existing housing, buildings and communities.

#### Office of Energy Efficiency - NRCan

Let us show you how to conserve energy, cut greenhouse gas emissions that contribute to climate change, and save money at home, at work and on the road.

#### CANMET Energy Technology Centre - NRCan

The CANMET Energy Technology Centre (CETC) is Canada's leading federal government S&T organization with a mandate to develop and demonstrate energy efficient, alternative and renewable energy technologies and processes. CETC has facilities in Devon, Alberta; Varennes, Quebec; and Ottawa, Ontario.

#### CETC-Varennes

CETC-Varennes promotes and facilitates the use of photovoltaic systems in buildings, by carrying out research and demonstration projects, serving on international standards committees and developing information and training tools. The photovoltaic energy research group's primary mandate is to help develop and deploy photovoltaic energy technologies in Canada. To this end, two strategic approaches are being taken. The first is to accelerate the deployment of this technology in Canada, while the second aims at exploiting the technology's potential, both nationally and internationally.

### [Canada Mortgage and Housing Corporation - CMHC](#)

Backed by 60 years of experience, we work with community organizations, the private sector, non-profit agencies and all levels of government to help create innovative solutions to today's housing challenges, anticipate tomorrow's needs, and improve the quality of life for all Canadians.

### [Net Zero Energy Healthy Housing in Canada](#)

Net Zero Energy Healthy Housing (NZEHH) combines passive solar, energy efficient design, construction and appliances, integrated with commercially available renewable energy systems to achieve net zero energy consumption on an annual basis, and significantly reduced environmental impacts and green house gas (GHG) emissions.

### [Sustainable Development Technology Canada \(SDTC\)](#)

Sustainable Development Technology Canada (SDTC) is a not-for-profit foundation that finances and supports the development and demonstration of clean technologies which provide solutions to issues of climate change, clean air, water quality and soil, and which deliver economic, environmental and health benefits to Canadians. To do so, the Foundation draws from an investment fund of \$550 million.

### [Technology Early Action Measures \(TEAM\)](#)

Technology Early Action Measures (TEAM) is an interdepartmental technology investment program. TEAM supports projects that are designed to demonstrate technologies that mitigate greenhouse gas (GHG) emissions nationally and internationally, and that sustain economic and social development.

### [Natural Sciences and Engineering Research Council of Canada – NSERC](#)

NSERC is the national instrument for making strategic investments in Canada's capability in science and technology. NSERC supports both basic university research through discovery grants and project research through partnerships among universities, governments and the private sector, as well as the advanced training of highly qualified people.

### [Institute for Research in Construction – National Research Council Canada](#)

The NRC Institute for Research in Construction (NRC-IRC) is the leading construction research agency in Canada, developing innovative solutions for the country's largest industry.

### [National Renewable Energy Laboratory \(NREL\)](#)

The U.S. Department of Energy's premier laboratory for renewable energy and energy efficiency research, development and deployment.

### [Centre for Buildings and Thermal Systems at NREL](#)

The Centre for Buildings and Thermal Systems at the National Renewable Energy Laboratory conducts research in heat transfer, thermal dynamics and system engineering. Their research accelerates industry adoption of advanced energy efficiency and renewable energy technologies.

### [High-Performance Photovoltaic \(HiPerf PV\) at NREL](#)

The High-Performance Photovoltaic (HiPerf PV) initiative is exploring the ultimate limits of the performance of existing PV technologies, with the aim to about double sunlight-to-electricity conversion efficiencies. This project, initiated by the U.S. Department of Energy in FY2001, will substantially increase the viability of PV for cost-competitive applications. As a result, PV will be able to contribute significantly to our energy supply and our environment in the 21st century.

### [Sandia National Laboratories](#)

Our mission within the Department of Energy's Concentrating Solar Power Program is to help provide for the energy, economic and environmental security of the United States. We are fulfilling our mission through technology research, development and field validation required for concentrating solar power technologies to make a major contribution to clean global energy resources in the years to come.

### [Energy research Centre of the Netherlands](#)

Welcome to the Energy research Centre of the Netherlands, the largest research centre in the Netherlands in the field of energy. At this moment ECN employs about 900 people. ECN is situated in the dunes near Petten, a village in the northern part of Holland. The research centre carries out research in the field of energy. With this work the researchers move between fundamental research at universities and appliance of knowledge and technologies in practice.

### [Solar Photovoltaics Research, Australian Greenhouse Office](#)

Innovative applications of solar photovoltaic technology being developed in Australia include the use of concentrating systems to focus the solar energy on to a smaller area of higher efficiency cells and the use of building integrated photovoltaics, where the PV cells perform architectural or structural functions as well as power generation, thereby offsetting some of the cost.

### [Solar Thermal Research, Australian Greenhouse Office](#)

Australia has been a world leader in the development of solar hot water systems and is a significant exporter of this technology. New technologies are being developed by manufacturers of solar hot water systems to utilise alternative low-cost materials (such as plastic) and systems are being developed that work effectively in cold climate export markets.

## **Research Institutes**

### [“Arbeitsgemeinschaft Erneuerbare Energie“ Institute for Sustainable Technologies \(AEE-INTEC\)](#)

The “Arbeitsgemeinschaft Erneuerbare Energie“ Institute for Sustainable Technologies (AEE-INTEC) located in Gleisdorf and is active in the development of scientific and technical basics for solar thermal applications, with the development of efficient energy supply systems for buildings as well as the development of sustainable technologies for water supply and sewage disposal. The Department for solar components and systems supports a wide market introduction of thermal solar plants by improving and developing new collectors, components and systems. Significant focuses in component development to date have been the improvement of flat-plate collectors, facade collectors, parabolic trough collectors for the medium temperature range and the development of optimised storage tanks.

### [Energy Research Centre of the Netherlands](#)

Welcome to the Energy research Centre of the Netherlands, the largest research centre in the Netherlands in the field of energy. At this moment ECN employs about 900 people. ECN is situated in the dunes near Petten, a village in the northern part of Holland. The research centre carries out research in the field of energy.

### [Fraunhofer ISE](#)

Building and construction and residential applications represent major markets for the future from both an ecological and economic perspective. In close co-operation with manufacturers, Fraunhofer ISE develops new materials and procedures as well as integrated energy concepts for buildings.

### [Hahn Meitner Institut \(HMI\)](#)

The Hahn Meitner Institut (HMI) concentrates on targeted basic research and uses this as the foundation for the technological development of prototypes for industrial applications. In the area of solar energy research there are five departments and one working group with the corresponding research projects: Silicon photovoltaics, Heterogeneous material systems, Technology, Dynamics of interfacial reactions, Solar energy, and Electronic structure of semiconductor interfaces.

### [Institut für Solare Energieversorgungstechnik \(ISET\)](#)

Institut für Solare Energieversorgungstechnik (ISET) addresses application-oriented research in the field of electrical engineering and systems technology for the use of renewable energies. The most important renewable energy technologies ISET is concerned with are wind energy, photovoltaics, bio energy, hydro power and marine energies. Besides this further topics are energy conversion and storages, static converters, hybrid systems and energy economy.

## **Academic Institutions**

### [Building Technologies Department at Lawrence Berkeley National Laboratory](#)

#### [Lawrence Berkeley Lab-Windows & Daylighting Group](#)

Glazing materials, window properties, daylighting, residential and commercial performance, choosing a residential window, specifying fenestration products for commercial buildings, questions and comments.

#### [HIGH-PERFORMANCE COMMERCIAL BUILDING FAÇADES](#)

Building Technologies Program, Environmental Energy Technologies Division Ernest Orlando Lawrence Berkeley National Laboratory, University of California, Berkeley.

### [Nonimaging Optics/Solar Energy Group, University of Chicago](#)

For more than twenty-five years, the University of Chicago Nonimaging Optics/Solar Energy Group has been developing novel concentrator designs and optical elements that achieve performance thought to be impossible under the limitations of imaging optics.

### [BCIT's Photovoltaic Energy Applied Research](#)

The BCIT's Photovoltaic Energy Applied Research team was created in response to increasing demand in Canada, and around the world, for resources and expertise in renewable energy technologies. This research group conducts all aspects of photovoltaic system development, from the design and testing of individual photovoltaic components to the installation and commissioning of large photovoltaic systems.

### [Concordia University – Research in Building Engineering](#)

The building engineer explores all phases of the life cycle of a building and develops an appreciation of the building as an advanced technological system. Problems are identified and appropriate solutions found to improve the performance of the building.

### [Photovoltaics Research and Education \(UCEP\) at Georgia Tech](#)

The Department of Energy (DOE) has established a University Center of Excellence for Photovoltaics Research and Education (UCEP) at Georgia Tech. Its mission is to improve the fundamental understanding of the science and technology of advanced PV devices, to fabricate record high efficiency solar cells, to provide training and enrich the educational experience of students in this field, and to give the U.S. a competitive edge by providing guidelines to industry and DOE for achieving cost-effective and high-efficiency PV devices.

### [Solar Energy and Energy in Buildings at University of Ulster](#)

Solar Energy and Energy in Buildings (formerly centre for Performance Research On the Built Environment) specializes in research on passive, hybrid and active solar energy systems, energy efficiency of buildings and the eco-sustainability of the built environments.

### [Photovoltaic Group at the Universität Wien](#)

The website of the Photovoltaic Group at the Universität Wien. The main research work of our group carried out at the institute focuses on the identification of defects in semiconductors. The influence of crystal defects and impurities in the semiconductor matrix on its electrical properties is investigated. One application of this work is the improvement of photovoltaic solar cells made from lower purity or multicrystalline silicon.

### [School of Photovoltaic and Renewable Energy Engineering at UNSW](#)

The School of Photovoltaic and Renewable Energy Engineering at the University of New South Wales is internationally recognised for its research in the area of photovoltaics, most of which is now conducted under the ARC Centre of Excellence in Advanced Silicon Photovoltaics and Photonics.

### [Solar Energy at Australian National University \(ANU\)](#)

There are several areas within the Australian National University (ANU) which have an interest in solar energy. This site is a presentation of the solar activities carried out within the Department of Engineering, which is part of the College of Engineering and Computer Science.

### [Building Physics & Solar Energy, Department of Physics, University of Siegen](#)

The Group for Building Physics & Solar Energy in the Department of Physics at the University of Siegen. The Group concentrates in research and education on the topics of: building physics, rational use of energy, renewable energies, especially solar energy, fluid mechanics and environment.

### [North Carolina Solar Center](#)

The North Carolina Solar Center conducts both technical and policy research related to renewable energy. Technical research and development work encompasses a wide range of areas including industrial solar thermal systems, residential passive solar options, building-integrated photovoltaic/thermal systems, alternative fuels and more.

### [Research at Architecture, Hong Kong University \(HKU\)](#)

The Department has received considerable funding in recent years for computer-based research projects. This funding has come primarily from the HKU University Grants Council, HKU Committee for Research and Conference Grants, HKU University Research Committee, HKU General Purposes Committee, Run Run Shaw Teaching Endowment, and the Croucher Foundation.

#### [Photovoltaics Research at HKU](#)

Architecture HKU has a photovoltaics programme run by a multi-disciplinary PV Research Team, which is formed amongst universities in Hong Kong, utilities and other sectors.

Contains information on research and projects.

#### [Building Energy Efficiency Research \(BEER\) at HKU](#)

#### [Case Studies](#)

## Other

### [Solar Buildings Research Network](#)

Development of the solar-optimized building as an integrated **advanced** technological system that approaches the net zero-energy target and is cost effective.

### [AEE - Institute for Sustainable Technologies](#)

Since the establishment in 1988, we carry out research, demonstration and know-how transfer projects in the field of solar thermal components and systems, sustainable buildings as well as sustainable water management. We offer numerous services besides our work in research and development.

### [Nanotech Web](#)

The Evident Nanotechnology Web™ Program is a no-charge, unique offering, developed to support higher education institutions with research opportunities in Nanotechnology. This program will provide higher education institutions with research resources from Evident Technologies. The Evident Nanotech Web Program makes it easier for faculty and researchers to access Evident products and technologies.

### [SINTEF](#)

The SINTEF Group is the largest independent research organisation in Scandinavia. Every year, SINTEF supports the development of 2000 or so Norwegian and overseas

### [Swiss Solar Energy Society \(SSES\)](#)

Swiss Solar Energy Society (SSES) promotes solar energy, renewable energy and energy efficiency, unites professionals, solar energy users, ecologists, fans and politicians, and provides detailed information in its "Renewable Energies" magazine in German and French.

### [VTT Technical Research Centre of Finland](#)

VTT Technical Research Centre of Finland is the biggest contract research organisation in Northern Europe. VTT provides high-end technology solutions and innovation services. From its wide knowledge base, VTT can combine different technologies, create new innovations and a substantial range of world class technologies and applied research services thus improving its clients' competitiveness and competence. Through its international scientific and technology network, VTT can produce information, upgrade technology knowledge, create business intelligence and value added to its stakeholders.

## Research Portals

### [NREL's Publications Database](#)

Welcome to NREL's Publications Database. This database contains references to documents written and/or edited by staff and subcontractors of NREL. Covering subjects related to sustainable energy technologies from 1977 to the present, our bibliographic database includes NREL technical reports, fact sheets, brochures, videos, books, journal articles, conference papers, patents, and exhibits.

### [Renewable And Appropriate Energy Laboratory \(Rael\)](#)

Renewable And Appropriate Energy Laboratory (Rael), numerous publications.

### [World-wide Information System for Renewable Energy \(WIRE\) provided by ISES](#)

Research Reports, Interim results, interesting new applications, scientific breakthroughs and research reports are available here. The initiative enables researchers world-wide to present their findings using the latest communication technology even if their own resources do not allow it.

### [Information Bridge: DOE Scientific and Technical Information](#)

The Information Bridge: DOE Scientific and Technical Information provides free public access to full-text documents and bibliographic citations of Department of Energy (DOE) research report literature. Documents are primarily from 1994 forward and were produced by DOE, the DOE contractor community, and/or DOE grantees. Legacy documents are added as they become available in electronic format.

## **Selected Research Papers**

### [Optimization of Building Integrated Photovoltaic Systems](#)

A paper for IEEE specialst conference on optimization of building integrated PV systems. Smiley and Stamenic, 2002.

Source: <http://www.bcit.ca/appliedresearch/pv/publications.shtml>

### [Low Irradiance Performance Modelling for Building Integrated Photovoltaics](#)

The low irradiance efficiency of photovoltaic modules is important to the accurate performance modelling of Building Integrated Photovoltaic (BIPV) systems.

Smiley et al., 2001. Source: <http://www.bcit.ca/appliedresearch/pv/publications.shtml>

### [Performance Modelling of Building Integrated Photovoltaic Systems](#)

Modelling BIPV performance, especially BIPV systems in northern latitudes, requires the effect of light intensity on the efficiency of solar cells to be included. Many commercial modules have reduced module efficiency at low light levels. Using a modification of the ideal diode equation for the calculation of the open circuit voltage of the PV array, it is possible to produce a model of the BIPV array that correlates very closely with efficiency data collected at the Photovoltaic Energy Applied Research Lab, British Columbia, Canada. Smiley et al., 2000.

Source: <http://www.bcit.ca/appliedresearch/pv/publications.shtml>

### [Research and Development on the first AC BIPV installation in Canada](#)

This paper describes the design of a 1kWp Building Integrated photovoltaic system, the monitoring system and how initial system performance meets the design criteria. In particular, the ability of the micro-inverter in the AC photovoltaic modules to perform at low light levels is a critical aspect of the system design. The installed system produces power at insolation values below 20 W/m<sup>2</sup>, and overall system efficiency varies between 4% at 20 W/m<sup>2</sup> and 10% at approximately 400 W/m<sup>2</sup>.

Stamenic et al., 1999.

Source: <http://www.bcit.ca/appliedresearch/pv/publications.shtml>

### [Measured Performance of Building Integrated Photovoltaic Panels – Round 2.](#)

National Institute of Standards and Technology, Gaithersburg, Maryland

Dougherty et al., revised March 2001.

Source: <http://fire.nist.gov/bfrlpubs/>

### [Window Performance for Human Thermal Comfort](#)

Center for Environmental Design Research, University of California, Berkeley, California, P. Lyons and D. Arasteh, August 1999.

Source: <http://btech.lbl.gov/>

### [Comparative analysis of active and passive solar heating systems with transparent insulation](#)

Solar Energy

Peuportier and Michel, 1995.

Source: <http://www-cenerg.ensmp.fr/francais/themes/cycle/>

[The Future of Passive Solar Design: Regionalism And Appropriate Technology](#)

Center for Maximum Potential Building Systems, Inc.

P. Fisk, 1972.

Source: <http://www.cmpbs.org/>

[Solar Thermal Collectors at High Latitudes: Design and Performance of Non-Tracking Concentrators](#)

Uppsala University

M. Adsten, 2002.

Source: <http://www.diva-portal.org/>

[Ventilation impact of a solar chimney on indoor temperature fluctuation](#)

The aim of this research was to investigate, experimentally, both the feasibility of a solar chimney to reduce heat gain in a house by inducing natural ventilation and the effect of openings, door, window and inlet of solar chimney on the ventilation rate.

King Mongkut's University of Technology Thonburi, Bangkok, Thailand.

Khedari et al., 1999.

Source: <http://www.ecaa.ntu.edu.tw/ecaaeng/index1.htm>

[Field performance of a Japanese low energy home relying on renewable energy](#)

This paper describes the construction and evaluation of an experimental low energy home assisted by a hybrid system using natural energy resources and unused energy. The home, for which a ground source heat pump (GSHP) system has been installed, was built on the campus of Hokkaido University, Japan in March 1997.

Hokkaido University. Hamada et al., 2001.

[Hybrid Pv/T Systems With Dual Heat Extraction Operation](#)

Hybrid Pv/T Systems With Dual Heat Extraction Operation

Physics Department, University of Patras, Greece.

Tripanagnostopoulos et al., 2002.

Source: <http://www.ecn.nl/publications/>

<http://www.ecn.nl/files/dego/extranet/pvt/patras04.pdf>

Hybrid Pv/T System With Improved Air Heat Extraction Modification, Y. Tripanagnostopoulos, et. al. 17th European Photovoltaic Solar Energy Conference, Munich, 2001.

Source: <http://www.ecn.nl/publications/>

[http://www.ecn.nl/files/dego/extranet/pvt/eurosun04\\_lca.pdf](http://www.ecn.nl/files/dego/extranet/pvt/eurosun04_lca.pdf)

Application aspects of hybrid PVT/AIR solar systems, Y. Tripanagnostopoulos, et. al., Proceedings of EuroSun2004, Freiburg.

Source: <http://www.ecn.nl/publications/>

[Performance and Characterization of Building Integrated Photovoltaic Panels](#)

Proceedings of the 29th IEEE Photovoltaic Specialists Conference (PVSC)

Hunter Fanney, et. al., 2002.

Source: <http://fire.nist.gov/bfrlpubs/>

[DElight: a daylighting and electric lighting simulation engine](#)

Eighth International IBPSA Conference.

R. Hitchcock, W. Carroll, August 11-14, 2003,

Source: <http://gundog.lbl.gov/>

### [Solar Control](#)

An important quality characteristic of façade systems is the “robustness” against so-called “faulty operation”. In this paper, we describe our methodology, which has been used to assess the performance of façade systems for many high-rise buildings.

Fraunhofer Institute for Solar Energy Systems (ISE)

Tilmann E. Kuhn, Jan Wienold, 2003.

Source: [http://www.ise.fraunhofer.de/welcome\\_english.html](http://www.ise.fraunhofer.de/welcome_english.html)

### [Photovoltaics in the year 2025](#)

International Journal of Hydrogen Energy 25

G.H. Lin, D.E. Carlson, 2000.

Source: [http://www.ipc.uni-linz.ac.at/os/index\\_os.html](http://www.ipc.uni-linz.ac.at/os/index_os.html)

### [Photovoltaic and Solar-Thermal Technologies in Residential Building Codes: Tackling Building Code Requirements to Overcome the Impediments to Applying New Technologies](#)

D. Wortman and L. Echo-Hawk, September 1999.

Source: <http://www.nrel.gov/>

### [Using the Whole-Building Design Approach to Incorporate Daylighting into a Retail Space](#)

American Council for an Energy-Efficient Economy Pacific Grove, California

S. Hayter, et. al., June 2000.

Source: <http://www.nrel.gov/>

### [CIGSS Thin Film Solar Cells, Final Subcontract Report](#)

Florida Solar Energy Center Cocoa, Florida.

N.G. Dhere, 2005.

Source: <http://www.nrel.gov/>

### [Photovoltaic Manufacturing Technology Phase 2b: Spherical Solar Technology.](#)

NREL

R.R. Schmit, 1995.

Source: <http://www.nrel.gov/>

### [Innovative Approach for the Design and Optimization for Multijunction Photovoltaic](#)

National Center for Photovoltaics and Solar Program Review Meeting

S. Michael, M. Green, March 24–26, 2003, Denver, Colorado.

Source: <http://www.nrel.gov/>

### [Predicting Long-Term Performance of Photovoltaic Arrays Using Short-Term Test Data and an Annual Simulation Tool](#)

NREL

G. Barker, P. Norton, Revised November, 2003.

Source: <http://www.nrel.gov/>

### [Pipe Freeze Prevention for Passive Solar Water Heaters Using a Room-Air Natural Convection Loop](#)

J. Burch, Solar 2006, Denver, Colorado.

Source: <http://www.nrel.gov/>

[PV and PV/Hybrid Products for Buildings](#)

Presented at the 16th European Photovoltaic Solar Energy Conference and Exhibition  
Glasgow, Scotland, U.K. May 1-5, 2000.

H.P. Thomas and S.J. Hayter

Source: <http://www.nrel.gov/>

[Building Integrated Photovoltaic Systems Analysis: Preliminary Report](#)

NREL

ERG International Inc., August, 1993.

Source: <http://www.osti.gov/bridge/>

[A new method for predicting the solar heat gain of complex fenestration systems: 1. Overview and derivation of the matrix Layer calculation](#)

UC Berkeley

Klems, J.H. 1993 Oct 2001

Source: <http://www.osti.gov/energycitations/>

[Phase Change Materials in Floor Tiles for Thermal Energy Storage](#)

Colorado State University

Douglas C. Hittle, October, 2002.

Source: <http://www.osti.gov/bridge/>

[Hybrid Photovoltaic Building Components: Overall Performance Assessment by Testing and Simulation](#)

Belgian Building Research Institute

L. Vandaele, et. al., 1997.

Source: <http://www.paslink.org/>

[Experimental Techniques for Measuring Temperature and Velocity Fields to Improve the Use and Validation of Building Heat Transfer Models](#)

Brent Griffith, et. al.

Source: <http://repositories.cdlib.org/escholarship/>

[Intelligent Commercial Lighting: Demand-Responsive Conditioning and Increased User Satisfaction](#)

University of California Energy Institute

Alice M. Agogino, 2005.

Source: <http://repositories.cdlib.org/escholarship/>

[Monitoring the Energy-Use Effects of Cool Roofs on California Commercial Buildings](#)

Lawrence Berkeley National Laboratory

Hashem Akbari et. al., 2004.

Source: <http://repositories.cdlib.org/escholarship/>

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# **Innovation/Products**

## **Photovoltaics/Collectors/Systems**

### Altair Energy

Altair Energy is known for professionally engineered, turnkey solar electricity systems (photovoltaics or PV). As a solar energy service provider, we offer utility-quality installations, through licensed local contractors, maintenance, extended warranties and financing for PV systems.

### ASE Americas, Inc.

ASE Americas is the fastest growing PV manufacturer in the U.S. and is now the third largest in the U.S.

### AstroPower

AstroPower produces the world's largest solar electric (photovoltaic) cells and a full line of solar modules.

### Atlantis Energy Systems, Inc.

Atlantis Energy Systems, Inc. is a manufacturer of Building Integrated Photovoltaic (BIPV) products. Our two product lines are Sunslates PV roofing slates and custom PV glass laminates. AES services include: system design, project coordination, system integration and training.

### [Beijing Sunda Solar Energy Technology Co. Ltd.](#)

The Sino-German Joint Venture Beijing Sunda Solar Energy Technology Co. Ltd. was founded in 1995 by Beijing Sunpu Technical Company and Daimler-Benz Aerospace AG based on a cooperation in evacuated tubular solar collector field from 1986. Its main product is high quality & efficiency Evacuated Tube Solar Collector with metal absorber.

### [Bekaert ECD Solar Systems LLC \(Formerly United Solar Systems Corp.\)](#)

United Solar develops and manufactures solar cells for the UNI-SOLAR brand of solar panels and systems. Bekaert ECD assembles and sells these solar panels and systems through its worldwide distribution network.

### [BP Solar](#)

BP Solar manufactures, designs, markets and installs quality solar electric systems for a wide range of applications in the residential, commercial and industrial sectors. BP Solar's full range of high efficiency crystalline and thin film photovoltaic modules ensure that you'll get the best solar power system for your application and budget. From small DC lighting and pumping systems to large AC grid-intertied commercial power plants, BP Solar has the products and services to meet your needs.

### [C&D Technologies, Inc.](#)

C&D Technologies Powercom Division engineers and markets fully integrated power systems which provide back-up battery power in the event of a primary power loss or interruption and can both monitor and rectify AC to DC current in telecommunications equipment.

### [CentennialSolar](#)

CentennialSolar is a Canadian-based company evolving in the photovoltaic industry. As an eco-friendly company, our goal is to promote the use of renewable energy sources; more precisely we are committed to solar-powered systems.

### [Conergy](#)

Conergy is one of the leading system suppliers in the area of regenerative energies in Europe.

### [CSG Solar](#)

As the photovoltaic industry is becoming more and more significant to the worldwide supply of sustainable electricity, CSG Solar intends to play an active role in the market growth, pro-actively shaping its development with its innovative and patented > Crystalline Silicon on Glass (CSG) technology.

### [Direct Water and Power](#)

Direct Power & Water Corporation designs, distributes and installs a full line of solar electric equipment. We take great pride in our ability to custom engineer and design remote power systems.

### [Ecostream](#)

Ecostream is a quality supplier of turnkey solar power plants and systems with over two decades of experience. We offer custom-built sustainable energy systems in five European countries, allowing you to generate a high, long-term return on your investment.

### [Edisun Power AG](#)

Edisun Power AG: Secure returns on capital from the Swiss solar power business. Invest in the future with Switzerland's leading solar power contractor.

### [EMCORE](#)

EMCORE's photovoltaic division designs and manufactures multi-junction compound semiconductor solar cells and solar panels for commercial satellite applications.

### [Energia Total](#)

Energia Total provides pre-assembled solar and wind electric systems that use energy from the sun to provide conventional AC power for your remote cabin or manufactured home. We also provide back-up power and grid-connected solar electric systems for those of you who already have grid power.

### [Energy Photovoltaics, Inc. \(EPV\)](#)

Energy Photovoltaics, Inc. (EPV) is a solar energy company that primarily designs, develops, manufactures, and markets thin-film photovoltaic (PV) modules and Integrated Manufacturing Systems for the growing international PV marketplace. Located near Princeton, New Jersey, USA, EPV is a privately owned company that has been at the forefront of research, development, and commercialization of thin-film PV technologies since 1991 when it was founded by pioneers in the solar industry.

### [ENTECH](#)

ENTECH provides advanced solar energy technology for a variety of applications, ranging from daylighting systems for commercial buildings to solar power arrays for spacecraft. We have also developed a new daylighting system for illuminating stores, schools, offices, and other buildings with unprecedented performance.

### [Evergreen Solar, Inc.](#)

The PV modules produced by Evergreen Solar are distinctive in their appearance because they incorporate proprietary crystalline silicon technology known as String Ribbon. This technology, explained further on, enables an innovative approach to manufacturing dependable and cost-effective PV modules.

### [Evident Technologies](#)

Our technical expertise and advances, particularly with respect to our proprietary non-environmentally restricted quantum dot formulations so important for future applications, have made Evident the partner-of-choice for a growing number of companies in our three key target markets: Life Sciences, Security & Military Applications and LEDs/ Displays.

### [flexcell](#)

flexcell (VHF-Technologies SA) is a Swiss company founded in 2000 at the Ecole d'Ingénieurs du Canton de Neuchâtel by three forward-thinking scientists and entrepreneurs, passionate about renewable energy and skilled in plasma deposition processes of amorphous silicon. Over the past few years, flexcell has evolved from a technology start-up to a leading-edge technology company in the photovoltaic (PV) industry. The company manufactures flexible, thin and lightweight photovoltaic modules, using its proprietary Very-High-Frequency plasma technology to deposit thin layers of amorphous silicon onto plastic substrates.

### [Free Energy Europe](#)

Free Energy Europe produces fourth generation amorphous silicon panels. The panels are the best choice for remote low power applications, due to the combination of high reliability and low cost.

### [Global Solar](#)

With its advanced thin-film technologies, GLOBAL SOLAR is developing new ways to install solar photovoltaics (PV) and improve its economics. Benefits of this enabling solar technology range from various building integrated options to low-cost global shipping and handling of flexible and lightweight modules.

### [ICP Solar Technologies Inc.](#)

ICP Solar Technologies Inc. has empowered its employees to push the boundaries of solar technology since the company was founded in 1988. From day one, ICP Solar has been committed to the research, development, manufacturing, marketing and sales of leading-edge solar energy products. ICP Solar's user-friendly solar panels and accessories have been widely used in a variety of applications in the consumer, construction and OEM markets. ICP Solar is renowned for products that are reliable, innovative and efficient.

### [Kaneka](#)

The Japanese company Kaneka was founded in 1949 and employs 3,000 people in various divisions - amongst others in the production of glass fibres and other conductor materials. The PV division produces silicon PV panels.

### [Kyocera Solar, Inc.](#)

Kyocera is the world's largest vertically-integrated producer and supplier of solar energy products. Our solar division has headquarters in Scottsdale, Arizona, and regional sales centers on five continents, Kyocera Solar, Inc (KSI), our North American solar products subsidiary, services thousands of customers in both the developed and developing world.

### [Matrix Energy Inc.](#)

Matrix Energy Inc. is a diversified renewable energy company and their website gives an overview of the technologies and products that they employ to achieve their customers' Autonomous Power or Energy Efficiency requirements.

### [Matrix Solar Technologies, Inc.](#)

Early in 1997 Matrix Solar Technologies, Inc., a subsidiary of ATS Automation Tooling Systems Inc., acquired Photowatt International. Photowatt, founded in 1979, is now the largest integrated manufacturer of photovoltaic wafers, cells and modules in Europe, and the world leader in thin silicon cell technology.

### [Morning Star](#)

Morningstar Corporation is a world-leading supplier of photovoltaic (PV) controllers using advanced technology. Our products are sold in 49 countries through a global network of 98 authorized Morningstar distributors.

### [MSK](#)

MSK is Japan's largest specialist PV company. Since 1984 our business has been the design and manufacture of high-quality photovoltaic modules and systems. In addition to supplying innovative products, we excel in providing complete turnkey solutions to our clients. MSK is able to produce custom-order modules to meet the requirements of any project. Our services range from pre-system preliminary studies through to post-installation commissioning and maintenance. MSK has entered new stage of growth by agreeing to merge with Suntech.

### [UNSW PERL](#)

The UNSW PERL high efficiency cells, are the world's highest performing silicon solar cells. Whilst they are very suitable for specialist applications such as solar car racing, research and other applications where efficiency is the prime consideration they are not a cost competitive solution to most domestic and commercial solar cell applications. As a guide they are about 100 times the cost of a standard commercial solar cell. If your application needs it, and your budget can afford the best silicon has to offer, then please read on.....

### [Phönix SonnenStrom AG](#)

As a specialist wholesaler, Phönix SonnenStrom AG sells solar modules, inverters, accessories and complete solar power systems.

### [PowerLight](#)

PowerLight is a leading global provider of large-scale solar power systems.

We are committed to making solar power a mainstream source of energy, bringing unmatched experience and proven financial performance to commercial, public sector and residential customers worldwide.

### [RMS Electric, Inc.](#)

RMS Electric provides top quality services and products to fulfill your electrical power project needs. We are a problem solving company that provides permanent solutions for our customers. Our reputation for premium quality customer service is the key to our many years of successful business.

### [SCHOTT Corporation](#)

SCHOTT Corporation, with its subsidiary SCHOTT North America, Inc., is the North American headquarters and holding company for SCHOTT AG (Germany). With 16 divisions and subsidiaries in the United States, Canada, and Mexico, SCHOTT Corporation employs approximately 2,500 people for the manufacture and distribution of special glass and glass-related systems, including solar PV and solar thermal systems.

### [SHARP](#)

SHARP, a high tech company founded in 1912, is known for a variety of product innovations such as the development of the pocket calculator or LCD technology. SHARP is also a pioneer in solar technologies and has been producing solar cells since 1959. Today SHARP is one of the world's biggest suppliers of solar modules.

### [Solar Cell](#)

Welcome to the web site of the Danish project PEC (photo electro chemical) Solar Cell. The objective of this project is to develop a dye-sensitised solar cell dedicated for building integrated systems.

### [Solardyne Corporation](#)

Solardyne Corporation brings you reliable renewable energy technology, and energy conserving appliances. Place your order securely on-line, or call us TOLL FREE at 1-866-244-5815. We look forward to being of service.

### [Solar Energy International](#)

Your one stop shopping site for all your solar and alternative energy needs. Visit our "ON-LINE CATALOG" for great deals on Solar Electric, Solar Thermal, Wind Power and Micro-Hydro components, accessories and much more. . .

### [Solar Roof Integration Frame from Schweizer.](#)

Solar Roof Integration Frame from Schweizer. The innovative solution for PV systems in sloped roofs

### [Solar Webb](#)

At Solar Webb, Inc. we provide an alternative to energy production using photovoltaic power, the natural energy of the sun, to run low voltage electric equipment for your home or business.

### [Solar Works, Inc.](#)

Since 1980, Solar Works, Inc., has provided renewable energy services and equipment to government agencies, utilities, private businesses, homeowners, and not-for-profit organizations in the United States and overseas.

### [SolarWorld AG](#)

SolarWorld AG is a solar group with a fully integrated solar value chain process from solar silicon as the raw material to high quality solar power generating systems.

### [Solland](#)

Solland is a German/Dutch solar cell producer.

### [SOLON AG](#)

SOLON AG was founded in 1997 and when it was floated at the German Stock Exchange in 1998 it became Germany's first listed solar products company. SOLON is one of Germany's leading producers of solar modules and supplier of photovoltaic systems for large-scale solar power plants. The SOLON Group has daughter companies in Germany, Austria, Italy and Switzerland. Besides being a manufacturer of modules, SOLON also develops and produces solar trackers, the so-called "Solon Mover".

### [SPS Energy Solutions](#)

With offices across North America, SPS Energy Solutions manufactures its own products, has in-house engineering and marketing capabilities, and is a master distributor for world-class companies. Our mission is to offer the industry's best renewable energy knowledge, service and products to our partners.

### [Southwest PV Systems](#)

Since its inception in 1986, Southwest PV Systems, Inc. (SWPV) has grown from a small regional supplier of solar electric products and systems to one of the world's largest distributors and integrators of standalone systems for industrial and rural electrification applications.

### [Spherical Solar Power](#)

is located in Cambridge, Ontario, Canada. Spherical Solar™ technology uses silicon to convert sunlight into electricity. The result of over 40 worldwide patents, this unique proprietary technology incorporates thousands of tiny silicon spheres, bonded between thin flexible aluminum foil substrates to form solar cells. Products include flexible, lightweight solar panels for recreational use; lightweight, durable power modules for residential and commercial buildings; and, building integrated solar products.

### [Spire Corporation](#)

Spire Corporation develops, manufactures and markets highly-engineered photovoltaic module manufacturing equipment, and provides advanced surface treatments for the biomedical industry.

### [Stretched Lens Array](#)

SLA technology will provide cost-effective space power, at unprecedented performance levels, for near-term exploration missions in the earth-moon neighborhood, and for longer range missions to mars and the rest of the solar system.... and spectacular ground solar power spin-offs are also in the works!

### [Sunnyside Solar](#)

Sunnyside Solar, Inc. is a small family owned company specializing in photovoltaic electric systems - Sunlight to Electricity. We provide design, engineering, sales, installation and service. Sunnyside Solar was founded in 1979 primarily working at that time with solar domestic hot water systems, solar greenhouses and conservation projects.

### [SunPower Corp.](#)

SunPower Corp. designs and manufactures high-efficiency silicon solar cells and solar panels based on an all-back contact cell design. SunPower's solar cells and panels generate up to 50 percent more power per unit area than conventional solar technologies and have a uniquely attractive, all-black appearance.

### [Suntaics](#)

Since 2003 we are engaged in the field of Renewable Energies, mainly as a wholesale dealer and manufacturer of solar panels.

### [Suntech](#)

Suntech exclusively produces solar cells and solar modules and is one of the fastest growing companies in this field. Suntech's production has seen a twelve fold increase in only 3 years and today is one of the 10 biggest suppliers of solar cells and solar modules worldwide.

### [SunWize Technologies, Inc.](#)

SunWize Technologies, Inc. is a photovoltaic technology company specializing in the manufacture of integrated power systems and the distribution of solar modules and balance of systems components.

### [United Solar Ovonic](#)

United Solar Ovonic, a wholly owned subsidiary of ECD Ovonics, by building upon the technology invented and pioneered by ECD Ovonics, has become the world leader in thin-film amorphous photovoltaics (PV) technology and commercial applications.

### [Viva Solar Inc.](#)

Viva Solar Inc. is a Canadian incorporated company with head offices in Toronto and production facilities in Krasnodon, a city in Southern Russia where major developments in solar science were made. The company has been manufacturing under Canadian supervision monocrystal Silicon solar photovoltaic cells and modules since 1990. Viva Solar PV cells and modules are known for high durability, stable power output and an elegant appearance which does not degrade with time. The minimum commercial guaranteed efficiency of Viva Solar' cells is currently 13% with majority of the cells having 14-16% efficiency. Another feature of R&D is a further development of double-sided cells and modules able to produce power from both sides thereby enhancing overall power output.

### [Yingli Solar](#)

Yingli is one of the largest Chinese solar companies, not only producing modules but also producing silicon ingots, wafers and cells. Yingli controls the complete production of components to manufacture solar modules.

### [Zephyr Industries](#)

Manufacturer of the Power Vent Battery Box Ventilator and Back Draft Damper.

## **Balance of Systems**

### [Advanced Energy Systems Inc.](#)

Advanced Energy, Inc. designs and manufactures conditioning and control electronics, primarily for on-site, power generation systems.

### [Ballard](#)

Ballard designs, develops, and manufactures power electronics products for fuel cells, photovoltaic (PV), and other distributed generation products. Ballard sells the Ecostar™ power converter (EPC) for photovoltaic applications to PV panel original equipment manufacturers (OEMs), PV integrators and distributors.

### [Beacon Power](#)

Our products address two key energy applications: power conversion and energy storage. In both cases our product design goals are reliability, performance, and sustainable value.

### [Eco Energy](#)

Eco Energy has been a manufacturer of electronics for the solar industry since 1992. Eco Energy located in Belleville, Ontario, and manufactures solar charge controllers, battery chargers, low voltage disconnects, battery voltage monitors and custom requests.

### [Fire Wind and Rain Technologies](#)

State of the art charge controllers, data acquisition gear, DC-AC inverters, and much more, all at affordable prices.

### [Fronius USA Solar Electronics Division](#)

The Fronius USA Solar Electronics Division is a branch of Fronius International GmbH. Fronius USA has operated in the United States since 2002 and is proud to bring the Fronius reputation for quality, service, performance, and reliability to the North American market. Fronius Solar Inverters have been engineered and refined to operate well – even in the harshest of environments.

### [Mastervolt](#)

Mastervolt is a world leader in the supply of electrical power system solutions to a wide variety of markets. Our mission is to make dependable AC or DC available to all those who require power at locations where no public utility is available.

### [Morningstar Corporation](#)

Morningstar Corporation is a world-leading supplier of photovoltaic (PV) controllers using advanced technology. Our products are sold in 57 countries through a global network of 163 authorized Morningstar distributors.

### [RMS Electric, Inc.](#)

RMS Electric provides top quality services and products to fulfill your electrical power project needs. We are a problem solving company that provides permanent solutions for our customers. Our reputation for premium quality customer service is the key to our many years of successful business.

### [SatCon Technology Corporation](#)

SatCon Technology Corporation, incorporated in 1986, is an industry leader in the development and manufacturer of power electronics and control systems. SatCon offers diversified and sophisticated power products for the Alternative Energy, Hybrid-Electric Vehicle, Grid Support, High Reliability Electronics and Advanced Power Technology markets.

### [Satellite Photovoltaic Yield Control & Evaluation](#)

Satellite Photovoltaic Yield Control & Evaluation. SPYCE monitors your system.

### [Schletter](#)

The Munich based Schletter company was founded in 1968 and produces high quality aluminium, stainless steel and iron mounting systems. Their products are characterised by their flexibility and exceptionally easy installation.

### [SMA Technologie AG](#)

Founded in Germany in 1981, SMA Technologie AG has grown to over 1000 employees worldwide. SMA America's office in California supplies the North and South American renewable energy markets with the highest efficiency, most reliable inverters available.

### [Solar Converters](#)

Solar Converters Inc. is a manufacturer of leading edge charge controllers with Maximum Power Point Tracking, (MPPT) designed to optimize the value of your system. Also, we have developed a line of high quality linear current boosters, battery equalizers and cathodic protection controllers. We have recently added a line of battery powered DC motor pump drivers to operate DC submersible pumps of various manufacturers from home battery power.

### [Solardyne Corporation](#)

Solardyne Corporation brings you reliable renewable energy technology, and energy conserving appliances. Place your order securely on-line, or call us TOLL FREE at 1-866-244-5815. We look forward to being of service.

### [Solar Works, Inc.](#)

Since 1980, Solar Works, Inc., has provided renewable energy services and equipment to government agencies, utilities, private businesses, homeowners, and not-for-profit organizations in the United States and overseas.

### [Specialty Concepts](#)

Specialty Concepts manufactures the broadest line of electronics for photovoltaic systems in the world. For over 18 years, we have been producing high-quality, reliable units and custom designs for special applications.

### [SunWize Technologies, Inc.](#)

SunWize Technologies, Inc. is a photovoltaic technology company specializing in the manufacture of integrated power systems and the distribution of solar modules and balance of systems components.

### [Thermomax Technologies](#)

We offer a wide range of microprocessor based Differential Controllers, Alarm Systems, Data Loggers and all your Electronics Manufacturing needs.

### [Ubbink](#)

Ubbink (subsidiary of Centrotec, a specialist in energy-saving systems) is a supplier of mounting systems for solar modules.

### [UniRac, Inc.](#)

Manufacturer of quality photovoltaic mounting structures.

### [Xantrex](#)

Xantrex is a leading designer, manufacturer, and marketer of advanced power electronics and control products.

## **Measurement and Testing Equipment**

### [Atlas Weathering Services Group](#)

The Atlas Weathering Services Group (AWSG) is a global network of material testing and evaluation laboratories. AWSG is a division of Atlas Electric Devices Company, a world leader in materials durability testing for over 80 years.

### [Devices & Services](#)

The source for instruments to measure reflectance, absorptance, transmittance, emittance.

### [Eppley Labs](#)

Located in Newport, Rhode Island USA, the Eppley Laboratory has been committed to developing the finest scientific instrumentation for precision measurements since 1917. The Meteorology Department produces radiometer, pyranometers, pyrhemometers and pyrgeometers that measure solar and terrestrial radiation. Many National Meteorological Authorities are using Eppley Instrumentation as their standards for radiometric measurements.

### [Kipp & Zonen, Inc.](#)

Kipp & Zonen Inc. was previously known as SCI-TEC Instruments Inc., a company located in Saskatoon, Canada, which started in business in 1981. Over the past twenty years, this Company, founded by Ken Lamb and Neil Foulds, has built up a sound reputation as the only world manufacturer of the Brewer Spectrophotometer, a specialized scientific measuring instrument for ozone and UV research.

### [PVSAT](#)

PVSAT is a performance check for photovoltaic (PV) system operations. It aims to reduce costs by optimizing energy yields and system maintenance. For operators of a PV system, PVSAT offers a performance check to increase the system's efficiency and productivity.

## **Solar Thermal**

### [Beijing Sunda Solar Energy Technology Co. Ltd.](#)

The Sino-German Joint Venture Beijing Sunda Solar Energy Technology Co. Ltd. was founded in 1995 by Beijing Sunpu Technical Company and Daimler-Benz Aerospace AG based on a cooperation in evacuated tubular solar collector field from 1986. Its main product is high quality & efficiency Evacuated Tube Solar Collector with metal absorber.

### [Canadian Solar Technologies Inc. \(CST\)](#)

Canadian Solar Technologies Inc. (CST) is a high-tech provider of evacuated tube solar collectors, manufactured by Beijing Sunda Solar Energy Technology Co., a highly acclaimed solar collector manufacturer.

### [Conergy](#)

Conergy is one of the leading system suppliers in the area of regenerative energies in Europe.

### [Conserval](#)

SOLARWALL is the most EFFICIENT and cost effective way to solar heat large buildings. Our patented metal wall cladding and air handling system can heat intake air, improve indoor air quality, improve heat distribution, provide summer cooling and decrease maintenance costs.

### [EnerWorks](#)

EnerWorks, a London, Ontario based company established in 1999, is a developer and manufacturer of proprietary renewable energy appliances for residential and commercial markets.

### [SCHOTT Corporation](#)

SCHOTT Corporation, with its subsidiary SCHOTT North America, Inc., is the North American headquarters and holding company for SCHOTT AG (Germany). With 16 divisions and subsidiaries in the United States, Canada, and Mexico, SCHOTT Corporation employs approximately 2,500 people for the manufacture and distribution of special glass and glass-related systems, including solar PV and solar thermal systems.

### [Solardyne Corporation](#)

Solardyne Corporation brings you reliable renewable energy technology, and energy conserving appliances.

### [Solar Energy International](#)

Your one stop shopping site for all your solar and alternative energy needs. Visit our "ON-LINE CATALOG" for great deals on Solar Electric, Solar Thermal, Wind Power and Micro-Hydro components, accessories and much more. . .

### [Solar Roofs.com](#)

Harness the sun with the Fireball 2001TM, the world's first user-friendly solar water heater.

### [Solar Works, Inc.](#)

Since 1980, Solar Works, Inc., has provided renewable energy services and equipment to government agencies, utilities, private businesses, homeowners, and not-for-profit organizations in the United States and overseas.

### [SunEarth](#)

SunEarth Inc. was incorporated in the state of California in May, 1978 and has grown to become one of the most experienced solar thermal product manufacturers in the world.

### [Sun Spot Solar & Heating](#)

Sun Spot Solar & Heating markets the Beijing Sunda line of evacuated tube solar collectors for a variety of residential and commercial water heating applications.

### [Thermo Dynamics Ltd.](#)

Thermo Dynamics Ltd. (TDL) is a Canadian company engaged in the research, development, production, distribution and installation of solar thermal equipment. Our specialization is liquid, flat plate, glazed collectors with aluminum/copper absorbers.

### [XINWANG Solar](#)

XINWANG Green Energy development Co., Ltd is a large manufacturer and exporter of solar water heating system. It supplies solar water heater parts and whole System to individual, commercial, industrial domestic and international users.

## **Glazings/Daylighting Controls**

### <http://www.advancedglazings.com/>

Advanced Glazings Ltd. was founded in 1995 by Dr. Douglas I. Milburn to develop, manufacture and market sustainable and commercially viable technologies related to sunlight. To date, Advanced Glazings Ltd. has developed two important products; SoleraTM, for the architectural daylighting market and InsolCoreTM for the greenhouse market, both based upon transparent insulation technology. Solera was introduced at the 2000 conference of the American Institute of Architecture.

### [AFG Industries](#)

AFG is the leader in glass manufacturing in North America. As a fully integrated company, AFG has expertise in flat glass manufacturing, distribution, fabrication, packaging and coating technologies. AFG is part of a global glass manufacturing organization (Asahi Glass Company, Ltd.).

### [Colt International Limited](#)

Colt offers intelligent and attractive architectural solutions to problems of solar heat gain, including solar shading systems and screening and performance louvers.

### [Pilkington-LOF](#)

Pilkington plc is a large-scale manufacturer of glass and glazing products for building, automotive and technical markets.

### [Somfy Group](#)

Somfy Group's activities are based on one business: automatic control of openings and closures in homes and buildings.

## **Software/Modelling**

### [Building Energy Software Tools Directory](#)

This directory is sponsored by the U.S. Department of Energy (DOE) and provides information on 318 building software tools for evaluation energy efficiency, renewable energy, and sustainability in buildings.

### [CoDePro](#)

CoDePro - Collector Design Program (Design your own solar collector and compute the efficiency curves in various conditions. You can also compare these curves to experimental data

### [Division of Building Physics & Solar Energy Products](#)

The Division of Building Physics & Solar Energy offers several downloadable and online products.

### [DOE-2](#)

DOE-2 is a widely used and accepted freeware building energy analysis program that can predict the energy use and cost for all types of buildings. DOE-2 uses a description of the building layout, constructions, usage, conditioning systems (lighting, HVAC, etc.) and utility rates provided by the user, along with weather data, to perform an hourly simulation of the building and to estimate utility bills.

### [DOE-2.1E](#)

DOE-2.1E is for professional energy analysts who require state-of-the-art simulation tools for building energy use. It performs a detailed / zone-by-zone hourly simulation, and includes a wide variety of modeling features that make it possible to simulate "real buildings." These capabilities offer much greater accuracy and detail than possible with handbook methods or simplified analysis.

### [ENERGY-10](#)

ENERGY-10 software is a powerful design tool that analyzes—and illustrates—the energy and cost savings that can be achieved through more than a dozen sustainable design strategies. Hourly energy simulations help you quantify, assess, and clearly depict the benefits of daylighting, passive solar heating, natural ventilation, well-insulated envelopes, better windows, lighting systems, mechanical equipment, and more.

### [VisualDOE 4.0](#)

VisualDOE is a powerful, yet easy-to-use "front end" to DOE2.1E, the industry standard building energy simulation program. VisualDOE is developed and supported by architects and engineers as a tool for other designers and building scientists to accurately estimate performance of building design alternatives. Energy calculations for LEED certification is a common application.

### [EnergyPlus](#)

EnergyPlus is a building energy simulation program for modeling building heating, cooling, lighting, ventilating, and other energy flows. While it is based on the most popular features and capabilities of BLAST and DOE-2, it includes many innovative simulation capabilities such as time

steps of less than an hour, modular systems and plant integrated with heat balance-based zone simulation, multizone air flow, thermal comfort, and photovoltaic systems.

#### [Enerpath](#)

Data acquisition tools for HVAC, lighting, etc.

#### [ESP-r](#)

ESP-r is an integrated modelling tool for the simulation of the thermal, visual and acoustic performance of buildings and the assessment of the energy use and gaseous emissions associated with the environmental control systems and constructional materials. In undertaking its assessments, the system is equipped to model heat, air, moisture and electrical power flows at user determined resolution.

#### [F-CHART](#)

F-CHART is the authoritative solar system analysis and design program written by S.A. Klein and W.A. Beckman, the originators of the F-Chart method.

#### [HOT2000](#)

Easy-to-use energy analysis and design software for low-rise residential buildings. Utilizing current heat loss/gain and system performance models, the program aids in the simulation and design of buildings for thermal effectiveness, passive solar heating and the operation and performance of heating and cooling systems.

#### [Lumen Micro](#)

Lumen Micro provides you with tools to create and simulate lighting layouts for both indoor and outdoor applications in a quick and easy to use manner. Interior spaces and exterior sites may be easily modeled using Lumen Micro's advanced CAD capabilities, then accurate numerical and graphical results are only a click away.

#### [PVWATTS](#)

PVWATTS calculates electrical energy produced by a grid-connected photovoltaic (PV) system. Researchers at the National Renewable Energy Laboratory developed PVWATTS to permit non-experts to quickly obtain performance estimates for grid-connected PV systems within the United States and its territories.

#### [Radiance](#)

RADIANCE is a highly accurate ray-tracing software system for UNIX computers that is licensed at no cost to users for non-commercial use; commercial use licenses including distribution rights are available for a fee. Radiance was developed with primary support from the U.S. Department Of Energy and additional support from the Swiss Federal Government. It is copyrighted by the Regents of the University of California.

#### [Rayfront](#)

Rayfront lighting design software, developed by Georg Mischler. He is an architect, lighting and daylighting consultant, and a freelancing software developer in the field of physically accurate lighting simulation and visualization, software development were acquired in practical application and self-training.

#### [RaySim6](#)

RaySim6 is a graphical user interface (GUI) software program for geometrical ray tracing of solar cells that runs under most modern MS Windows Operating Systems. RaySim version 6.0 is presently being prepared for free public release, but you can download a beta version and try it out.

#### [RETSCREEN](#)

clean energy decision support software.

### [SolArch](#)

SolArch is a shareware design tool for architects. The European Commission Directorate General for Energy (DG XVII) supported this work as a THERMIE Programme action.

### [TREAT](#)

Powerful Software Tools for Energy Audits, Building Performance Contracting, & Weatherization.

### [TRNSYS](#)

TRNSYS (pronounced 'tran-sis'), commercially available since 1975, is a flexible tool designed to simulate the transient performance of thermal energy systems. TRNSYS's beginnings can be found in a joint project between the University of Wisconsin – Madison Solar Energy Lab and the University of Colorado Solar Energy Applications Lab.

### [Valentin Energy Software](#)

Valentin Energy Software grew out of the Dr. Valentin planning office, Berlin. The company therefore has extensive experience in systems planning for energy supply and research, in particular in the fields of renewable energy and rational energy use. This experience has proved to be invaluable in the development of our software products.

## **Related Sites**

### [BLDG SIM](#)

BLDG-SIM is a mailing list for users of building energy simulation programs. Examples of building simulation programs include DOE-2, EnergyPlus, Trace-600, HAP, Blast, ESP, SERIRES, TRNSYS, TASE, Energy-10, and others (see link below for a more complete list).

## **Research Papers on Modeling/Software**

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