

## Community-Scale Solar Photovoltaics: Housing and Public Development Examples



PVPS

PHOTOVOLTAIC  
POWER SYSTEMS  
PROGRAMME

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Community-Scale Solar Photovoltaics :  
Housing and Public Development Examples

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## Foreword

The International Energy Agency (IEA), founded in November 1974, is an autonomous body within the framework of the Organization for Economic Cooperation and Development (OECD) which carries out a comprehensive programme of energy co-operation among its member countries. The European Commission also participates in the work of the IEA.

The IEA Photovoltaic Power Systems Programme (PVPS) is one of the collaborative R & D Agreements established within the IEA. Since 1993, the PVPS participants have been conducting a variety of joint projects in the application of photovoltaic conversion of solar energy into electricity.

The mission of the Photovoltaic Power Systems Programme is “to enhance the international collaboration efforts which accelerate the development and deployment of photovoltaic solar energy as a significant and sustainable renewable energy option”. The underlying assumption is that the market for PV systems is gradually expanding from the present niche markets of remote applications and consumer products, to the rapidly growing markets for building-integrated and other diffused and centralised PV generation systems.

The overall programme is headed by an Executive Committee composed of one representative from each participating country, while the management of individual research projects (Tasks) is the responsibility of Operating Agents. By the end of 2007, twelve Tasks were established within the PVPS programme.

The objective of Task 10 is to enhance the opportunities for wide-scale, solution-oriented application of photovoltaics (PV) in the urban environment as part of an integrated approach that maximizes building energy efficiency and solar thermal and Photovoltaics usage. The Task’s long term goal is for urban-scale PV to be a desirable and commonplace feature of the urban environment in IEA PVPS member countries.

The report expresses, as nearly as possible, the international consensus of opinion of the Task10 experts on the subjects dealt with.

Further information on the activities and results of the Task can be found at:  
<http://www.iea-pvps.org> and <http://www.iea-pvps-task10.org>

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## Executive Summary

A major step towards mainstreaming PV on an Urban Scale is communities that standardise PV technology in the housing or community design. This report provides examples of housing developments and incorporated townships that have integrated multiple stakeholder values<sup>1</sup> into business solutions. Total installed distributed PV power in the IEA PVPS countries reached 5,7 GW in 2006<sup>2</sup>. In the emerging distributed energy market, community-scale PV is the key to portfolio diversity with benefits far beyond the community of installations.

The database was developed with a template for gathering the information distributed to Task 10<sup>3</sup> and PV-UP-SCALE participants resulting in 38 communities surveyed. Most of the community scale PV examples are residential. There is also one Swedish example of the City of Malmo installing PV on public buildings. The community examples are categorised as 'residential – urban' and 'public'. This collection of examples is not all inclusive and diverse communities combining commercial, residential and/or public building PV installations and loads may result in more benefits to all stakeholders.<sup>4</sup>

Truly integrated PV communities can maximise the benefits through careful planning and multilateral involvement of all stakeholders. The urban scale PV market is not the bilateral (customer/utility) relationship of traditional central generation electricity sales. When urban scale PV is mainstreamed, the planning and business relationships will also be common place. However, as this market emerges, these initial PV communities result in large numbers of systems connected to the "traditional" one-way network grid in a limited area. In these early adopter developments, emphasis is on the collaboration between the utility, building sector and government agencies. However, alliance of all the Task 10 targeted stakeholders may strengthen both the economic and technical success of PV Communities with considerations such as:

- **Building Sector:** Builders/developers, architects, and engineers, need to consider orientation, aesthetics, load diversity, energy efficiency, grid infrastructure and end use. Real estate agents need to fully understand the functional differences in whole building design and on-site energy to assure full disclosure to their clients.
- **End-Users:** Residential and commercial building owners or occupants need to consider the electric service design relative to loads, green image, and economic differences (less operational expense) and opportunities (feed-in tariff, or renewable energy credit- REC sales).
- **Government:** Local government can codify and verify building energy performance. Also, permitting preference can be given to high performance buildings. Government agencies may be involved in licensing and certification of installers to assure customer confidence in, as well as, quality and performance. All levels of governments have implemented policy incentives to energy market transition. All government actions can be tied to economic and population growth management.
- **Finance and Insurance Sector:** Banks need to consider the operational savings in the overall debt allowances. Banks and insurance companies may consider the value

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<sup>1</sup> D. Suna, R. Haas and A. Polo, *Analysis of PV System's Values Beyond Energy –by country, by stakeholder*, Report IEA-PVPS T10-02:2008, January 2008

<sup>2</sup> *Trends in photovoltaic applications. Survey report of selected IEA countries between 1992 and 2006*, IEA PVPS T1-16:2007

<sup>3</sup> The report was mainly developed through IEA-PVPS Task 10. However, it is a joint product with PV-UP Scale, considered a participant in Task 10 through the European Commission.

<sup>4</sup> H. Laukamp, J. Diaz, T. Erge, G. Ebert, *Grid Effects of a Large, Distributed PV Capacity in a Modern Urban Settlement*, PV-UP-Scale deliverable 4.3

on the reduced financial risk of volatile energy prices as well as reduced property loss costs from more disaster resistant building stock<sup>5</sup>.

- **PV Industry:** System manufacturers and integrators can develop standardised systems as the “community market becomes mainstream. PV system supply chain and retail sector can standardise installations in developments and increase and diversify labour skills.
- **Electricity Sector:** In the emerging PV community market, utilities are considering counter measures. However, utilities are quickly gaining awareness of business opportunities such as reduced grid service infrastructure requirements, selling green, and reduced operational costs on a smart-portfolio diversified grid and even a “smart grid”<sup>6</sup>
- **Education Sector:** The need for professionals and skilled labour workforce development has grown as drastically as the PV market. There may be greater opportunities for educators to develop the necessary curricula and on-the-job experience through PV communities.

Residential housing is a major energy consumer and market opportunity for PV.<sup>7</sup> The retrofit market is immense in PVPS countries, but new housing developments provide opportunities for standardisation of design and installation of the PV systems. Urban areas have strong grids with low impedance, minimising the requirement for countermeasures in the grid service design.

Advanced facilities like PV systems are a high initial investment. However, these can be an added value of the houses and the community. In addition, it is expected the environmental consciousness and identity as a community will emerge to become widespread marketing and value tool regionally.

It is envisioned that a well-designed PV community would be one of the promising options of mainstreaming PV in urban areas and stimulate PV market for further deployment.

This report provides information of existing PV communities and would be a useful reference for design or planning of community-scale PV developments in urban areas. Not only builders, developers and planners, but all stakeholders involved in the business chain occurring in a PV community.

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<sup>5</sup> A. Deerling and J. Thornton, *Applications of Solar Technology for Catastrophe Response, Claims Management, and Loss Prevention*, Seminar Paper, June 1998

<sup>6</sup> [www.xcelenergy.com/smartgrid](http://www.xcelenergy.com/smartgrid)

<sup>7</sup> D. Elzinga, *Urban BIPV in the New Residential Construction Industry*, Report IEA-PVPS T10-03:2008 March 2008

# 1. Introduction

## 1.1 Background and objectives

Annual PV installations in IEA PVPS countries have increased on average by over 40% for the last decade. Of the 5,7 GW cumulative installations in 2006 nearly 90% (5,1 GW) are grid-connected PV systems. The Community-scale PV market segment is growing rapidly as developers, builders, planners, and communities realise the related benefits and business opportunities. Community-scale PV also brings together all the successful elements to reach the overall Task 10 objective – mainstreaming PV in the urban environment.

The approach to reach the Task 10 objective was to pull together an international, uniform set of analysis and tools for the broad range of stakeholders in the PV - distributed energy market. Community-scale solar exemplifies urban scale PV applications. PV communities are most successful, monetarily and operationally, when all stakeholders are included. Most PV developments are in urban areas with a strong grid and diversified loads so that network impacts are minimised. Workforce development, system and installation standardisation, and smart network operation opportunities occur with multiple systems. The tangential values of environmentally “green” are realised by residents, occupants and the businesses involved. Finally, the new business opportunities such as customer aggregation, renewable energy credits/green tags, lease to own distributed generation and/or premium reliability electric service can develop with the multiple stakeholders involved with community-scale PV.

A well-designed PV community would contribute to and stimulate PV market for further deployment. Multiple systems in a smaller area provide the network company experience, not provided with single system installations. Since most PV market barriers are network related, barriers reduction is reached more quickly (See Annex 1 – Barriers Table). Developers and builders achieve market differentiation with a green, low to zero energy consumption, and more robust building product. In addition to common community identities such as architectural design, building occupants identify as environmental stewards. Cost reduction is always accelerated with the standardisation and volume resulting from community-scale PV installations

This report provides information on existing PV communities. It is a useful reference for a design or planning of PV developments in urban areas.



*Jo-Town Kanokodai, a community-scale PV development in Kobe, Hyogo. With 3 KW per single family dwelling, the 95 residences can boast of a nearly 300kW PV community.*

*The developer obviously considered orientation for solar access in both the roof design and the development layout plan.*

## 1.2 Definition of PV community in this report

In this report, the PV community is defined as ‘an area where a significant number of houses, buildings and/or structures are equipped with PV systems’<sup>8</sup>. A demonstration project for PV installation and operation is included. PV application type in the community is not limited to building integrated PV such as PV roof tile or integrated façade. The focus of the definition is multiple systems in a community.

This report is intended to provide examples of PV communities. PV market potential in the residential building market as a whole – information, analysis and process reasoning are provided in the Task 10 report, *Residential Urban BIPV in the Mainstream Building Industry*. This report provides examples of the community-scale PV variations of planning, design and development in existing PV communities.

PV communities included in this report are categorized as ‘Residential –urban’ and ‘Public’, although PV communities could include various kinds of urban area, e.g. Residential (urban, village and other), Commercial (urban, sub-urban, other), Public (University, other), Mixed and other, etc.

## 1.3 Approaches for the database

Information on the PV communities in this report was provided by experts of the Task 10 and the PV-UP-SCALE, based on literatures survey, interviews to developers, etc. The database information for each community was all that was provided by the experts. A standard information template was used for information gathering on all PV communities. However, in some cases, the information was proprietary or not available.

The PV community information will also be included in the PV-UP-Scale on-line database<sup>9</sup>. As the objective of this report is to disseminate examples of PV communities, the database hasn’t covered all the communities of participating counties to the IEA PVPS Task10 and the PV-UP-SCALE. However representative examples of their countries are surveyed and included in the database.

The template developed for collecting the information is included as Annex 2. For some items subtables were also prescribed and included for information in the annex. The main categories of information are:

BIODATA -	PV community name
	Kind of urban area (sub-table A)
	Main building type in community (sub-table B)
	New/Retrofit/Added (sub-table C)
	Type of project (sub-table D)
	Start of operation
	Location/City, state, etc.
	Country
	Latitude
	Longitude
PV SYSTEM CHARACTERISTICS -	Total PV power
	Number of houses/buildings
	PV power per unit

<sup>8</sup> An exception was made to the definition for the two UK examples of Newbiggin Hall Estate and Campkin Court, Cambridge. Even though the examples are single buildings, they represent social housing communities.

<sup>9</sup> [www.PVDATABASE.org](http://www.PVDATABASE.org)

	Energy yield per year Main PV system type (sub-table E) Main PV application type (sub-table F) Main PV module type (sub-table G) Main PV cell type (sub-table H) PV module manufacturer/brand Inverter manufacturer/brand Investment for PV systems
OWNERSHIP -	Building owner PV owner PV energy user
PHOTO -	Photo Copywrite
PV COMMUNITY DESCRIPTION -	PV Community Brief Grid issue Urban planning and architectural issues Economic / financial issues Other remarks
COMMUNITY INFORMATION	Project leader company Other project company Project's www Contact address



*Pal-Town Jyosai-no-mori, located in Ota, Gunma, consists of 553 houses with PV systems, a total of 2,16 MW of PV power in the community.(2,6-5,0 kW/house). The Community-scale PV development serves as a test field for NEDO. The objective of the 5 year (FY2002-FY2007) test project is to demonstrate that a power system of several hundred residences, where each residence installs the PV system, can be controlled by the technologies developed in this program without any technical problems. All residences have data monitoring. There are four research subject areas:*

*Subject 1:*

*Development of technology to avoid restriction of PV output (including storage device trials on lithium-ion battery and electric double layer capacitor - EDLC)*

*Subject 2:*

*Analyses and evaluation of higher harmonics*

*Subject 3:*

*Analyses of mis-actuation of function to prevent islanding operation*

*Subject 4:*

*Development of applied simulations including economic analysis*

'BIODATA' includes items for identifying the community and their locations. 'PV SYSTEM CHARACTERISTICS' describes characteristics of PV systems installed in the community. 'OWNERSHIP' information provides some indication of the business arrangement. Care was taken to obtain legal photographs for the 'PHOTO' category and includes the copyright.

The information in the 'PV COMMUNITY DESCRIPTION' is the focus and purpose of this document as a Task 10 project. A well designed PV community achieves integration with the grid, the building, and the community. Existing communities that have resolved issues related to the grid, urban planning, architecture and economics provide practical experience for the future market. For instance, Pal-Town Jyosai-no-mori (see sidebar) has been a long term research project for Japan's New Energy and Industrial Technology Development Organization (NEDO).

And, finally, 'COMMUNITY INFORMATION' includes project companies and contact addresses for the PV development.

## 2. Summary of PV communities surveyed

### 2.1 PV communities surveyed in this study

A total of 38 communities were surveyed. The country-by-country numbers are Australia: 1, Austria: 1, Canada: 1, Denmark: 2, France: 2, Japan: 13, Korea: 2, the Netherlands: 3, Sweden: 1, Switzerland: 1, United Kingdom: 5, and United States: 6. A summary of the PV communities surveyed with selected key attributes is provided as **Table 2-1**.

One PV community in Sweden is categorised as ‘public’ and consists of 15 buildings such as museums, schools, etc. The total capacity of PV systems is 500kW.

The other 37 communities are in ‘residential – urban’. There are 21 ‘Single house’ communities, 7 ‘Multi-story apartment building’ communities, 8 ‘Attached houses’ communities, and 1 a mixture of all three types. The five communities in the United Kingdom are social housing projects. In Japan and the United States, nearly all the community surveyed except one (in Japan - Retrofit – old area with new buildings) are newly developed. The European PV communities were mainly ‘Retrofit’ or ‘Added’.

In ‘residential – urban’ PV communities, the largest project is ‘Stad van de Zon’ (City of the Sun) (the Netherlands), which is consisted of more than 3 500 dwellings and approximately 5MW in total. The second largest for total PV power is ‘Pal Town Josai-no-mori’ (Japan, 553 houses, 2 160 kW), and that for number of houses is ‘Olympic Village, Sydney’ (Australia, 935 houses, 857 kW).

As for the PV system type and the PV application type, two French projects are ‘grid-connected – supply side’, with one ‘Façade – mounted’ and the other ‘Inclined roof – PV roof tile’. Most other communities PV system type is ‘grid-connected – demand side’ and PV modules are basically placed on the roof, e.g. inclined roof, flat roof. The roof applications are approximately half PV roof tiles and half mounted type. The Swedish project has ‘Flat roof - mounted & mechanical fixing’ and ‘Façade - integrated in fixed sunscreens and mounted’ as PV application type.

All PV cells used in the communities are silicon-based. In Japan amorphous Si PV modules are used in some communities and those PV modules are used as PV roof tiles.

As for the ownership, PV systems for single houses and attached houses are basically owned by inhabitant, while, in case of project of Switzerland and two projects in the Netherlands, PV systems are owned by utilities. The ownership for multi-story apartment buildings, UK social housing, and public buildings are owned by other organisations. The PV energy user is classified into inhabitant, other organisation (building owner) and utility, and this basically depends upon scheme for PV electricity, e.g. net-metering or feed-in-tariff, and PV owner. In case of Switzerland’s one, the PV energy user is the Solar Stock Exchange.

### 2.2 Aspects of grid, urban planning and architectural integration

Community-scale PV requires multiple stakeholder input and coordination. The business relationship is no longer a bilateral customer – electric utility, client – provider relationship. The multilateral business opportunities for distributed generation have broadened the stakeholder group. In the case of these early adopter PV developments, the most important stakeholders are the urban planners, the grid operators, and the builder/developer/designer. The two page narratives of each PV community provide specific details on integration and the related success factors and issues. Provided here are the commonalities related to integration.

### **As for the Grid**

Grid operators are responsible for high quality, reliable electricity delivery. From the very beginning of grid development the electric service has been centralised generation and one-way energy flow. The grid reliability and protection design is based on this electric service plan and distributed generation such as PV may require countermeasures. The ultimate solution is a new design which accommodates distributed generation. However, the high concentration of distributed generation in PV communities provides opportunities to define a new grid design and transition the grid design. In fact some of the PV communities in this report include investigation into effects and counter measures, such as Denmark's – Solbyen, Japan's - Pal-Town Jyosai-no-mori, and United States – Premier Gardens. However, most of the PV communities reported no negative influence to the grid. Furthermore an extensive survey of utilities in the PV-UP-SCALE project which included utilities in large markets of Japan, Germany, and Spain resulted in utilities opinion of no insurmountable issues related to grid connected PV.

*Overall, it can be concluded that the experience and perception of PV-DG by European utilities is positive. Grid connected PV plants have demonstrated compatibility with LV distribution networks even at high densities.<sup>10</sup>*

The common success factor for the 38 PV communities is to involve the grid operator at the earliest possible, “concept”, phase of the project. Even with utility involvement, in the case of the 2 French communities, the requirement of an additional utility connection for the feed-in tariff was overlooked initially. Additional considerations are:

*Multi-use communities with both commercial and residential loads tend to smooth the load profile and optimise the on-site use of PV due to closer commercial load – PV generation match.*

*Non-urban, rural high impedance grids may require additional grid countermeasures<sup>7</sup>.*

Urban PV Communities also have the potential for even greater values to utilities. Smart grid operation, peak reduction, ancillary services<sup>11</sup>, renewable energy credit or green tag trading could be new business opportunities for grid operators. The new grid design may be able to take into account lower capacity requirements for grid equipment, especially in good PV capacity match areas, lowering the grid capital costs. Matching the generation profile of the PV to the load profile may be important for demand reduction. This typically occurs when large peaks are caused by air conditioning loads on the grid. A test home in Lakeland Florida USA<sup>12</sup> designed a portion of the PV system to be west facing, thus shifting the profile to slightly later in the day for maximum effective load carrying capacity - ELCC<sup>13</sup>. Often in urban settings, the building density, traffic congestion, poor air quality and other common urban attributes result in high cost, to nearly impossible distribution grid upgrades. Clean quiet distributed PV generators and energy efficiency become the only solution to continued reliable electric service.

### **As for urban planning and architecture**

The most important issue of urban planning is to create a harmonised landscape as a community. Long term aesthetics are directly proportional to property values. However, only

<sup>10</sup> *Utilities Experience and Perception of PV Distributed Generation*, Deliverable 4.2, [www.PVUPScale.org](http://www.PVUPScale.org)

<sup>11</sup> Ancillary services may include intentional reactive power from the inverters or voltage support

<sup>12</sup> Field Evaluation of Efficient Building Technology with Photovoltaic Power Production in New Florida Residential Housing, Report Florida Solar Energy Center, FSEC-CR-1044-98

<sup>13</sup> R. Perez, R. Margolis, M. Kniecik, M. Schwab, M. Perez, *Update: Effective Load Carrying Capability of Photovoltaics In The United States*, American Solar Energy Society Conference 2006, [www.asrc.cestm.albany.edu/perez](http://www.asrc.cestm.albany.edu/perez)



three communities surveyed included building integrated (BIPV) applications. As can be seen by the photography in the database, curb appeal can still be achieved without full BIPV integration.

At the very concept stage of a development project, solar access and mounting or integration relative to building design must be considered. Optimum electricity generation occurs in most locations with the PV system facing south (north in the southern hemisphere) and tilted at an angle equal to the latitude. However, the utility and/or customer may prefer a demand reduction (reducing the peak kW) trade-off to optimal electricity produced. This preference can provide more design options, because demand reduction is achieved with west facing installations. Attractive communities can be both appealing and functional. In most of the examples included in the report, design was achieved for the PV systems to operate very near to optimum electricity output. Another design consideration may be equality among the neighbours, so that each residence has the same capacity of PV thus creating a community sense of unity.

Both appeal and functionality can serve as the community identity. For a community identity including energy and the environment, the integration of the whole building/whole community operational design is imperative<sup>14</sup>.

In a building development the identity sells the community initially, thus releasing the development capital or debt for increased value to the builder. However, energy performance also helps the building stock retain long term resale value. A solar electric system increases home value by 20 000 USD for each 1 000 USD in annual reduced operating costs due to the system<sup>15</sup>.

For 'Public' communities like the City of Malmo, the city is responsible for the urban planning and land use. Malmo wants to be identified as "The solar city of Sweden" and has started this by public building installations. Other Cities have started the process by including energy in the long term growth management planning. In the future, a "whole community" approach will be for the city to justify a long-term energy efficiency renewable energy plan through economic and infrastructure growth management. The "whole community" approach would include public buildings and stringent building energy performance measures.

### **Other remarks**

Many communities surveyed in this report, take a 'whole building' approach. This includes high energy efficiency, 'green' environmentally friendly facilities, passive solar, solar thermal and PV. In terms of economics and performance, efficiency, passive solar and solar thermal are lower cost measures resulting in a higher thermal and therefore electric performance building, and thus lowering the capacity required from the higher cost PV technology. Otherwise the PV technology may be used to heat water electrically at 5 000 USD to 10 000 USD per kW rather than using solar thermal at 500 -1 000 USD per kW<sup>16</sup>. In case of 'La Darnaise' (France), in addition to high-efficiency insulation and windows, solar thermal panels and a wood chip fired plant are installed and providing heat to the community.

<sup>14</sup> Some of the participating countries define urban planners as municipal government responsible for the whole community and in some countries urban planners are the community design firm.

<sup>15</sup> Black, A., American Solar Energy Society Annual Conference, Portland, Oregon, USA, 2004

<sup>16</sup> [www.solar-rating.org](http://www.solar-rating.org) (see solar facts), also the IEA Solar Heating and Cooling, [www.iea-shc.org](http://www.iea-shc.org). Solar hot water heater that is 6 m<sup>2</sup> will deliver, on average, 3 400 kWh per year for an initial cost of 2 000 – 4 000 USD, a comparatively sited PV system that delivers 3 400 kWh per year would cost 15 000 - 24 000 USD.



This 'whole building' and 'whole community' approach results in an environmental stewardship identity for the inhabitants. In a time when all OEDC countries have admitted climate change as a reality, the 'green' identity became a market differentiation for the developer/builder and a life-style differentiation for the community with the associated economic benefits and is expected to become widespread regionally.

Table 2-1(1): List of PV communities surveyed in this report

Kind of urban area	Country	City, state, etc.	Name of community	Main building type	New/ Retrofit/ Add	Number of houses/ buildings	Total PV power (kW)	Start of operation
Residential – urban	Australia	Sydney	Olympic village	Attached houses	New	935	857	Year 1999
	Austria	Voralberg	Thüringerberg	Single houses	Added	17	146	Year 2000 (complete in 2003)
	Canada	Waterloo	Solar Community Demonstration project	Single houses	New	4	12.8	Year 2003
	Denmark	Brædstrup	Solbyen	Single houses	Retrofit / Added	30	60	Year 1997
		(8 districts)	Sol 300			300	750	Year 1999 (complete in 2000)
	France	Venissieux	La Darnaise	Multi-story apartment buildings	Retrofit	11	92	Year 2005
		Saint Priest	Les Hauts de Feuilly	Attached houses	New	22	25	Year 2006
	Japan	Chiba	Villa garten Shin-Matsudo	Single houses	New	41	123	Year 1999
		Saitama	Tiara court Kasukabe			35	101	Year 1999
		Saitama	Cosmo-town Kiyomino saizu			79	237	Year 2001
		Hyogo	Jo-town Kanokodai			95	285	Year 2002
		Saitama	Cosmo-town Yumemino saizu licht paadje			88	180	Year 2003
		Hokkaido	Hills garden Kiyota			142 (as of Dec. 2006)	336 (as of Dec. 2006)	Year 2003
		Gunma	Pal Town Josai-no-mori			553	2 160	Year 2003 (complete in 2006)
		Chiba	Sekisui Harmonate-town Shin-Kamagaya			29	90	Year 2004
		Hyogo	Panahome-city Seishin-Minami			100	299	Year 2004
		Saitama	Sengendai sai-no-michi			25	50	Year 2005

Kind of urban area	Country	City, state, etc.	Name of community	Main building type	New/ Retrofit/ Add	Number of houses/ buildings	Total PV power (kW)	Start of operation
Residential – urban (continued)	Japan (continued)	Okayama	Sekisui Harmonate-town Tsurunoura	Single houses	New	25 (as of Apr. 2007)	98 (as of Apr. 2007)	Year 2005
		Osaka	Jo-town Rinku Hawaiian village			236	476	Year 2005
	Korea	Aichi	Hazama-so	Multi-story apartment buildings	Retrofit	8	200	Year 2000
		Asan	Asan Green Village	Attached houses	Added	26 buildings (104 families)	208	Year 2005
	the Netherlands	Cheonju	Korea National Housing Corp.-apartment	Multi-story apartment buildings	n.a.	n.a. (1 215 families)	250	Year 2006
		Amsterdam	Nieuw-Sloten PV houses	Attached houses	New	about 100	250	Year 1996
		Amersfoort	Nieuwland 1MW PV project			over 500	1 350	Year 1999
	Switzerland	Heerhugowaard	Stad van de Zon (City of the Sun)			over 3 500	5 000	Year 2002 - 2008
		Zurich	ABZ Residential area 'Moos'	Multi-story apartment buildings	Retrofit	11	100	Year 2000 and Year 2003
	United Kingdom	Clifton	Corncroft, Nottingham	Attached houses	New	22	34	Year 2002
		Liverpool	Pinehurst			9	14	Year 2002
		Castlereagh	Belfast field trials – Sunderland road	Multi-story apartment buildings	Retrofit	3 buildings (30 flats)	51	Year 2003
	United States	Westerhope	Newbiggin Hall Estate			1 building (25 flats)	38,25	Year 2004
		Cambridge	Campkin Court, Cambridge			1 building (23 flats)	22,1	Year 2004
		Watsonville, CA	Vista Montana	Mixed	New	177 single, 80 town homes, 2 buildings (132 flats)	>300	Year 2003
		Rancho Cordova, CA	Premier Gardens	Single houses		95	209	Year 2004
		Pleasanton, CA	Avignon			30	105	Year 2007

Kind of urban area	Country	City, state, etc.	Name of community	Main building type	New/ Retrofit/ Add	Number of houses/ buildings	Total PV power (kW)	Start of operation
Residential – urban (continued)	United States (continued)	Rocklin, CA	Carsten Crossings	Single houses	New	144	345	Year 2006 (not yet completed)
		Sacramento, CA	Fallen Leaf			32	64	Year 2006 (not yet completed)
		San Diego, CA	Shea Homes – San Angelo			100	120	Year 2002
Public	Sweden	Malmö	City of Malmö	Non-residential buildings	Added	15 buildings	300	Year 2001

Table 2-1(2): List of PV communities surveyed in this report (continued)

Country	Name of community	Main building type	Main PV system type	Main PV application type	Main PV cell type	PV owner	PV energy user
Australia	Olympic village	Attached houses	Grid-connected - demand side	Inclined roof – integrated, and PV roof tile	Crystalline Si	inhabitant	inhabitant
Austria	Thüringerberg	Single houses	Grid-connected - demand side	Inclined roof - mounted	Crystalline Si	inhabitant	Utility
Canada	Solar Community Demonstration project	Single houses	Grid-connected - demand side	Inclined roof - integrated	Amorphous Si	inhabitant	inhabitant
Denmark	Solbyen	Single houses	Grid-connected - demand side	Inclined roof - mounted	Crystalline Si	inhabitant	inhabitant
	Sol 300						
France	La Darnaise	Multi-story apartment buildings	Grid-connected - supply side	Façade - mounted	Crystalline Si	Other organisation	Utility
	Les Hauts de Feuilley	Attached houses		Inclined roof - PV roof tile		Inhabitant	Utility
Japan	Villa garten Shin-Matsudo	Single houses	Grid-connected - demand side	Inclined roof - mounted	Crystalline Si	inhabitant	inhabitant
	Tiara court Kasukabe						
	Cosmo-town Kiyomino saizu			Inclined roof - PV roof tile	Amorphous Si		
	Jo-town Kanokodai						
	Cosmo-town Yumemino saizu licht paadje						
	Hills garden Kiyota			Inclined roof - mounted Inclined roof - PV roof tile Flat roof - mounted	Crystalline Si		
	Pal Town Josai-no-mori						
	Sekisui Harmonate-town Shin-Kamagaya			Flat roof - mounted Inclined roof - mounted Inclined roof - PV roof tile	Crystalline Si Amorphous Si		
	Panahome-city Seishin-Minami			Inclined roof - mounted Inclined roof - PV roof tile	Crystalline Si		
	Sengendai sai-no-michi			Inclined roof - PV roof tile	Amorphous Si		

Country	Name of community	Main building type	Main PV system type	Main PV application type	Main PV cell type	PV owner	PV energy user
Japan (continued)	Sekisui Harmonate-town Tsurunoura	Single houses	Grid-connected - demand side	Flat roof - mounted Inclined roof - mounted	Crystalline Si	inhabitant	inhabitant
	Jo-town Rinku Hawaiian village	Multi-story apartment buildings		Inclined roof - PV roof tile	Amorphous Si		
	Hazama-so			Flat roof - mounted & mechanical fixing	Crystalline Si		
Korea	Asan Green Village	Attached houses	Grid-connected - demand side	Inclined roof - mounted	Crystalline Si	inhabitant	inhabitant
	Korea National Housing Corp.-apartment	Multi-story apartment buildings					
	the Netherlands	Nieuw-Sloten PV houses	Attached houses	Grid-connected - supply side	Inclined roof – integrated	Crystalline Si	inhabitant
Nieuwland 1MW PV project		Grid-connected - demand side	Inclined roof – integrated Flat roof – integrated				
Stad van de Zon (City of the Sun)							
Switzerland	ABZ Residential area 'Moos'	Multi-story apartment buildings	Grid-connected - demand side	Inclined roof – integrated	Crystalline Si	Other organisation	Other organisation
United Kingdom	Corncroft, Nottingham	Attached houses	Grid-connected - demand side	Inclined roof – integrated	Crystalline Si	Other organisation	inhabitant
	Pinehurst			Inclined roof - PV roof tile			
	Belfast field trials – Sunderland road	Multi-story apartment buildings		Inclined roof – integrated			
	Newbiggin Hall Estate			Inclined roof - mounted			
	Campkin Court, Cambridge			Flat roof - mounted & mechanical fixing			
United States	Vista Montana	Mixed	Grid-connected - demand side	Inclined roof - mounted	Crystalline Si	inhabitant	inhabitant
	Premier Gardens	Single houses		Inclined roof - PV roof tile			
	Avignon						

Country	Name of community	Main building type	Main PV system type	Main PV application type	Main PV cell type	PV owner	PV energy user
United States (continued)	Carsten Crossings	Single houses	Grid-connected - demand side	Inclined roof - PV roof tile	Crystalline Si	inhabitant	inhabitant
	Fallen Leaf			Inclined roof - mounted			
	Shea Homes – San Angelo			Flat roof - mounted & mechanical fixing, Façade - integrated & mounted			
Sweden	City of Malmö	Non-residential buildings	Grid-connected - demand side		Crystalline Si	Other organisation	Other organisation

### 3. Conclusions

Community-scale PV is a small market relative to the residential new construction. The communities surveyed are a small set of the PV inclusive development market emerging. Even in this small set of surveys, it is evident that the 'green' identity tangential value can become a real economic value above the energy performance through faster sales for developers, higher resale value for home-owners and economic growth to communities.

The common factor to success is positive collaboration starting at the earliest project concept including planners, PV manufacturers, housing/building industry, real estate agents, and utility companies. However, as the PV community scale market emerges, additional stakeholder considerations can optimise the economics and operational benefits such as:

- **Building Sector:** Builders/developers, architects, and engineers, need to consider orientation, aesthetics, load diversity, energy efficiency, grid infrastructure and end use. Real estate agents need to fully understand the functional differences in whole building design and on-site energy to assure full disclosure to their clients.
- **End-Users:** Residential and commercial building owners or occupants need to consider the electric service design relative to loads, green image, and economic differences (less operational expense) and opportunities (feed-in tariff, or renewable energy credit- REC sales).
- **Government:** Local government can codify and verify building energy performance. Also, permitting preference can be given to high performance buildings. Government agencies may be involved in licensing and certification of installers to assure customer confidence in, as well as, quality and performance. All levels of governments have implemented policy incentives to energy market transition. All government actions can be tied to economic and population growth management.
- **Finance and Insurance Sector:** Banks need to consider the operational savings in the overall debt allowances. Banks and insurance companies may consider the value on the reduced financial risk of volatile energy prices as well as reduced property loss costs from more disaster resistant building stock.
- **PV Industry:** System manufacturers and integrators can develop standardised systems as the "community market becomes mainstream. PV system supply chain and the retail sector can standardise installations in developments and increase and diversify labour skills.
- **Electricity Sector:** In the emerging PV community market, utilities are considering counter measures. However, utilities are quickly gaining awareness of business opportunities such as reduced grid service infrastructure requirements, selling green, and reduced operational costs on a smart-portfolio diversified grid and even a "smart grid"
- **Education Sector:** The need for professionals and skilled labour workforce development has grown as drastically as the PV market. There may be greater opportunities for educators to develop the necessary curricula and on-the-job experience through PV communities.

Community-scale PV benefits can be optimized through design, planning, technology and operational integration using 'whole building' and 'whole community' approaches. It is envisioned that a well-designed PV community would be one of the promising options of mainstreaming PV in urban areas and stimulate PV market for further deployment.



#### **4. PV community database: Examples of community scale PV installation in urban area**

The following two page database entries are the detailed descriptions of Community-Scale PV projects forming the basis of this report.



## Austria: Thüringerberg

### BIODATA

**PV community name:** Thüringerberg  
**Kind of urban area:** Residential – urban  
**Main building type in community:** Houses - single houses  
**New/Retrofit/Added:** Added separately to the buildings  
**Type of project:** -  
**Start of operation:** Year 2000 (completed in 2003)  
**City, state, etc.:** Vorarlberg  
**Country:** Austria  
**Latitude:** N47 13' 0"  
**Longitude:** E9 46' 59"

### PV SYSTEM CHARACTERISTICS

**Total PV power:** 146 kW  
**Number of houses/buildings:** 17 (15 single houses, the elementary school and the community centre)  
**PV power per unit:** Approx. 8,5 kW  
**Energy yield per year:** Approx. 956 kWh/kW (derived from the data of 5 PV systems in this community over 3 years)  
**Main PV system type:** Grid-connected - demand side  
**Main PV application type:** Inclined roof - mounted  
**Main PV module type:** Framed regular module  
**Main PV cell type:** Crystalline silicon  
**PV module manufacturer:** Kyocera, Solar Fabrik, Aspro Power, Atersa, Böhler  
**Inverter manufacturer:** Fronius, SMA/Sunny Boy, Sputnik/Solar Max  
**Investment for PV systems:** Approx. 8500 EUR/kW (price from the year 1999)  
 Approx. 7000 EUR/kW (price from the year 2002)  
 Approx. 5900 EUR/kW (price from the year 2003)

### OWNERSHIP

**Building owner:** Inhabitant  
**PV owner:** Inhabitant  
**PV energy user:** Utility (VKW)



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## PV COMMUNITY DESCRIPTION

### PV Community Brief

Community Thüringerberg is located in Vorarlberg which is the western province of Austria. This community is one of the 6 communities of "das Große Walsertal" biosphere park. Biosphere parks are marked up by UNESCO as model regions for sustainable and economized life. This community is located 890 m above sea level where there is less fog in the winter. The number of habitants is 690; the number of households is 210.

Energieinstitut Vorarlberg coordinated the PV Power plant on the roof of community centre which was implemented in the framework of "SONNENSCHN" campaign. After that some inhabitants wanted to have their own PV systems. The "feed in tariff" gave them the possibility to realize these.

### Grid issue

For grid connection, the directives of Utility in Vorarlberg province (VKW) were implemented. Special attention has been given to the protection against lightning. The surplus electricity of community centre, where the first PV system was installed, has been fed into the grid but after coming into force of feed-in tariff system, 100% of generated electricity could be fed into the grid.

### Urban planning and architectural issues

Because of landscape protection all PV systems are roof integrated. In the two of the households PV roof tiles were used.

### Economic / financial issues

A PV system with a capacity of 1,725 kW (PV Power Plant) has been installed, in February 2000, on the roof of new community centre within the framework of private shareholder programme "SONNENSCHN" campaign which was launched in the Austrian province of Vorarlberg in 1997. The programme was coordinated by the 'Energieinstitut Vorarlberg'. Within this programme private individuals and local governments are encouraged to purchase 'Sonnenscheine' (= 'sun bill'). The price of one share was set at 70 EUR and the installations are supported by means of 30% to 35% rebates from the province of Vorarlberg. For this PV system the householders of community Thüringerberg purchased 175 shares.

In October 2001 the feed in tariff came into force in Vorarlberg. 72 EURcent/kWh for new systems and 50 EURcent/kWh for old systems have been granted for 15 years. This incentive stimulated the residential PV System installations.

15 inhabitants built a "private partnership" and invested in a PV system on the roof of primary school. The shareholders may obtain the money earned from electricity generation at the end of every 6 months.

### Other remarks:

Comprehensive information campaigns, technical tours, and education activities accompanied the programme "SONNENSCHN". Moreover, frequent meetings of shareholders and operators ensured that the campaign is kind of a public event. Through this campaign the public interest has increased in Vorarlberg.

## COMMUNITY INFORMATION

**Project leader company:** -

**Other project company:** -

**Project's www:** <http://www.solalbert.info>

<http://www.solalbert.info/pv/anlageninfo/index.php?region=1&gemende=1>

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## Canada: Waterloo, Ontario Solar Community Demonstration Project

### BIODATA

<b>PV community name:</b>	Waterloo, Ontario Solar Community Demonstration Project
<b>Kind of urban area:</b>	Residential – urban
<b>Main building type in community:</b>	Houses - single houses
<b>New/Retrofit/Added:</b>	New district/community- building integration
<b>Type of project:</b>	Demonstration project
<b>Start of operation:</b>	April, 2003
<b>City, state, etc.:</b>	Waterloo, Ontario
<b>Country:</b>	Canada
<b>Latitude:</b>	N 43° 28' 46"
<b>Longitude:</b>	W 80° 32' 28"

### PV SYSTEM CHARACTERISTICS

<b>Total PV power:</b>	12,8 kW
<b>Number of houses/buildings:</b>	4 houses
<b>PV power per unit:</b>	3,2 kW/house
<b>Energy yield per year:</b>	1 200 kWh/kW
<b>Main PV system type:</b>	Grid-connected – demand side
<b>Main PV application type:</b>	Inclined roof – integrated
<b>Main PV module type:</b>	Laminates – regular laminate
<b>Main PV cell type:</b>	Amorphous silicon
<b>PV module manufacturer/brand:</b>	Uni-Solar
<b>Inverter manufacturer/brand:</b>	SMA, Xantrex and Fronius
<b>Investment for PV systems:</b>	12 500 CAD/kW DC (including Standing Seam metal roofing material)

### OWNERSHIP

<b>Building owner:</b>	Inhabitant
<b>PV owner:</b>	Inhabitant
<b>PV energy user:</b>	Inhabitant



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## PV COMMUNITY DESCRIPTION

### PV Community Brief

Waterloo, Ontario is located in central Canada, approximately 600 km South West of Ottawa, the Canadian Capital. This project was the first demonstration of a grid-connected PV community in Canada. The aim was to offer the solar home package; including 3,2 kW of grid-connected PV system with energy efficiency upgrades to the mainstream homebuyer market.

### Grid issue

Due to the early stage of the use of grid-connected PV system in the Canadian Market under which this project was performed, significant discussion with the utility was required to allow installations to be connected to the local utility grid. In the net metering scenario, it was difficult to find an appropriate meter that could be used due to Canadian electrical revenue metering regulations and in the end a standard electro-mechanical meter was used.

### Urban planning and architectural issues

Only gable roofs with the rear roof surface facing south were used for solar homes. The geometric shape of the roof proved appropriate to provide the required space for the installation of the amorphous silicon PV modules. The rear of the house was the only location that was acceptable by the architect who was required to approve all home designs. The builder, although very supportive of the project, insisted the first of the four homes be built in a smaller adjacent subdivision, rather than being built in the main subdivision. Once comfortable with the aesthetics of the PV, the solar homes could be built in the main subdivision as shown in the picture above.

### Economic / financial issues

The solar company selling and installing the PV systems was provided with funding from the Canadian Federal government that resulted in the customer being able to purchase the Solar option with energy efficiency upgrades for 50% of its true retail cost of 40 000 CAD /system. The supporting federal program that provided support for this project was called Technology Early Action Measures ([www.team.gc.ca](http://www.team.gc.ca)) from the department of Natural Resources Canada (NRCan). The customer entered into a net-metering program with their local utility where the solar electricity was traded at the same price that the customer paid for consumed electricity. Time-of-day pricing was not incorporated into the electricity pricing regime.

### Other remarks

As a first in Canada this project provided a significant contribution to the development of grid connection standards and provided a demonstration of PV technology that had a positive aesthetic compared to past applications.

## COMMUNITY INFORMATION

**Project leader company:** ARISE Technologies Corporation

**Other project company:** Cook Homes ([www.cookhomes.ca](http://www.cookhomes.ca))

**Project's www:**

**Contact address:** ARISE Technologies Corporation

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Tel: +011 519 725 2244

[www.arisetech.com](http://www.arisetech.com)

## Denmark: Solbyen

### BIODATA

**PV community name:** Solbyen  
**Kind of urban area:** Residential – urban  
**Main building type in community:** Houses - single houses  
**New/Retrofit/Added:** Retrofit – building integration & Added separately to the buildings  
**Type of project:** Demonstration project  
**Start of operation:** Year 1997  
**City, state, etc.:** Ring Sø, Brædstrup  
**Country:** Denmark  
**Latitude:** N55 57' 58"  
**Longitude:** E9 36' 13"

### PV SYSTEM CHARACTERISTICS

**Total PV power:** 60 kW  
**Number of houses/buildings:** 30 houses  
**PV power per unit:** 1 - 3 kW/house  
**Energy yield per year:** 800 kWh/kW  
**Main PV system type:** Grid-connected – demand side  
**Main PV application type:** Inclined roof – mounted  
**Main PV module type:** Framed regular module  
**Main PV cell type:** Crystalline silicon – multi  
**PV module manufacturer/brand:** Solarex/MSX 53  
**Inverter manufacturer/brand:** SAM/SWR700  
**Investment for PV systems:** 8 000 DKK/kW

### OWNERSHIP

**Building owner:** Inhabitant  
**PV owner:** Inhabitant  
**PV energy user:** Inhabitant



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## PV COMMUNITY DESCRIPTION

### PV Community Brief

The SUN CITY is located in Ring Sø on the outskirts of Brædstrup. Since its commissioning in the summer of 1997, residents on the 30 houses with PV modules on the roofs have changed their habits of power consumption significantly. At the same time, it has been found that the PV systems produce more electricity than expected, and that they do not affect voltage quality in the electricity grid.

### Grid issue

The project also investigates whether the electricity generated in the SUN CITY affects the power quality of the electricity grid.

The question was whether the electricity produced by the PV system would reduce the general power-quality on the grid. But no changes in the power quality were noted in the grid, and the PV systems' irregular electricity production has had no negative influence.

### Urban planning and architectural issues

An architect participated in the planning of the PV arrays, which occupy 10, 20 and 30 m<sup>2</sup> respectively. Twenty-seven installations are on slanted roofs, one is installed on a vertical house wall, and two are situated on flat garage roofs. The installations are placed on existing buildings, designed without regard for the optimal placing of PV modules, that's facing south at an angle of 42 degrees. But none of the SUN CITY's houses meet the optimal requirements for the placing of PV arrays. Individual houses even have angles of up to 60 degrees to the south. Despite the generally non optimal options for placing the PV installations, the readings show that the PV systems are extremely productive. On installations orientated at 60 degrees to the south, only 10% reduction is found relative to the optimum electricity generation. All units have thus lived up to expectations, and in the periods with most sunlight, individual units have even covered the entire consumption in each house.

### Economic / financial issues

One of the factors which make the practical use of PV-generated electricity difficult is that many families in the SUN CITY work away from home during daylight hours, when the PV plants generate the most electricity. The project has shown that half of the PV electricity cannot be used in the SUN CITY when produced, and is therefore sold to the electricity grid. At the beginning of the project, there were price differences between purchase and sale of electricity to the grid. But the project has been a factor in the Danish parliament's changing of the tariffs for a trial period, so that producers of PV electricity may store their electricity without charge in the grid (net metering).

### Other remarks

To investigate consumer behaviour during the project, data on each family's electricity consumption were collected in the months before the installation of the PV systems.

Against this background, an average reduction of 4,5 % in the SUN CITY families' electricity consumption was found. It is noteworthy that the savings were achieved by altering consumption patterns. Only a few households bought energy-saving household appliances during the period in question.

Many households say that the newly developed »PV meter« has been a factor in drawing attention to electricity consumption, thus paving the way for savings. Neither did the residents of the SUN CITY compromise their comfort to save electricity.

In 2006 ten years after the project was started we can still see the added value in terms of energy savings, the households is still using 5-10% less energy than a reference group.

## COMMUNITY INFORMATION

**Project leader company:** EnergiMidt

**Other project company:** Knudsen og Halling, Velux

**Project's www:** -

**Contact address:** EnergiMidt

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Tel. +45 7658 1100 Fax +45 7658 1111

[www.energimidt.dk](http://www.energimidt.dk)



## Denmark: Sol 300

### BIODATA

<b>PV community name:</b>	Sol 300
<b>Kind of urban area:</b>	Residential – urban
<b>Main building type in community:</b>	Houses - single houses
<b>New/Retrofit/Added:</b>	Retrofit – building integration & Added separately to the buildings
<b>Type of project:</b>	Demonstration project
<b>Start of operation:</b>	Year 1999 (completed in 2000)
<b>City, state, etc.:</b>	8 communities in Denmark; Fanø, Tofthund, Brædstrup, Knudby-Borup, Norup, Vestbjerg, Korup, Gudme
<b>Country:</b>	Denmark
<b>Latitude:</b>	Spread around Denmark
<b>Longitude:</b>	Spread around Denmark

### PV SYSTEM CHARACTERISTICS

<b>Total PV power:</b>	750 kW
<b>Number of houses/buildings:</b>	300 houses
<b>PV power per unit:</b>	0,9 - 6 kW/house
<b>Energy yield per year:</b>	850 kWh/kW in average
<b>Main PV system type:</b>	Grid-connected – demand side
<b>Main PV application type:</b>	Inclined roof – mounted
<b>Main PV module type:</b>	Framed regular module
<b>Main PV cell type:</b>	Crystalline silicon – multi and mono
<b>PV module manufacturer/brand:</b>	BP Solar/BP585, IBC Solar/IBC Megaline 120, Shell Solar/RMS75
<b>Inverter manufacturer/brand:</b>	SMA/SWR850-1500, ASP Top class
<b>Investment for PV systems:</b>	10 000 DKK/kW

### OWNERSHIP

<b>Building owner:</b>	Inhabitant
<b>PV owner:</b>	Inhabitant
<b>PV energy user:</b>	Inhabitant



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## PV COMMUNITY DESCRIPTION

### PV Community Brief

In 1998, the biggest Danish solar power project to date, SOL-300, was set in motion, and it ran until 2001. SOL-300 is one of the biggest projects of its kind in Europe and builds on the experience gained in the Danish SUN CITY Project (1996-1999), in which 30 single-family houses were supplied with PV systems. In SOL-300, PV systems have been installed on the roofs of 300 single-family houses in Jutland and on Fyn. The houses are equipped with PV systems from 0,9 - 6 kW, and the total capacity for all 300 houses is 750 kW. The first PV systems were installed in the spring of 1999, and by summer 2000, all installations were fully operative and producing electricity.

The overriding purpose of SOL-300 is to contribute to an increased use of solar cells in the Danish electricity sector. This can be divided into five subsidiary goals:

- to contribute to a continued reduction in the price of PV systems connected to the grid.
- to stimulate Danish developments within installation technology.
- to contribute to the building up of quality assurance schemes.
- to develop and extend the electricity sector's commitment to PV system as a future business area.
- to increase general knowledge of PV system.

After the first media presentation of SOL-300 a large number of interested residents applied for further details of the project. In some areas 30-40 homeowners made a joint application to participate. It was then up to the eight distribution utilities participating in SOL-300 to select specific residential areas and the individual houses.

### Grid issue

No special investigations were made.

### Urban planning and architectural issues

When the individual houses were selected, the architects started to work out the positions of the PV modules on the houses from a viewpoint of combination of aesthetics and correct placing.

More than aesthetic considerations were involved: there were also the owners' wishes and the location of the PV modules in relation to the sun-optimally, facing due south at an angle of about 45 degrees. Most of the PV systems have been mounted on standard fittings from the suppliers, but the SOL-300 architects have also developed an entirely new mounting system.

1. Area for big group: installation and experimental system, Terrace houses
2. Close-low.
3. Holiday cottage area
4. Pre-1960 residential areas: individually built houses, bungalows, standard single family houses
5. Post-1960 residential areas: standard single-family houses, tract houses -older subdivision
6. Post-1980 residential areas: standard single-family houses, tract houses -newer subdivision
7. Village area I: village houses, individually built houses, tract houses
8. Village area II: village houses, individually built houses, tract houses

### Economic / financial issues

All the houses are under the net metering tariff.

### Other remarks

Measurements of the 300 PV systems' efficiency are an important element in SOL-300. The measurements provide valuable experience with the PV system's production under Danish conditions. All 300 houses have therefore had their ordinary electricity meters replaced by a special meter which registers the purchase and sale of electricity. Another meter registers the PV system's production. The meters are connected to a data logger, which calls a central computer each week. Information from all houses is registered here and converted to statistics in the form of graphs and tables. The statistics are available on the Internet shortly afterwards. In each of the eight areas there is also a meter which daily records the solar radiation in the area. This information is required to evaluate the individual systems' various levels of production. This meter also sends its data to the central computer.

The SOL-300 houses are equipped with a PV meter which shows the system's electricity production and the household's purchase and sale of power. The families to save on electricity consumption when the light diodes provide a fast picture of the house's current electricity consumption. Many families have the PV meter sitting centrally in the house and they can thus monitor whether, for example, lights are burning where they should be switched off. The PV meter thus also comes to act as an energy guardian, and in many cases this has led to electricity savings.

## COMMUNITY INFORMATION

**Project leader company:** EnergiMidt

**Other project company:** Energinet.dk

**Project's www:** -

**Contact address:** EnergiMidt, Søndergade 27, 8740 Brædstrup, Denmark  
Tel. +45 7658 1100 Fax +45 7658 1111, [www.energimidt.dk](http://www.energimidt.dk)

## France: La Darnaise

### BIODATA

<b>PV community name:</b>	La Darnaise
<b>Kind of urban area:</b>	Residential – urban
<b>Main building type in community:</b>	Houses - Multi-story apartment buildings
<b>New/Retrofit/Added:</b>	Retrofit – building integration
<b>Type of project:</b>	Demonstration project
<b>Start of operation:</b>	Year 2005
<b>City, state, etc.:</b>	Venissieux, Grand-Lyon
<b>Country:</b>	France
<b>Latitude:</b>	N45 41' 33"
<b>Longitude:</b>	E4 51' 53"

### PV SYSTEM CHATACTERISTICS

<b>Total PV power:</b>	92 kW
<b>Number of houses/buildings:</b>	11 buildings
<b>PV power per unit:</b>	4,8 or 12 kW/building
<b>Energy yield per year:</b>	640 kWh/kW (calculated)
<b>Main PV system type:</b>	Grid-connected – supply side
<b>Main PV application type:</b>	Façade – mounted
<b>Main PV module type:</b>	Framed regular module
<b>Main PV cell type:</b>	Crystalline silicon - multi
<b>PV module manufacturer/brand:</b>	Tenesol/TE1300
<b>Inverter manufacturer/brand:</b>	Tenesol, Gridfit
<b>Investment for PV systems:</b>	580 000 EUR in total

### OWNERSHIP

<b>Building owner:</b>	Public social housing organisation
<b>PV owner:</b>	Public social housing organisation
<b>PV energy user:</b>	Utility



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## PV COMMUNITY DESCRIPTION

### PV Community Brief

Vénissieux is a municipality of the Grand-Lyon conurbation, the second largest in France, with large social housing and industrial mix. The name of this city is unfortunately still associated with social and urban riots that occurred in this area since the 1960's. Today, the Vénissieux area is one of the Grand-Lyon's priorities in terms of large-scale urban regeneration and improvement of the quality of life for inhabitants. La Darnaise district is the concrete illustration of the possibility to transform an old social housing area into an energy efficient and renewable energy powered district.

### Grid issue

Although all PV modules are owned by the same owner, the local social housing organisation, this project is composed of 11 independent PV systems, one for each building, that have their own connection point to the grid and their own contract with the utility for the connection to the grid. As it is for all PV systems in France, the utility created an additional connection point to the grid dedicated to the PV system of each building in order to benefit from the feed-in tariff for the totality of the energy produced. The new connection point to the grid for the PV system is installed close to other existing connection points for building inhabitants.

### Urban planning and architectural issues

High-rise buildings generally offer limited roof area suited for photovoltaics, especially when the flat roof is also used for solar thermal, which is the case of this project. The architect of this project, Bernard Paris, and the building owner, decided not to install PV on the roofs, but to integrate PV on the southern façade of each building. This technical choice lead to use PV also for its visibility, as solar thermal, building insulation or wood based district heating are not visible, although the annual yield of PV is lower than a roof based solution. In this large scale urban regeneration, as it was not possible to adapt the urban plan to optimize the use of PV, the PV system was sized and positioned on each building to limit mutual shading.

### Economic / financial issues

The total cost of the PV system is 580 000 EUR (696 000 USD), of which only one third was paid by the building owner as the French National Agency for Environment and Energy Savings (ADEME) and the Rhône-Alpes Regional Council co-funded this project. Although this PV system benefits from the national feed-in tariff for the electricity produced by PV, the PV system owner will never have a financial payback for this project. The reason is that the PV system owner chooses to use the annual revenue generated by the electricity not to reimburse a loan or it's investment, but to reduce service charges of buildings, in order to increase its social role and reduce the poverty of inhabitants.

### Other remarks

PV is just a small part of this large-scale regeneration project that aims to improve the quality of life of inhabitants and reduce service charges by the improvement of energy efficiency and the use of renewable energy systems. Buildings are equipped with high-efficiency insulation and windows, district heating is powered by a 12 MW wood chip fired power plant and 730 m<sup>2</sup> of solar thermal panels produce part of the domestic hot water needs. This makes La Darnaise one of the first renewable powered districts in France whose flagship is the PV system installed on the building façades.

## COMMUNITY INFORMATION

**Project leader company:** OPAC du Grand-Lyon, [www.opac-grandlyon.com](http://www.opac-grandlyon.com) (building owner)

**Other project company:** Tenesol, [www.tenesol.com](http://www.tenesol.com) (PV system supplier)

**Project's www:** -

**Contact address:** Hespul, France  
[info@hespul.org](mailto:info@hespul.org)  
[www.hespul.org](http://www.hespul.org)



## France: Les Hauts de Feuilly

### BIODATA

<b>PV community name:</b>	Les Hauts de Feuilly
<b>Kind of urban area:</b>	Residential – urban
<b>Main building type in community:</b>	Houses - Attached houses & Multi-story apartment buildings
<b>New/Retrofit/Added:</b>	New district/community – building integration
<b>Type of project:</b>	Commercial project
<b>Start of operation:</b>	Year 2006
<b>City, state, etc.:</b>	Saint-Priest, Grand-Lyon
<b>Country:</b>	France
<b>Latitude:</b>	N45 42' 20"
<b>Longitude:</b>	E4 56' 22"

### PV SYSTEM CHARACTERISTICS

<b>Total PV power:</b>	25 kW
<b>Number of houses/buildings:</b>	22 (19 attached houses and 3 multi-story apartment buildings)
<b>PV power per unit:</b>	1 or 2 kW/house
<b>Energy yield per year:</b>	877 kWh/kW (calculated)
<b>Main PV system type:</b>	Grid-connected – supply side
<b>Main PV application type:</b>	Inclined roof – integrated: PV roof tiles
<b>Main PV module type:</b>	PV roof tile
<b>Main PV cell type:</b>	Crystalline silicon - multi
<b>PV module manufacturer/brand:</b>	Photowatt/IMERYS TC roof tile
<b>Inverter manufacturer/brand:</b>	SMA
<b>Investment for PV systems:</b>	10 000 EUR/house

### OWNERSHIP

<b>Building owner:</b>	Inhabitant
<b>PV owner:</b>	Inhabitant
<b>PV energy user:</b>	Utility



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## PV COMMUNITY DESCRIPTION

### PV Community Brief

Saint-Priest is a municipality of 40 000 inhabitants located in the Grand-Lyon conurbation, the second largest in France, with a mix of large commercial areas and industry. Les Hauts de Feuilly is a new housing district of 27 700 m<sup>2</sup> of useful floor area created by the Grand-Lyon Community in 1998 in order to develop a new form of housing based on high quality architecture and urban living. This project includes the construction of 117 individual homes and 81 dwellings in 6 multi-apartment buildings. At the very beginning of the project, PV was not part of the development scheme. Environmental issues were first discussed when one shareholder of the SERL, the public company in charge of the commercialisation of the land, raised the idea of using an environmental management method for the construction of this project. France-Terre, one developer selected for the construction of this project, chose then to install photovoltaic systems, which was an innovative alternative to solar hot water systems in urban and collective housing projects.

### Grid issue

In France, in order to benefit from the feed-in tariff for the totality of the energy produced by a PV system, the utility has to create an additional connection point to the grid dedicated to the PV system. For this new development, the utility and the developer just first created the connection point to the grid to supply each house with electricity as done for regular development but did not anticipate to fact that an additional connection point to the grid was necessary for each PV system. This was done at a later stage of the project, once the inhabitants moved into their homes, which delayed the commissioning of all PV systems.

### Urban planning and architectural issues

In order to offer the same quality to each house owner, the developer of this project, France-Terre, decided to integrate a 1 kW PV system in the roof of each house. But, due to the fact the urban planning was done before knowing that this development will be equipped with PV, some PV systems are installed on roofs that do not face south.

France-Terre also initially planned to build each roof with red clay tiles which is the traditional way of building roofs in Lyon. But, in order to improve the aesthetical integration of each PV system, the promoter finally designed each house with dark flat tiles that are compatible aesthetically and technically with the chosen PV tile.

### Economic / financial issues

The price of each PV system was approx. 10 000 EUR including VAT, which represents less than 5% of the total price paid by private owners for each house, approx. 250 000 EUR. In order to help the promoter to correctly sell the houses and private owners to buy them, each PV system was funded by the European Commission thanks to the use of an innovative PV product, the IMERYS TC PV tile, the French National Agency for Environment and Energy Savings, ADEME, and the Rhone-Alps Regional Council. The final over-cost of each PV system was for private owners finally less than 1% of the total price of the delivered house.

At the completion of the project in 2006, the applicable feed-in tariff for PV systems was 0,14 EUR/kWh. But fortunately for the house owners, due to a delay in the official connection of each PV system to the grid, none of the PV systems were commissioned before summer 2006, when the new feed-in tariff was released by the government. Finally, as the PV systems are integrated into the roof, the applicable feed-in tariff for this project will be 0,55 EUR/kWh for a guaranteed period of 20 years.

### Other remarks

-

## COMMUNITY INFORMATION

**Project leader company:** SERL, [www.serl.fr](http://www.serl.fr) (company in charge of urban planning)

**Other project company:** Imerys TC, [www.pv-starlet.com](http://www.pv-starlet.com) (PV roof tile supplier)

**Project's www:** -

**Contact address:** Hespul, France  
[info@hespul.org](mailto:info@hespul.org)  
[www.hespul.org](http://www.hespul.org)

## Japan: Villa Garten Shin-Matsudo & Tiara Court Kasukabe

### BIODATA

<b>PV community name:</b>	Villa Garten Shin-Matsudo	Tiara Court Kasukabe
<b>Kind of urban area:</b>	Residential – urban	Residential – urban
<b>Main building type in community:</b>	Houses - single houses	Houses - single houses
<b>New/Retrofit/Added:</b>	New district/community building integration	– New district/community building integration –
<b>Type of project:</b>	Commercial project	Commercial project
<b>Start of operation:</b>	Year 1999	Year 1999
<b>City, state, etc.:</b>	Matsudo, Chiba	Kasukabe, Saitama
<b>Country:</b>	Japan	Japan
<b>Latitude:</b>	N35 49' 22"	N35 58' 21"
<b>Longitude:</b>	E139 55' 27"	E139 45' 32"

### PV SYSTEM CHARACTERISTICS

<b>Total PV power:</b>	123 kW	101 kW
<b>Number of houses/buildings:</b>	41 houses	35 houses
<b>PV power per unit:</b>	2,86 – 3,1 kW/house	2,88 kW/house
<b>Energy yield per year:</b>	2 800 – 3 050 kWh/3kW/year (calculated)	2 840 kWh/3kW/year (calculated)
<b>Main PV system type:</b>	Grid-connected - demand side	Grid-connected - demand side
<b>Main PV application type:</b>	Inclined roof – mounted	Inclined roof – mounted
<b>Main PV module type:</b>	Framed regular module	Framed regular module
<b>Main PV cell type:</b>	Crystalline silicon	Crystalline silicon
<b>PV module manufacturer/brand:</b>	Sharp corporation	Sharp corporation
<b>Inverter manufacturer/brand:</b>	Sharp corporation	Sharp corporation
<b>Investment for PV systems:</b>	1 000 000 JPY/kW	1 000 000 JPY/kW

### OWNERSHIP

<b>Building owner:</b>	Inhabitant
<b>PV owner:</b>	Inhabitant
<b>PV energy user:</b>	Inhabitant

< Villa Garten Shin-Matsudo >



< Tiara Court Kasukabe >



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## PV COMMUNITY DESCRIPTION

### PV Community Brief

A target for the project was to deploy residential PV systems with the housing sector playing a role in PV system installation in a residential area and to create a practical case study. The target was achieved and a massive and creative project where all houses are equipped with PV systems was launched in two areas of the Tokyo metropolitan region, e.g. 36 PV houses in Matsudo, Chiba, and 35 PV houses in Kasukabe, Saitama.

These projects set a precedent for concentrated installation of residential PV systems, e.g. 'PV community', and were given 'New Energy Award in FY1999' in Japan.

The projects were practical case studies of developing a community equipped with PV systems and since then, similar projects were launched in various regions.

As for the Matsudo project (Villa Garten Shin-Matsudo), five additional houses equipped with PV systems were constructed and the community now consists of 41 PV houses in total.

### Grid issue

Because there was no experience of such a high-density PV systems installation into a limited area, a precise negotiation with a utility company (Tokyo Electric Power corporation) was implemented to avoid negative influences against a grid network. Although the negotiation required much time, the PV system provider prepared preliminary test data on grid-connection with multiple inverters and no negative impacts were forecasted in their operation.

These preparatory efforts by project members made the project successful.

### Urban planning and architectural issues

A harmonization between a house and PV system was well discussed at the beginning of planning.

Insolation condition, azimuth orientation and inclination of roof, appearance of house, etc. were considered house-to-house and the design for obtaining a maximum electricity generation from PV system was adopted basically.

In addition to PV systems, various kinds of facilities for energy conservation, reducing demand of air-conditioning were designed thus improving availability of equipment.

### Economic / financial issues

Installing lots of PV systems in a limited area, as well as bulk buying, worked for reducing installation cost.

The PV system received a governmental subsidy, available through Japan's residential PV program. After starting operation, a net-metering scheme was applied so that surplus PV is traded between the inhabitant and the utility company, at the same price of the residential electric tariff.

### Other remarks

This project was a 'Pioneer' of concentrated installation of residential PV systems and has been contributing to deploying residential area PV system installations.

House sector's positive action for environmental protection has realized increasing consumers' concerns for energy conservation and environmental problems.

In addition, publicity for the project companies was increased.

## COMMUNITY INFORMATION

**Project leader company:** Chuo Jutaku Co., Ltd.

**Other project company:** Sharp corporation

**Project's www:** -

**Contact address:** POLUS group

Koshigaya-shi, Saitama, 343-0845, Japan

Tel: +81-48-987-0813 FAX: +81-48-987-0816



## Japan: Cosmo-Town Kiyomino Saizu

### BIODATA

<b>PV community name:</b>	Cosmo-Town Kiyomino Saizu
<b>Kind of urban area:</b>	Residential - urban
<b>Main building type in community:</b>	Houses - single houses
<b>New/Retrofit/Added:</b>	New district/community – building integration
<b>Type of project:</b>	Commercial project
<b>Start of operation:</b>	Year 2001
<b>City, state, etc.:</b>	Yoshikawa, Saitama
<b>Country:</b>	Japan
<b>Latitude:</b>	N35 53' 54"
<b>Longitude:</b>	E139 51' 22"

### PV SYSTEM CHATACTERISTICS

<b>Total PV power:</b>	239 kW
<b>Number of houses/buildings:</b>	79 houses
<b>PV power per unit:</b>	3 kW/house
<b>Energy yield per year:</b>	3 106 kWh/year (calculated)
<b>Main PV system type:</b>	Grid-connected - demand side
<b>Main PV application type:</b>	Inclined roof – integrated: PV roof tiles
<b>Main PV module type:</b>	PV roof tile
<b>Main PV cell type:</b>	Amorphous Si
<b>PV module manufacturer/brand:</b>	Kubota corporation
<b>Inverter manufacturer/brand:</b>	Kubota corporation
<b>Investment for PV systems:</b>	2 300 000 JPY/3kW

### OWNERSHIP

<b>Building owner:</b>	Inhabitant
<b>PV owner:</b>	Inhabitant
<b>PV energy user:</b>	Inhabitant



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## PV COMMUNITY DESCRIPTION

### PV Community Brief

Kiyomino is located in the northeast of Yoshikawa-city, Saitama, and is approximately 20km from the center of Tokyo. The area has been developed toward a comfortable living environment of 21<sup>st</sup> century and its concept is “human-friendly town development”.

The development of Kiyomino area was planned and promoted by the Urban Renaissance Agency of Japan (the UR). Hakushin corporation was allowed to develop and sell 79 houses in the area. Then, they decided to develop a PV community, e.g. all houses equipped with PV systems.

The community was one of advanced and practical cases of ‘PV community’ and was given ‘New Energy Award in FY2002’ in Japan.

### Grid issue

To avoid negative influences on the grid network caused by a high-density of PV systems installed in a limited area, a precise negotiation with a utility company (Tokyo Electric Power corporation) was implemented and the design of grid-connection was decided below;

- each PV system (each house) has each point for grid-connection (LV line)
- one transformer for four PV systems
- enhancement of a capacity of transformer

The negotiation with the utility company was in charge of PV system provider for the community.

### Urban planning and architectural issues

To create a well-designed appearance of the houses and a harmonized streetscape as a community, well-integrated PV modules into the roof were required, as well as satisfying fundamental facilities of ‘roof’ is indispensable. From the viewpoints, design of PV modules, technological reliability on developing and installing roof materials and the cost were comprehensively evaluated for selecting PV module manufacturer.

Originally, roofing geometry of houses was a gable roof design. However, the design was changed to a shed roof to maximize PV system electricity generation and still creating well-designed roofs.

### Economic / financial issues

The development plan of Kiyomino area given by the UR defined the averaged sale price of the houses in the area. To realize the price level, the costs of house itself and various kinds of equipment, including PV system had to be reduced. Drawing up a cost-effective construction schedule was a promising cost reduction measure and installing many PV systems in a limited area also reduced installation cost.

The PV system received a governmental subsidy, available through Japan’s residential PV program. After starting operation, a net-metering scheme was applied so that surplus PV is traded between the inhabitant and the utility company, at the same price of the residential electric tariff.

### Other remarks

The community project has been contributing not only to deploying areal PV system installation in residential area but also to increasing publicity of the project companies.

The concept of the community development and equipping PV systems was well accepted and handed down to the inhabitants. Some of houses in the community were also equipped with a high-efficiency electric water heater, called “Eco-Cute”.

According to the recent interview, the inhabitants’ concern about environmental problems and motivation of energy saving have been growing.

## COMMUNITY INFORMATION

**Project leader company:** Hakushin Co., Ltd. and Urban Renaissance Agency

**Other project company:** Kubota corporation, Fuji-design Co., Ltd.

**Project's www:** -

**Contact address:** MSK corporation

Shinjuku, Tokyo, 160-0023, Japan

Tel: +81-3-3342-3838 FAX: +81-3-3342-6534

Website: <http://www.msk.ne.jp/>

## Japan: Jo-Town Kanokodai

### BIODATA

**PV community name:** Jo-Town Kanokodai  
**Kind of urban area:** Residential – urban  
**Main building type in community:** Houses - single houses  
**New/Retrofit/Added:** New district/community – building integration  
**Type of project:** Commercial project  
**Start of operation:** Year 2002  
**City, state, etc.:** Kita, Kobe, Hyogo  
**Country:** Japan  
**Latitude:** N34 51' 38"  
**Longitude:** E135 12' 58"

### PV SYSTEM CHARACTERISTICS

**Total PV power:** 285 kW  
**Number of houses/buildings:** 95 houses  
**PV power per unit:** 3 kW/house  
**Energy yield per year:** -  
**Main PV system type:** Grid-connected - demand side  
**Main PV application type:** Inclined roof – integrated: PV roof tiles  
**Main PV module type:** PV roof tile  
**Main PV cell type:** Amorphous Si  
**PV module manufacturer/brand:** Kubota corporation  
**Inverter manufacturer/brand:** Kubota corporation  
**Investment for PV systems:** -

### OWNERSHIP

**Building owner:** Inhabitant  
**PV owner:** Inhabitant  
**PV energy user:** Inhabitant



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## PV COMMUNITY DESCRIPTION

### PV Community Brief

Jo-Town Kanokodai is located in the north of Kobe city, Hyogo.

Jo-Cooperation is aspiring to build environment-conscious houses as an effort toward a global environmental problem in the residential sector. They are focusing on PV system as a typical equipment to give environmental conscious life-style to customers and decided all houses in this community should be equipped with PV system.

Originally, the number of house compartments planned was 70. However, many customers had a great deal of empathy for their plan and 25 compartments were added to the development plan. As a result, the community has 95 houses equipped with PV systems.

### Grid issue

When the development was planned, the number of PV systems installed in a limited area with a high-density grid-connection was the largest in the Kansai area. Therefore, to avoid negative influences against a grid network by the high-density PV systems installation, a precise negotiation with a utility company (Kansai Electric Power corporation) was implemented.

### Urban planning and architectural issues

The compartments before building houses were sold with carrying option to build an all-electric house equipped with a PV system. Then each house was designed and built on the compartment according to users' (inhabitants') requirements.

To create a well-designed appearance of the houses and a harmonized streetscape as a community, PV roof tiles were selected for the PV systems.

### Economic / financial issues

The PV system received a governmental subsidy, available through Japan's residential PV program. After starting operation, a net-metering scheme was applied so that surplus PV is traded between the inhabitant and the utility company, at the same price of the residential electric tariff.

### Other remarks

The concept of the community development and equipping PV systems was well accepted and handed down to the inhabitants. The number of houses equipped with PV system was over the original development plan.

The project has been contributing not only to deploying areal PV system installation in residential area but also to increasing publicity of the project companies.

## COMMUNITY INFORMATION

**Project leader company:** Jo-Cooperation Co., Ltd.

**Other project company:** Kubota corporation, Fujimoto-Yogyo Co., Ltd.

**Project's www:** <http://www.hakushin.com>

**Contact address:** MSK corporation

Shinjuku, Tokyo, 160-0023, Japan

Tel: +81-3-3342-3838 FAX: +81-3-3342-6534

Website: <http://www.msk.ne.jp/>



## Japan: Cosmo-Town Yumemino Saizu Licht paadje

### BIODATA

<b>PV community name:</b>	Cosmo-Town Yumemino Saizu Licht paagje
<b>Kind of urban area:</b>	Residential – urban
<b>Main building type in community:</b>	Houses - single houses
<b>New/Retrofit/Added:</b>	New district/community – building integration
<b>Type of project:</b>	Commercial project
<b>Start of operation:</b>	Year 2003
<b>City, state, etc.:</b>	Matsubushi, Saitama
<b>Country:</b>	Japan
<b>Latitude:</b>	N35 55' 34"
<b>Longitude:</b>	E139 49' 17"

### PV SYSTEM CHATACTERISTICS

<b>Total PV power:</b>	180 kW
<b>Number of houses/buildings:</b>	88 houses
<b>PV power per unit:</b>	2 kW/house
<b>Energy yield per year:</b>	-
<b>Main PV system type:</b>	Grid-connected - demand side
<b>Main PV application type:</b>	Inclined roof – integrated: PV roof tiles
<b>Main PV module type:</b>	PV roof tile
<b>Main PV cell type:</b>	Amorphous Si
<b>PV module manufacturer/brand:</b>	Kubota corporation
<b>Inverter manufacturer/brand:</b>	Kubota corporation
<b>Investment for PV systems:</b>	800 000 – 850 000/kW

### OWNERSHIP

<b>Building owner:</b>	Inhabitant
<b>PV owner:</b>	Inhabitant
<b>PV energy user:</b>	Inhabitant



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## PV COMMUNITY DESCRIPTION

### PV Community Brief

Yumemino Licht paadje is located in Matsubushi-town, Saitama.

A development of the area was planned and promoted by the Urban Renaissance Agency of Japan (the UR). Hakushin corporation proposed a concept of 'Earth friendly town' and was allowed to develop and sell 90 house compartments in the area.

Taking advantage of their experience of 'Kiyomino PV town', Hakushin promoted developing a PV community, e.g. all houses equipped with PV system. In addition, all houses were all-electric in this community.

### Grid issue

To avoid negative influences against a grid network caused by a high-density of PV system installation in a limited area, a precise negotiation with a utility company (Tokyo Electric Power corporation) was implemented.

The electricity distribution line in the area was designed and constructed by the utility company, and each transformer was set for four houses, e.g. four PV systems.

### Urban planning and architectural issues

To create a well-designed appearance of the houses and a harmonized streetscape as a community, PV roof tiles were selected for the PV systems.

It was decided that roofing geometry of all houses be designed as a gable roof and PV modules were installed on the south-face of the roof. Based on the design of the roof, an energy consumption pattern and a price level of house etc. a capacity of PV system was standardized as 2kW.

At the beginning of development, it was planned to develop built-for-sale houses equipped with PV and all-electric facilities. However, many customers had a great deal of empathy for their plan and concept to coincide with release, most of the compartments was sold before building houses.

### Economic / financial issues

The target was to reduce the price level of the houses while keeping a quality and performance of houses.

Due to the PV system capacity and the roof geometry design for maximizing amounts of PV electricity the house price increased, the capacity of PV system was then limited to 2kW.

The PV system received a governmental subsidy, available through Japan's residential PV program. After starting operation, a net-metering scheme was applied so that surplus PV is traded between the inhabitant and the utility company, at the same price of the residential electric tariff.

### Other remarks

This 'Yumemino' project was implemented by taking advantage of experiences of 'Kiyomino' project.

In this project, an all-electric house is standardized and all houses are equipped with a high-efficiency electric water heater, called "Eco-Cute", as well as PV system. Then, the project was attention-getting as a high efficiency all-electrified community and contributed to increasing publicity of the project companies.

## COMMUNITY INFORMATION

**Project leader company:** Hakushin Co., Ltd. and Urban Renaissance Agency

**Other project company:** Kubota corporation

**Project's www:** <http://www.hakushin.com>

**Contact address:** MSK corporation

Shinjuku, Tokyo, 160-0023, Japan

Tel: +81-3-3342-3838 FAX: +81-3-3342-6534

Website: <http://www.msk.ne.jp/>

## Japan: Hills-Garden Kiyota

### BIODATA

<b>PV community name:</b>	Hills-Garden Kiyota
<b>Kind of urban area:</b>	Residential – urban
<b>Main building type in community:</b>	Houses - single houses
<b>New/Retrofit/Added:</b>	New district/community – building integration
<b>Type of project:</b>	Commercial project
<b>Start of operation:</b>	Year 2003
<b>City, state, etc.:</b>	Sapporo, Hokkaido
<b>Country:</b>	Japan
<b>Latitude:</b>	N42 59' 12"
<b>Longitude:</b>	E141 25' 30"

### PV SYSTEM CHARACTERISTICS

<b>Total PV power:</b>	336 kW (as of Dec. 2006)
<b>Number of houses/buildings:</b>	142 houses (as of Dec. 2006)
<b>PV power per unit:</b>	2,4 kW/house
<b>Energy yield per year:</b>	-
<b>Main PV system type:</b>	Grid-connected - demand side
<b>Main PV application type:</b>	Inclined roof – mounted, integrated: PV roof tiles
<b>Main PV module type:</b>	Framed regular module, PV roof tiles
<b>Main PV cell type:</b>	Crystalline silicon – mixed
<b>PV module manufacturer/brand:</b>	-
<b>Inverter manufacturer/brand:</b>	-
<b>Investment for PV systems:</b>	-

### OWNERSHIP

<b>Building owner:</b>	Inhabitant
<b>PV owner:</b>	Inhabitant
<b>PV energy user:</b>	Inhabitant



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## PV COMMUNITY DESCRIPTION

### PV Community Brief

Hills-Garden Kiyota is located in the east of Sapporo-city, Hokkaido. The community is a residential area designed for the 21<sup>st</sup> century, aimed at a harmonization of “life”, “local environment” and “global environment”.

Hokkaido is the most northerly in Japan, and the energy demand for heating and hot-water supply is larger. All houses of the Hills-Garden Kiyota are all-electric and using high-efficiency energy equipment such as a heat pump system, as well as PV system. The community realizes a low maintenance and operation cost, in addition to a low energy-consumption and low CO<sub>2</sub> emissions.

### Grid issue

To avoid negative influences against the grid network caused by a high-density of PV systems installed in a limited area, a precise negotiation with a utility company was implemented and the design of grid-connection was decided.

### Urban planning and architectural issues

To create a well-designed appearance of the houses and a harmonized streetscape as required by the community. As well, a high thermal insulation performance was designed for energy conservation.

### Economic / financial issues

After starting operation, a net-metering scheme was applied so that surplus PV is traded between the inhabitant and the utility company, at the same price of the residential electric tariff.

### Other remarks

All houses of the community were all-electric. A heat pump system for heating, a high-efficiency electric water heater and an induction heater (for kitchen) were used to realize a high efficiency energy system.

## COMMUNITY INFORMATION

**Project leader company:** Misawa Homes Co., Ltd.

**Other project company:** -

**Project's www:** -

**Contact address:** -



## Japan: Pal Town Josai-no-Mori

### BIODATA

<b>PV community name:</b>	Pal Town Josai-no-Mori
<b>Kind of urban area:</b>	Residential – urban
<b>Main building type in community:</b>	Houses - single houses
<b>New/Retrofit/Added:</b>	New district/community – building integration
<b>Type of project:</b>	Demonstration project
<b>Start of operation:</b>	Year 2004(completed in 2006)
<b>City, state, etc.:</b>	Ota, Gunma
<b>Country:</b>	Japan
<b>Latitude:</b>	N36 18' 32"
<b>Longitude:</b>	E139 20' 6"

### PV SYSTEM CHARACTERISTICS

<b>Total PV power:</b>	2 160 kW
<b>Number of houses/buildings:</b>	553 houses
<b>PV power per unit:</b>	2,6 – 5,0 kW/house (averaged power: 3,85 kW/house)
<b>Energy yield per year:</b>	PV Output is controlled by energy management system under R&D planning.
<b>Main PV system type:</b>	Grid-connected - demand side
<b>Main PV application type:</b>	Inclined roof – mounted & Flat roof – mounted
<b>Main PV module type:</b>	Framed regular module
<b>Main PV cell type:</b>	Crystalline silicon
<b>PV module manufacturer/brand:</b>	SANYO Electric Co., Ltd., Kyocera corporation, Sharp corporation, Mitsubishi Electric corporation & Matsushita Ecology Systems Co., Ltd.
<b>Inverter manufacturer/brand:</b>	SANYO Electric Co., Ltd., Kyocera corporation, Sharp corporation, Mitsubishi Electric corporation, Mitsubishi Heavy Industries, Ltd., Matsushita Ecology Systems Co., Ltd.(trial product)
<b>Investment for PV systems:</b>	-

### OWNERSHIP

<b>Building owner:</b>	Inhabitant
<b>PV owner:</b>	NEDO
<b>PV energy user:</b>	Inhabitant



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## PV COMMUNITY DESCRIPTION

### PV Community Brief

A large number of PV systems have been installed on the roofs of houses in the new “Pal Town Josai-no-Mori” residential complex in Ota City, Gunma Prefecture, as a demonstrative research project commissioned by NEDO, and all PV systems have been connected to the power grid as a cluster. This demonstrative research aims to evaluate performances and capabilities of the PV systems, examine their negative influence on distribution lines, and develop the technology to resolve potential issues. The number of PV systems to be installed in this project eventually reached to 553 houses and total capacity is 2 310kW, one of the world's largest residential clustered PV systems connected to a single distribution line. The project is being implemented with the cooperation of Tokyo Electric Power Co., Ltd. in addition to the R&D consortium organized by project companies, etc. (see below; “Community information”)

### Grid issue

In order to promote the introduction of PV systems smoothly and in a reasonable manner, this project aims to develop the generalized technology, which will prevent the suppression of clustered PV system's output caused by the excess voltage on the distribution system, and to demonstrate their effectiveness using actual installed clustered PV systems.

Along with these aims, following technologies are demonstrated from viewpoints of grid issues.

#### <Output suppression avoidance system>

Generated output power will be used for house load in residential PV systems and surplus power will be supplied to the power grid. The voltage in the distribution line rises with increasing surplus output power and the voltage sometimes exceeds the operational range. PV systems have a built-in function to reduce its output when the voltage reaches the upper limit of the operational range to prevent over voltage. However, this phenomenon may occur frequently in clustered PV systems and the suppression of the output may lower the system efficiency significantly. To solve this problem, this project is tasked to develop an “output suppression avoidance system” which uses a battery as energy storage. Surplus power, which may be suppressed in conventional systems, will be stored in the battery. This output suppression avoidance system will allow PV systems to generate their maximum output power even when they are clustered.

#### <Centralized control system>

A centralized control system that will collectively control PV systems based on data such as the amount of power generated by the PV systems, the amount of battery charge/discharge, and the amount of power consumed, will be developed. It is expected that such centralized control will improve the overall efficiency of the area where PV systems are clustered and enhance the performance significantly. Furthermore obtained data will also be utilized for diagnosing battery life and facilitate early detection of system malfunction.

#### <New type islanding protection system>

The residential PV system features a built-in function for detecting islanding. The function is designed to prevent the occurrence of accidents resulting in injuries or death as well as equipment malfunctions by instantaneously halting PV system power generation during blackout. However, the use of a conventional islanding protection system in clustered PV systems may result in failure of islanding detection or unnecessary cut off. To avoid the failure of islanding protection in clustered PV systems, a new type islanding protection system will be developed. The new type islanding protection system will be able to shut off rapidly and securely in the event of distribution system power failure, and during normal operation, will ensure they remain free of malfunctions.

### Urban planning and architectural issues

To implement a demonstrative research project on clustered PV systems, NEDO held a competition of project proposals. Ota city submitted their proposals and it was adopted. Although Ota city had had their original plan of developing residential community without installing PV systems, they changed the plan for applying the competition and this PV community was realized.

### Economic / financial issues

A net-metering scheme was applied so that surplus PV is traded between the inhabitant and the utility company, at the same price of the residential electric tariff. A cost of PV systems is paid by NEDO, and the PV systems are owned by NEDO during the demonstration period.

### Other remarks

Reversed power flow from battery system is prohibited.

## COMMUNITY INFORMATION

**Project leader company:** Kandenko Co., Ltd. & NEDO

**Other project company:** Meidensha Corporation, Electric Power Engineering Systems Co., Ltd., Shin-Kobe Electric Machinery Co., Ltd., Matsushita Ecology Systems Co., Ltd., OMRON Corporation, Tokyo University of Agriculture and Technology, Nihon University & Ota City Office

**Project's www:** -

**Contact address:** Kandenko Co., Ltd.

Minato-ku, Tokyo, 108-8533, Japan

Tel: +81-3-4431-3486 FAX: +81-3-4431-3497

## Japan: Sekisui Harmonate-town Shin-Kamagaya

### BIODATA

<b>PV community name:</b>	Sekisui Harmonate-town Shin-Kamagaya
<b>Kind of urban area:</b>	Residential – urban
<b>Main building type in community:</b>	Houses - single houses
<b>New/Retrofit/Added:</b>	New district/community – building integration
<b>Type of project:</b>	Commercial project
<b>Start of operation:</b>	Year 2004
<b>City, state, etc.:</b>	Kamagaya, Chiba
<b>Country:</b>	Japan
<b>Latitude:</b>	N35 46' 32"
<b>Longitude:</b>	E139 59' 49"

### PV SYSTEM CHARACTERISTICS

<b>Total PV power:</b>	90 kW
<b>Number of houses/buildings:</b>	29 houses
<b>PV power per unit:</b>	2,0 – 5,6 kW/house (averaged power: 3.1 kW/house)
<b>Energy yield per year:</b>	1 000 kWh/kW/year (calculated)
<b>Main PV system type:</b>	Grid-connected - demand side
<b>Main PV application type:</b>	Flat roof – mounted (13), Inclined roof – mounted (15) & Inclined roof – integrated: PV roof tile (1)
<b>Main PV module type:</b>	Framed regular module (28) & PV roof tile (1)
<b>Main PV cell type:</b>	Crystalline silicon – multi (13), Crystalline silicon – mono (15) & Amorphous silicon (1)
<b>PV module manufacturer/brand:</b>	Sharp corporation (28) & Kaneka corporation (1)
<b>Inverter manufacturer/brand:</b>	Sharp corporation (28) & Omron corporation (1)
<b>Investment for PV systems:</b>	500 000 JPY/kW

### OWNERSHIP

<b>Building owner:</b>	Inhabitant
<b>PV owner:</b>	Inhabitant
<b>PV energy user:</b>	Inhabitant



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## PV COMMUNITY DESCRIPTION

### PV Community Brief

Sekisui Harmonate-town Shin-Kamagaya is located in the west of Chiba prefecture and is 40 minutes from the center of Tokyo. The area is 6 500 m<sup>2</sup> in total and consists of 29 house compartments. A concept of developing the area was 'A house living with sun & a town living with future' and all houses were equipped with PV systems.

Generally, an approach for symbiosis housing in the suburb is to have a green area in a large site and to build a house in a low building-to-land rate. However, because the site is an existing urban area near city center, to design a large compartment was difficult from an economical viewpoint. Therefore, to develop an urban-type symbiosis housing equipped with facilities for energy conservation and creation was decided. An effective utilization of building roof area was very important and to install PV systems on all houses was decided. The houses achieved the energy conservation standards for houses and were all-electric. Further, electric power lines were laid underground in the area. One of the important factors to realize and succeed the project was to obtain a positive support by the utility company.

### Grid issue

There was concern for over-voltage phenomenon caused by a concentrated PV systems in a limited area. In addition, supplying electricity to the area where lots of all-electric houses would be constructed should be the most important issue for a utility company. Therefore, the electricity distribution line in the area, including countermeasures for the concentrated PV systems installation was designed and constructed by the utility company (the Tokyo Electric Power Company).

As a result, one transformer was set for two houses, e.g. two PV systems.

### Urban planning and architectural issues

To begin with the project, compartments before building houses were sold with carrying option to build an all-electric house equipped with PV system. Then, each house was designed and built on the compartment according to users' (inhabitants') intention. Two kinds of the roof-type are there; one is inclined-roof and the other is flat-roof. In case of inclined-roof, PV modules were mounted in the angle of inclination of the roof. In case of flat-roof, PV modules were fixed with support structure in the angle of 10 degree because of an effective utilization of roof area. Also, because the electric power lines were laid underground, an open environment was created in the area.

### Economic / financial issues

The PV system received a governmental subsidy, available through Japan's residential PV program. After starting operation, a net-metering scheme was applied so that surplus PV is traded between the inhabitant and the utility company, at the same price of the residential electric tariff.

For the all-electric house, electricity tariff structure is different than usual. The daytime rate is higher, while in nighttime the tariff is discounted. This means the value of the PV electricity from inhabitant to the utility company is higher.

Additional significant energy bill reductions resulted from energy conservation measures of high thermal insulation and high efficiency equipment.

### Other remarks

In addition to thermal insulation performance satisfying the energy conservation standards, all-electric houses were standardized. Not only PV system but also a high-efficiency electric water heater, called "Eco-Cute", was equipped in all houses. These advanced facilities caused high price of the houses, however the added value of the houses and the community has highly-regarded property value.

As well as each inhabitant's environmental consciousness, it is expected the extensive consciousness and actions for environment as a community will be developed.

## COMMUNITY INFORMATION

**Project leader company:** Sekisui Chemical Co., Ltd.

**Other project company:** -

**Project's www:** -

**Contact address:** Sekisui Chemical Co., Ltd.

Minato-ku, Tokyo, 105-8450, Japan

Tel: +81-3-5521-0575 FAX: +81-3-5521-0597



## Japan: Panahome-city Seishin-Minami

### BIODATA

<b>PV community name:</b>	Panahome-city Seishin-Minami
<b>Kind of urban area:</b>	Residential – urban
<b>Main building type in community:</b>	Houses - single houses
<b>New/Retrofit/Added:</b>	New district/community – building integration
<b>Type of project:</b>	Commercial project
<b>Start of operation:</b>	Year 2004
<b>City, state, etc.:</b>	Nishi, Kobe, Hyogo
<b>Country:</b>	Japan
<b>Latitude:</b>	N34 42' 22"
<b>Longitude:</b>	E135 1' 41"

### PV SYSTEM CHARACTERISTICS

<b>Total PV power:</b>	299 kW
<b>Number of houses/buildings:</b>	100 houses
<b>PV power per unit:</b>	3 kW/house
<b>Energy yield per year:</b>	-
<b>Main PV system type:</b>	Grid-connected - demand side
<b>Main PV application type:</b>	Inclined roof – mounted (31 houses), integrated: PV roof tiles (69 houses)
<b>Main PV module type:</b>	Framed regular module (31 houses), PV roof tile (69 houses)
<b>Main PV cell type:</b>	Crystalline silicon – multi
<b>PV module manufacturer/brand:</b>	Kyocera corporation
<b>Inverter manufacturer/brand:</b>	Kyocera corporation
<b>Investment for PV systems:</b>	-

### OWNERSHIP

<b>Building owner:</b>	Inhabitant
<b>PV owner:</b>	Inhabitant
<b>PV energy user:</b>	Inhabitant



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## PV COMMUNITY DESCRIPTION

### PV Community Brief

Panahome-city Seishin-Minami is a community located in the Seishin-Minami new-town developed by Kobe city and about 30 minutes from center of Kobe-city. The area is 18 000 m<sup>2</sup> in total and consists of 100 house compartments.

PanaHome corporation, which is one of the biggest housing companies in Japan and is a main constituent of the PV community, is dealing with a eco-life house, named 'El Solana', pursuing the concept of 'Energy creation', 'Energy conservation' and 'Safety'. The El Solana is equipped with a PV system and 'SAMURAI' developed by Kyocera corporation is on the roof as PV modules.

A concept for developing the area was 'A human- and environment- friendly town' and this was realized by developing the eco-life houses' area.

### Grid issue

The electricity distribution line in the area was designed and constructed by the utility company (the Kansai Electric Power Company).

As a countermeasure of electric power failure caused by the earthquake, a power-conditioner having a function of autonomy-operation mode was adopted for the PV system.

### Urban planning and architectural issues

Seishin-Minami new-town is developed as a new urban development project of Kobe city. For a development of a residential area by the private sector, a competition was conducted and PanaHome corporation was one of the developers that the plan proposed was approved.

To create a well-designed appearance of the houses and a harmonized streetscape as a community, the houses were designed with a variety of color tones and configurations. The PV roofs were required to harmonize with the design. The shape of the roof was designed for 3kW a PV system.

### Economic / financial issues

A governmental subsidized program for residential PV systems was available for PV system installation. After starting operation, a net-metering scheme was applied so that surplus PV is traded between the inhabitant and the utility company, at the same price of the residential electric tariff.

### Other remarks

Based on the concept, 'Ecology & Safety', all houses are equipped with a rain water storage tank and a home security system in addition to the PV system.

Some houses are all-electric and equipped with a high-efficiency electric water heater, called "Eco-Cute", and others were equipped a gas co-generation system, called "Eco-Will".

## COMMUNITY INFORMATION

**Project leader company:** PanaHome corporation

**Other project company:** Kyocera corporation

**Project's www:** -

**Contact address:** Kyocera Solar corporation  
<http://global.kyocera.com/prdct/solar/index.html>

## Japan: Sengendai Sai-no-michi

### BIODATA

<b>PV community name:</b>	Sengendai Sai-no-michi
<b>Kind of urban area:</b>	Residential – urban
<b>Main building type in community:</b>	Houses - single houses
<b>New/Retrofit/Added:</b>	New district/community – building integration
<b>Type of project:</b>	Commercial project
<b>Start of operation:</b>	Year 2005
<b>City, state, etc.:</b>	Koshigaya, Saitama
<b>Country:</b>	Japan
<b>Latitude:</b>	N35 49' 22"
<b>Longitude:</b>	E139 45' 29"

### PV SYSTEM CHATACTERISTICS

<b>Total PV power:</b>	50 kW
<b>Number of houses/buildings:</b>	25 houses
<b>PV power per unit:</b>	2 kW/house
<b>Energy yield per year:</b>	-
<b>Main PV system type:</b>	Grid-connected - demand side
<b>Main PV application type:</b>	Inclined roof – integrated: PV roof tiles
<b>Main PV module type:</b>	PV roof tile
<b>Main PV cell type:</b>	Amorphous Si
<b>PV module manufacturer/brand:</b>	Kubota corporation / MSK corporation
<b>Inverter manufacturer/brand:</b>	Kubota corporation / MSK corporation
<b>Investment for PV systems:</b>	700 000 JPY/kW

### OWNERSHIP

<b>Building owner:</b>	Inhabitant
<b>PV owner:</b>	Inhabitant
<b>PV energy user:</b>	Inhabitant



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## PV COMMUNITY DESCRIPTION

### PV Community Brief

Sengendai Aya-no-Michi is located in Koshigaya city, Saitama. Koshigaya city is a major urban area about 25km from Tokyo area, and the urban development has been implemented according to 'Koshigaya city urban planning master plan'.

In the land readjustment project in 2004, the city government held a competition for residential area development. Hakushin corporation proposed a concept of 'Harmony of Ecology & Community: Shine and Wind, Green and Water, Approach for Communication' and the proposal won the competition.

Hakushin was allowed to develop and sale 25 house compartments in the area and promoted to develop a community of all-electric houses equipped with PV systems.

### Grid issue

To avoid negative influences against the grid network caused by a high-density of PV systems installation into a limited area, a precise negotiation with a utility company (Tokyo Electric Power corporation) was implemented.

The electricity distribution line in the area was designed and constructed by the utility company, and each transformer was set for four houses, e.g. four PV systems.

### Urban planning and architectural issues

To create a well-designed appearance of the houses and a harmonized streetscape as a community, it was decided that roofing geometry of all houses was designed as gable roof laid out to tilt at a 30 degrees angle from a compartment boundary. Due to the shape and direction of the compartments, south-faced geometry was difficult. The solution design layout in PV modules facing the south-east direction.

PV roof tiles were selected for the PV systems and, based the roof design, an energy consumption pattern and a desired house price level, etc. the PV system capacity was standardized at 2kW.

### Economic / financial issues

There were no available subsidy programs for residential PV systems, at this time. After starting operation, a net-metering scheme was applied so that surplus PV is traded between the inhabitant and the utility company, at the same price of the residential electric tariff.

### Other remarks

In this project, an all-electric house is standardized and all houses are equipped with a high-efficiency electric water heater, called "Eco-Cute", as well as the PV system.

In the center of the community, there is a stone-paved approach for inhabitants and a corridor of water along the approach. Rain water is used for the corridor and pump power is supplied from the PV system.

## COMMUNITY INFORMATION

**Project leader company:** Hakushin Co., Ltd.

**Other project company:** Kubota corporation / MSK corporation

**Project's www:** <http://www.hakushin.com>

**Contact address:** MSK corporation

Shinjuku, Tokyo, 160-0023, Japan

Tel: +81-3-3342-3838 FAX: +81-3-3342-6534

Website: <http://www.msk.ne.jp/>



## Japan: Sekisui Harmonate-town Tsuru-no-ura

### BIODATA

**PV community name:** Sekisui Harmonate-town Tsuru-no-ura  
**Kind of urban area:** Residential – urban  
**Main building type in community:** Houses - single houses  
**New/Retrofit/Added:** New district/community – building integration  
**Type of project:** Commercial project  
**Start of operation:** Year 2005  
**City, state, etc.:** Kurashiki, Okayama  
**Country:** Japan  
**Latitude:** N 34 32' 53"  
**Longitude:** E 133 42' 37"

### PV SYSTEM CHARACTERISTICS

**Total PV power:** 98 kW (as of Apr. 2007)  
**Number of houses/buildings:** 25 houses (as of Apr. 2007)  
**PV power per unit:** 3,5 – 4,0 kW/house  
**Energy yield per year:** 1 000 kWh/kW/year (calculated)  
**Main PV system type:** Grid-connected - demand side  
**Main PV application type:** Flat roof – mounted (9), Inclined roof – mounted (16)  
**Main PV module type:** Framed regular module  
**Main PV cell type:** Crystalline silicon – multi (9), Crystalline silicon – mono (16)  
**PV module manufacturer/brand:** Sharp corporation  
**Inverter manufacturer/brand:** Sharp corporation  
**Investment for PV systems:** 500 000 JPY/kW

### OWNERSHIP

**Building owner:** Inhabitant  
**PV owner:** Inhabitant  
**PV energy user:** Inhabitant



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## PV COMMUNITY DESCRIPTION

### PV Community Brief

Sekisui Harmonate-town Tsuru-no-Ura is located in Okayama prefecture. The area is 7 400 m<sup>2</sup> in total and consists of 32 house compartments.

In 2005, 16 houses equipped with PV system were sold and presently another 16 houses are being sold in lots. In December 2006, 19 houses in total were being built.

In the near future, the PV community consisting of 32 houses, all equipped with PV systems will be completed.

### Grid issue

To avoid negative influences such as an over-voltage phenomenon caused by a high-density of PV systems installation in a limited area, a precise negotiation with a utility company (Chugoku Electric Power corporation) was implemented. As a result, the PV system capacity was limited to not exceed 4 kW/house.

The electricity distribution line in the area was designed and constructed by the utility company.

### Urban planning and architectural issues

The compartments before building houses were sold with a carrying option to build an all-electric house equipped with PV system, then each house was designed and built on the compartment according to users' (inhabitants') requirements.

The electric power lines in the area were installed underground creating an open environment appearance.

### Economic / financial issues

A net-metering scheme has been applied and surplus electricity from the house is being traded between the inhabitant and the utility company, at the same price of electricity tariff for residential.

For the all-electric house, electricity tariff structure is different than usual. The daytime rate is higher, while in nighttime the tariff is discounted. This means the value of the PV electricity from inhabitant to the utility company is higher.

Additional significant energy bill reductions resulted from energy conservation measures of high thermal insulation and high efficiency equipment.

### Other remarks

In addition to thermal insulation performance satisfying the energy conservation standards, all-electrified houses were standardized. Not only PV system but also a high-efficiency electric water heater, called "Eco-Cute", was equipped in all houses. These advanced facilities caused a high price of the houses, however the added value of the houses and the community was highly-regarded as a property value.

As well as each inhabitant's environmental consciousness, it is expected the extensive consciousness and actions for environment as a community will be developed.

## COMMUNITY INFORMATION

**Project leader company:** Sekisui Chemical Co., Ltd.

**Other project company:** -

**Project's www:** -

**Contact address:** Sekisui Chemical Co., Ltd.

Minato-ku, Tokyo, 105-8450, Japan

Tel: +81-3-5521-0575 FAX: +81-3-5521-0597

## Japan: Jo-Town Rinku Hawaiian Village

### BIODATA

<b>PV community name:</b>	Jo-Town Rinku Hawaiian Village
<b>Kind of urban area:</b>	Residential – urban
<b>Main building type in community:</b>	Houses - single houses
<b>New/Retrofit/Added:</b>	New district/community – building integration
<b>Type of project:</b>	Commercial project
<b>Start of operation:</b>	Year 2005
<b>City, state, etc.:</b>	Tajiri, Sennan, Osaka
<b>Country:</b>	Japan
<b>Latitude:</b>	N34 23' 41"
<b>Longitude:</b>	E135 17' 14"

### PV SYSTEM CHARACTERISTICS

<b>Total PV power:</b>	476 kW
<b>Number of houses/buildings:</b>	236 houses
<b>PV power per unit:</b>	2 kW/house
<b>Energy yield per year:</b>	-
<b>Main PV system type:</b>	Grid-connected - demand side
<b>Main PV application type:</b>	Inclined roof – integrated: PV roof tiles
<b>Main PV module type:</b>	PV roof tile
<b>Main PV cell type:</b>	Amorphous Si
<b>PV module manufacturer/brand:</b>	Kubota corporation / MSK corporation
<b>Inverter manufacturer/brand:</b>	Kubota corporation / OMRON corporation
<b>Investment for PV systems:</b>	-

### OWNERSHIP

<b>Building owner:</b>	Inhabitant
<b>PV owner:</b>	Inhabitant
<b>PV energy user:</b>	Inhabitant



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## PV COMMUNITY DESCRIPTION

### PV Community Brief

Jo-Town Rinku Hawaiian Village is in Tajiri, Sennnan, Osaka, is located near the Kansai International Airport, approximately 60 minutes from center of Osaka city. The area is 22 100 m<sup>2</sup> comprising 258 house compartments to form a PV community. All houses are equipped with PV systems.

The community was developed by Jo Cooperation CO., Ltd. (proprietor) and Sakudafudousan Co., Ltd. (selling agency). Their strategy was to foster environment-consciousness to customers and expected customers to be first-time house owners.

In addition to PV systems, whole-house energy efficiency is enhanced, with all houses either all-electrific or equipped with a gas co-generation system, called "Eco-Will".

### Grid issue

To avoid negative influences against a grid network caused by a high-density of PV system installations in a limited area, a negotiation with a utility company (Kansai Electric Power corporation) was implemented.

The electricity distribution line in the area was designed and constructed by the utility company, and each electric pole was installed for five houses, e.g. five PV systems.

### Urban planning and architectural issues

The compartments before building houses were sold with carrying option to build a house equipped with PV system, and then, each house was designed and built on the compartment according to users' (inhabitants') requirements, including the choice of all-electric facilities or gas co-generation system.

The compartments layout was developed, for the PV roof to face south as much as possible, and to create a well-designed appearance of the houses and a harmonized streetscape as a community, PV roof tiles were selected for the PV systems.

Based on the design of the roof, the energy consumption pattern, the solar insolation and a price level of house etc., the PV system capacity was standardized at 2kW.

### Economic / financial issues

Trade-offs in PV system capacity, roof geometry for maximum PV electricity output led to an increased house price. The PV system capacity was set at 2kW. In some houses, a governmental subsidized program for residential PV systems was available.

After starting operation, a net-metering scheme was applied so that surplus PV is traded between the inhabitant and the utility company, at the same price of the residential electric tariff. For the all-electric house, electricity tariff structure is different than usual. The daytime rate is higher, while in nighttime the tariff is discounted. This means the value of the PV electricity from inhabitant to the utility company is higher.

Additional significant energy bill reductions resulted from energy conservation measures of high thermal insulation and high efficiency equipment.

### Other remarks

The concept of the community development, 'all houses would be equipped with PV systems', was well accepted and handed down to the inhabitants. Also, 95% of inhabitants chose gas co-generation system while choice of all-electrified facilities was only 5%.

The project, Jo-Toen Rinku, is the biggest PV community in Kansai area (west side of Japan), and has been contributing not only to deploying areal PV system installation in residential area but also to increasing publicity of the project companies.

Here, Sakurafudousan Co., Ltd., which is the selling agency of the project, has been promoting PV community in Kansai area other than this project. They are aspiring to create an environment-conscious community and to enhance a value of the community. Expected customers would be spread to ones who are well-aware of environmental problems. In their strategy, PV system is a main component of their community development.

## COMMUNITY INFORMATION

**Project leader company:** Sakurafudousan Co., Ltd., Jo-Cooperation Co., Ltd.

**Other project company:** Kubota corporation, MSK corporation

**Project's www:** -

**Contact address:** -



## Japan: Hazama-so

### BIODATA

**PV community name:** Hazama-so  
**Kind of urban area:** Residential – urban  
**Main building type in community:** Houses - multi-story apartment buildings  
**New/Retrofit/Added:** Retrofit - old area with new building  
**Type of project:** Commercial project  
**Start of operation:** Year 2000  
**City, state, etc.:** Nagoya, Aichi  
**Country:** Japan  
**Latitude:** N35 10' 26"  
**Longitude:** E136 58' 19"

### PV SYSTEM CHARACTERISTICS

**Total PV power:** 203 kW  
**Number of houses/buildings:** 8 buildings  
**PV power per unit:** 11 - 34 kW/building  
**Energy yield per year:** 214 996 kWh/year (calculated)  
**Main PV system type:** Grid-connected - demand side  
**Main PV application type:** Flat roof – mounted & mechanical fixing  
**Main PV module type:** Framed regular module  
**Main PV cell type:** Crystalline silicon - multi  
**PV module manufacturer/brand:** Mitsubishi Electric corporation  
**Inverter manufacturer/brand:** Mitsubishi Electric corporation  
**Investment for PV systems:** -

### OWNERSHIP

**Building owner:** Nagoya city government  
**PV owner:** Nagoya city government  
**PV energy user:** Nagoya city government



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## PV COMMUNITY DESCRIPTION

### PV Community Brief

Nagoya city is the fourth biggest city in Japan and with over 2 million inhabitants.

The city government is promoting the installation of PV systems on municipal dwelling houses in their environmental action plan. Hazama-so is one of the municipal dwelling houses (apartment buildings). Because the buildings were built in 1955 and 40 years old, it was decided to reconstruct the buildings in the mid- 90's. Afterward, according to their environmental action plan, it was decided to install PV systems onto the new buildings. The work of reconstruction started in 1998 and 8 new buildings, equipped with PV systems on the roof, were completed in 2000. Although a capacity of PV system of each building was different, 203kW of PV was installed in total.

The project to reconstruct the buildings with installing PV systems was approved as a symbiosis housing urban area development model project, which was applied to environmental-conscious housing construction project implemented by local public organizations.

### Grid issue

Wiring from PV systems is connected with a low-voltage circuit of the buildings and the electricity is supplied for common use such as corridor lights, lift, etc. To connect with the low-voltage circuit, 5kW inverters were used. The result was many inverters in a limited site and a maximum of 6 inverters were installed per building. To avoid negative influences against a grid network, an operation test on function of backflow operation was conducted in the presence of a utility company (Chubu Electric Power corporation) and it was recognized there would be no problems on the issue.

When the amount of PV system electricity over the demand of the common loads for the building, reverse power flow to the grid occurs. However, because dwelling units in the building demand electricity, the surplus electricity would be supplied for the dwelling units and not other grid customers. Therefore, an over-voltage phenomenon is not a concern.

Since starting operation, there are no PV system grid-connection problems.

### Urban planning and architectural issues

Since the decision to install PV system was after the development of the buildings' reconstruction plan, the domestic wiring design for the buildings was changed for PV system installation. BOS like inverters were put in a cubicle placed on the roof of the buildings.

PV arrays were mounted and mechanically-fixed to the roof. To maximize PV electric output, the inclination angle of the PV arrays was 20 degrees facing south.

### Economic / financial issues

Because the project was approved as a symbiosis housing urban area development model project, one-third of total project cost including PV systems was subsidized by the national government.

After starting operation, a net-metering scheme was applied so that surplus PV is traded between the inhabitant and the utility company, at the same price of the residential electric tariff.

### Other remarks

Besides the Hazama-so project, Nagoya city government is promoting to install PV systems onto other municipal dwelling houses (apartment buildings) and their activities for environmental protection are widely recognized.

Hazama-so is located in Chigusadai area in Nagoya city. A junior high school is there in Chigusadai area, also with a PV system.

## COMMUNITY INFORMATION

**Project leader company:** Nagoya city government

**Other project company:** Mitsubishi Electric corporation

**Project's www:** -

**Contact address:** -

## Korea / Asan Green Village

### BIODATA

**PV community name:** Asan green village  
**Kind of community:** Residential - urban  
**Main building type in community:** Houses – attached houses  
**New/Retrofit/Added:** Added separately to the buildings  
**Type of project:** -  
**Start of operation:** Year 2005  
**Location/City:** Asan, Changnam  
**Country:** Korea  
**Latitude:** N36 47'  
**Longitude:** E127 12'

### PV SYSTEM CHARACTERISTICS

**PV power total community:** 208kW  
**Number of houses/buildings:** 26 buildings (104 homes)  
**PV power per unit:** 8 kW/building (2 kW/home)  
**Energy yield per year:** -  
**Main PV system type:** Grid-connected  
**Main PV application type:** Inclined roof – mounted  
**Main PV module type:** Framed regular module  
**Main PV cell type:** Crystalline silicon – multi  
**PV module manufacturer/brand:** S-energy co., ltd.  
**Inverter manufacturer/brand:** Fronius  
**Investment for PV systems/modules:** -

### OWNERSHIP

**Building owner:** Inhabitant  
**PV owner:** Inhabitant  
**PV energy user:** Inhabitant



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## PV COMMUNITY DESCRIPTION

### PV Community Brief

Asan green village is one of the projects developed under the Local Energy Development Program in Korea. The objective of the program is to construct a cluster of homes whose energy is largely supplied by renewable energy sources. There are 26 buildings in Asan green village and each building has 4 families. The PV systems total capacity is 208kW and the capacity for each building is 8kW (2kW/home).

Asan green village was constructed by Habitat for Humanity Korea. Habitat for Humanity Korea, an affiliate of Habitat for Humanity International, was initiated in 1992 and formally registered with the government in 1995, and has built 396 houses through 13 local affiliates across the country and another 379 houses overseas for low-income families as of December 2005. The founding and current chairman of the board of Habitat for Humanity Korea is Dr. KunMo Chung, formerly the Korean Minister of Science and Technology, currently president of Myongji University and president of the Korean Academy of Science and Technology.

### Grid issue

-

### Urban planning and architectural issues

The buildings layout was developed, as their roofs would face to the south direction. PV modules were mounted in the angle of inclination of the roof.

### Economic / financial issues

A scheme of the Local Energy Development Program is that a local government shares 30% of the installation cost and the central government pays the rest (70%).

Each family substitutes 80% electric charges off on PV.

### Other remarks

-

## COMMUNITY INFORMATION

**Project leader company:** S-energy co., ltd.

**Other project company:** S-energy co., ltd.

**Project's www:** <http://www.s-energy.co.kr>

**Contact address:** S-energy co., ltd.

10<sup>th</sup> Fl., E&C Venture Dream Tower VI, 197-28

Guro-dong, Guro-gu, Seoul 152-719 KOREA

Tel. +82-2-801-7100 Fax. +82-2-801-8788

Website : <http://www.s-energy.co.kr>



## Korea / Korea National Housing Corporation-Apartment

### BIODATA

**PV community name:** Korea National Housing Corporation-Apartment  
**Kind of community:** Residential - urban  
**Main building type in community:** Houses - Multi-story apartment buildings  
**New/Retrofit/Added:** -  
**Type of project:** -  
**Start of operation:** Year 2006  
**Location/City:** Cheonju  
**Country:** Korea  
**Latitude:** N36 37'  
**Longitude:** E127 30'

### PV SYSTEM CHARACTERISTICS

**PV power total community:** 250kW  
**Number of houses/buildings:** (1 215 families)  
**PV power per unit:** -  
**Energy yield per year:** -  
**Main PV system type:** Grid-connected  
**Main PV application type:** Inclined roof – mounted  
**Main PV module type:** Framed regular module  
**Main PV cell type:** Crystalline silicon – mono  
**PV module manufacturer/brand:** S-energy co., ltd.  
**Inverter manufacturer/brand:** Fronius  
**Investment for PV systems/modules:** 1 702 486 900 KRW / 250 kW system

### OWNERSHIP

**Building owner:** Korea National Housing Corp.  
**PV owner:** Korea National Housing Corp.  
**PV energy user:** Korea National Housing Corp.



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## PV COMMUNITY DESCRIPTION

### PV Community Brief

The apartment buildings were built for low-income families by KNHC (Korea National Housing Cooperation) in new apartments' area, Cheonju, Korea, located about 300km south west of Seoul. The community is leased apartments for 1 215 families, and 55-80m<sup>2</sup>/family.

The national rental housing is a sort of public rental housing constructed with government financing and the National Housing Fund, and is rented to people who are houseless, or have low income, for a long-term and low price. KNHC purchases and repairs multi-unit tenement housing, and rents them to the vulnerable people who are living downtown at 30% of the market price so that they can dwell at their practical income level.

As a new residential application, a 250kW PV system was applied to the apartment buildings. This new application is a monumental one, since more than half of Korean housing is now multi-family type.

### Grid issue

Electricity produced by the PV system is mainly used for public, e.g. streetlight, emergency light etc.

Although the electricity by PV isn't used for each family, the electricity is re-supplied because a whole family has electric hot water equipment.

### Urban planning and architectural issues

-

### Economic / financial issues

-

### Other remarks

KNHC & S-ENERGY are developing a technique for application of BIPV systems, currently. A closer application will be expected for a green apartment using self-production green energy to be built.

## COMMUNITY INFORMATION

**Project leader company:** S-energy co., ltd.

**Other project company:** S-energy co., ltd.

**Project's www:**

**Contact address:** S-energy co., ltd.

10<sup>th</sup> Fl., E&C Venture Dream Tower VI, 197-28

Guro-dong, Guro-gu, Seoul 152-719 KOREA

Tel. +82-2-801-7100 Fax. +82-2-801-8788

Website : <http://www.s-energy.co.kr>

## Switzerland: ABZ Residential Area “Moos”

### BIODATA

<b>PV community name:</b>	ABZ Residential Area “Moos”
<b>Kind of urban area:</b>	Residential – urban
<b>Main building type in community:</b>	Houses – multi-story apartment buildings
<b>New/Retrofit/Added:</b>	Retrofit – building integration
<b>Type of project:</b>	Commercial project
<b>Start of operation:</b>	first stage: Year 2000, second stage: Year 2003
<b>City, state, etc.:</b>	Marchwartstreet, Zurich
<b>Country:</b>	Switzerland
<b>Latitude:</b>	N47 20' 15"
<b>Longitude:</b>	E8 31' 35"

### PV SYSTEM CHATACTERISTICS

<b>Total PV power:</b>	100 kW in total
<b>Number of houses/buildings:</b>	11 buildings
<b>PV power per unit:</b>	8,5 kW/building in average
<b>Energy yield per year:</b>	830 kWh/kW
<b>Main PV system type:</b>	Grid-connected – demand side
<b>Main PV application type:</b>	Inclined roof - integrated
<b>Main PV module type:</b>	Framed regular module
<b>Main PV cell type:</b>	Crystalline silicon - mono
<b>PV module manufacturer/brand:</b>	Solrif BP Modul 585
<b>Inverter manufacturer/brand:</b>	Top Class ASP
<b>Investment for PV systems:</b>	-

### OWNERSHIP

<b>Building owner:</b>	ABZ general firm, Zurich
<b>PV owner:</b>	Edisun Power AG, Zurich
<b>PV energy user:</b>	Solar Stock Exchange, Zurich



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## PV COMMUNITY DESCRIPTION

### PV Community Brief

The ABZ Residential Area is located on the Marchwartstreet, 8038 Zurich, which is the largest city in Switzerland with around 370 000 inhabitants. The community is composed of eleven blocks multi-story apartment buildings in four rows and is in quiet residential area not far away from the center of the city.

The solar plant on this project was realized in two stages (year 2000 and 2003) the second stage was an extension, meaning that on additional roofs of the same Residential Area had more solar fields installed.

### Grid issue

-

### Urban planning and architectural issues

The ABZ Residential Area-inhabitants accepted this solar power plant extraordinary well. It gives them a satisfying solution for their standard power consumption and thus ABZ (general firm of building contractors) realized some related Projects in series.

### Economic / financial issues

The Solar Stock Exchange Zurich brokers the solar electricity. It follows special rules: the solar power comes from over 80 local producers and is sold at the purchase price to solar power subscribers, with no benefit. The purchase is at cost covering prices, promoting solar installation and the subscribers can also make a conscious contribution for the promotion of the solar electricity.

### Other remarks

-

## COMMUNITY INFORMATION

**Project leader company:** Edisun Power AG, Zurich

**Other project company:** Enecolo AG, Monchaltorf

**Project's www:** [www.edisunpower.com](http://www.edisunpower.com)

**Contact address:** Enecolo AG, Mönchaltorf

## United Kingdom: Corncroft, Nottingham

### BIODATA

**PV community name:** Corncroft, Nottingham  
**Kind of urban area:** Residential – urban  
**Main building type in community:** Houses - attached houses (social housing)  
**New/Retrofit/Added:** New district/community - building Integration  
**Type of project:** Demonstration project  
**Start of operation:** Year 2002  
**City, state, etc.:** Clifton, Nottingham  
**Country:** United Kingdom  
**Latitude:** N52 54' 10"  
**Longitude:** W1 10' 40"

### PV SYSTEM CHARACTERISTICS

**Total PV power:** 34 kW  
**Number of houses/buildings:** 22 houses  
**PV power per unit:** 1,53 or 1,7 kW/house  
**Energy yield per year:** 25 602 kWh/34kW (measured)  
**Main PV system type:** Grid connected – demand side  
**Main PV application type:** Inclined roof – integrated  
**Main PV module type:** Regular laminate (without frame)  
**Main PV cell type:** Crystalline silicon – mono  
**PV module manufacturer/brand:** BP Solar/BP 585L laminates  
**Inverter manufacturer/brand:** SMA  
**Investment for PV systems:** 3,41 GBP/W - Module Costs only  
 5,08 GBP/W - Total system costs (excluding management and monitoring costs)

### OWNERSHIP

**Building owner:** Nottingham Community Housing Association  
**PV owner:** Nottingham Community Housing Association  
**PV energy user:** Inhabitant



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## PV COMMUNITY DESCRIPTION

### PV Community Brief

A large social housing scheme in Nottingham is making use of photovoltaic (PV) installations in its new build bungalows for elderly and disabled occupants. Corncroft has one of the largest concentrations of PV in the UK with half of the dwellings in the development incorporating PV. The buildings were designed to be low energy, with features such as low 'e' glass and very high levels of insulation alongside the PV installations. The PV systems were installed with support from the Domestic Field Trials (DFT).

### Grid issue

Permission to connect the PV systems to the grid was granted once the local District Network Operator (DNO) East Midlands Electricity Distribution was provided with the relevant information.

### Urban planning and architectural issues

Since this was a new build project, the 22 bungalows were built first, leaving a designated roof space without tiles for the PV integration. The pre-fabricated 'RIS' mounting section was then secured on the roof space. Once the mounting system had been fixed to the roof space the first PV laminates were inserted. The whole assembly keeps the plane of the array at about the same level as the tiles while maintaining rain and wind resistance. The finished installation has a neat and well-engineered appearance.

An effort was made to ensure good visual balance between the PV system and the rest of the building. The visual impact of the bright module frames were reduced, especially at a distance, by the white framing of doors and windows, and the white detailing of the gutters and drainpipes.

### Economic / financial issues

The total cost (excluding management and monitoring) was 5,08 GBP per W of capacity installed. This does not include the additional costs for extra scaffolding needed due to construction delays. Also excluded were costs for secure storage of the modules until the roof was ready for their installation. The total average costs (excluding management costs for the project team and monitoring costs specific to the DFT) over a predicted 25 year lifetime are 0,26 GBP per kWh.

Many tenants are optimizing their usage of electricity by running appliances when the PV system is likely to be operating. Meters are provided in each of the properties that allow the user to see the instantaneous system output. Discussions are ongoing with electricity suppliers to seek a tariff agreement that would allow the residents to be paid for any PV electricity exported to the grid, i.e. at times when the PV output is greater than the householders' demand. It has been estimated that the PV will reduce each dwelling's electricity demand by 30%, saving residents about 60 GBP per year.

### Other remarks

The project team felt that their installation was very successful. It has provided comfortable, energy efficient and affordable homes for the elderly. The majority of tenants were very positive about the PV system, realizing savings with their electricity bills. The Housing Association is very pleased with the project, and as a result is working on a tile integrated PV system on another site.

## COMMUNITY INFORMATION

**Project leader company:** Nottingham Community Housing Association

**Other project company:** Energy for Sustainable Development Ltd

**Project's www:** -

**Contact address:** Andrea Griffiths-James  
Energy and Environmental Services Co-ordinator  
Nottingham Community Housing Association  
12/14 Pelham Road  
Nottingham  
NG5 1AP  
Tel: +44 115 9104444

## United Kingdom: Pinehurst

### BIODATA

<b>PV community name:</b>	Pinehurst
<b>Kind of urban area:</b>	Residential – urban
<b>Main building type in community:</b>	Houses - attached houses (social housing)
<b>New/Retrofit/Added:</b>	New district/community - building Integration
<b>Type of project:</b>	Demonstration project
<b>Start of operation:</b>	Year 2002
<b>City, state, etc.:</b>	Liverpool
<b>Country:</b>	United Kingdom
<b>Latitude:</b>	N53 25' 55"
<b>Longitude:</b>	W2 56' 55"

### PV SYSTEM CHARACTERISTICS

<b>Total PV power:</b>	14 kW
<b>Number of houses/buildings:</b>	9 houses
<b>PV power per unit:</b>	1,4 or 1,68 kW/houses
<b>Energy yield per year:</b>	10 878 kWh/14kW
<b>Main PV system type:</b>	Grid connected – demand side
<b>Main PV application type:</b>	Inclined roof – integrated: PV roof tiles
<b>Main PV module type:</b>	PV building elements - PV roof tile
<b>Main PV cell type:</b>	Crystalline silicon - mono
<b>PV module manufacturer/brand:</b>	BP Solar/SRT 35 laminates (Redland PV700 tile system)
<b>Inverter manufacturer/brand:</b>	SMA
<b>Investment for PV systems:</b>	5,07 GBP/W – Module costs 6,18 GBP/W – Total system costs (excluding management and monitoring costs).

### OWNERSHIP

<b>Building owner:</b>	CDS Housing (Plus Housing Group)
<b>PV owner:</b>	CDS Housing
<b>PV energy user:</b>	Inhabitants



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## PV COMMUNITY DESCRIPTION

### PV Community Brief

The Pinehurst housing area is owned by the Plus Housing Group in Liverpool and has recently undergone refurbishment as part of a regeneration process within the area. Nine of the 55 houses were deemed to be beyond economic repair. Hence the decision was taken to build nine new properties incorporating photovoltaics (PV) which will benefit the low income families on this housing scheme. The PV systems were installed with support from the Domestic Field Trials (DFT).

### Grid issue

Permission to connect the systems was obtained by the local District Network Operator (DNO) Manweb, who showed good support for the project. Early contact helped to ensure a positive relationship with the DNO.

### Urban planning and architectural issues

The Redland PV700 tile system was chosen because the rest of the estate uses conventional Redland tiles. One PV tile displaces four conventional tiles. The PV tiles are designed to fit in with the conventional tiles' horizontal lines resulting in flushness with the roof. Also the contrast in colour between the red tiles and blue PV modules was deliberate. The overall result is an uncluttered roof with an eye-catching PV system.

### Economic / financial issues

The design of the PV system and its various installation stages ensured that these stages could easily be combined with the normal construction schedule. Non specialist work could be undertaken by site subcontractors employed by the Building Contractor. Also scaffolding was available at no extra cost.

The average electricity cost (excluding management costs for the project team and monitoring costs specific to the DFR) over a predicted 25 year lifetime is estimated to be 0,32 GBP per kWh. Information was provided to the householders on different electricity suppliers who might purchase the electricity produced at premium rate. However, as far as is known, this has not been taken forward by the householders.

### Other remarks

Overall, the Project Team is very positive about the PV installation and pleased that it has provided the Plus Housing Group with its first portfolio of PV properties. The housing group felt that the key to its success has been good teamwork and a positive approach from every team member including the main building contractor. This was very important especially in regards to problem solving and being able to deal with the few that did occur effectively and efficiently.

## COMMUNITY INFORMATION

**Project leader company:** CDS Housing (Plus Housing Group)

**Other project company:** John Moores University

PV Contractor - Sundog Energy

Architect - Denova Design

Monitoring - Technical Associate employed by Plus Housing Group

Standard Site Activities - Bardsley Construction Ltd.

**Project's www:** -

**Contact address:** Inger Leach,

Project Manager,

Plus Housing Group,

Pinehurst, Liverpool.



## United Kingdom: Belfast Field Trials – Sunderland road

### BIODATA

<b>PV community name:</b>	Belfast Field Trials – Sunderland road
<b>Kind of urban area:</b>	Residential – urban
<b>Main building type in community:</b>	Houses – multi-story apartment building (social housing)
<b>New/Retrofit/Added:</b>	Retrofit – building integration
<b>Type of project:</b>	Demonstration project
<b>Start of operation:</b>	Year 2003
<b>City, state, etc.:</b>	Castlereagh, Belfast
<b>Country:</b>	United Kingdom
<b>Latitude:</b>	N54 34' 35"
<b>Longitude:</b>	W5 53' 30"

### PV SYSTEM CHARACTERISTICS

<b>Total PV power:</b>	51 kW
<b>Number of houses/buildings:</b>	3 buildings with 30 flats
<b>PV power per unit:</b>	1,7 kW/flat
<b>Energy yield per year:</b>	36 000 kWh/51kW (calculated)
<b>Main PV system type:</b>	Grid Connected – demand side
<b>Main PV application type:</b>	Inclined roof - mounted
<b>Main PV module type:</b>	Regular laminate (without frame)
<b>Main PV cell type:</b>	Crystalline silicon - mono
<b>PV module manufacturer/brand:</b>	BP Solar/585 L Laminates
<b>Inverter manufacturer/brand:</b>	SMA
<b>Investment for PV systems:</b>	-

### OWNERSHIP

<b>Building owner:</b>	Northern Ireland Housing Executive
<b>PV owner:</b>	Northern Ireland Housing Executive
<b>PV energy user:</b>	Inhabitants



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## PV COMMUNITY DESCRIPTION

### PV Community Brief

Northern Ireland Housing Executive were refurbishing 3 blocks, consisting of 30 flats. The refurbishment consisted of energy efficiency features including high insulation, double glazing and re-roofing which allowed the opportunity to integrate the use of PV systems. This particular housing scheme has an issue with vandalism.

The PV systems were installed with support from the Domestic Field Trials (DFT).

### Grid issue

Each flat has an inverter, and 30 inverters were installed in total.

The PV systems were connected to the grid via the DNO – Northern Ireland Electricity. There were no reported problems in connecting the PV systems to the grid.

### Urban planning and architectural issues

Originally it was thought that the houses' existing roof structures would be strong enough to support the integration of PV systems, but a structural survey concluded that the roofs were at the end of their design life. This meant a change in design, to re-roof the blocks with a sloping roof and integrate the PV systems onto the new roof.

Of the three blocks, the south facing block is the smallest and has six of the PV systems. The remaining 24 systems are split between the other two orientations.

### Economic / financial issues

Grant of 40 749 GBP received for this project. However, other information is not available.

### Other remarks

The change in roof design meant a change in strategy resulting in installing PV systems to provide electricity for all 30 flats instead of only 24 flats as originally planned. This added additional project costs and time to the project.

An ongoing issue with this site is vandalism, which is a known problem in this area.

## COMMUNITY INFORMATION

**Project leader company:** Northern Ireland Housing Executive

**Other project company:** Installer – BP Solar

Monitoring – University of Ulster

**Project's www:** -

**Contact address:** -

## United Kingdom: Newbiggin Hall Estate

### BIODATA

<b>PV community name:</b>	Newbiggin Hall Estate
<b>Kind of urban area:</b>	Residential – urban
<b>Main building type in community:</b>	Houses – multi-story apartment building (social housing)
<b>New/Retrofit/Added:</b>	Retrofit – building integration
<b>Type of project:</b>	Demonstration project
<b>Start of operation:</b>	Year 2004
<b>City, state, etc.:</b>	Westerhope, Newcastle Upon Tyne
<b>Country:</b>	United Kingdom
<b>Latitude:</b>	N54 59' 20"
<b>Longitude:</b>	W1 39' 37"

### PV SYSTEM CHARACTERISTICS

<b>Total PV power:</b>	38,25 kW
<b>Number of houses/buildings:</b>	1 building with 25 flats
<b>PV power per unit:</b>	1 – 3 kW/flat
<b>Energy yield per year:</b>	26 316 kWh/38,25kW
<b>Main PV system type:</b>	Grid connected – demand side
<b>Main PV application type:</b>	Inclined roof – integrated
<b>Main PV module type:</b>	Regular laminate (without frame)
<b>Main PV cell type:</b>	Crystalline silicon - mono
<b>PV module manufacturer/brand:</b>	BP Solar/BP 585L laminates
<b>Inverter manufacturer/brand:</b>	SMA
<b>Investment for PV systems:</b>	Total cost of approx. 200 000 GBP

### OWNERSHIP

<b>Building owner:</b>	Newcastle County Council, Newcastle Upon Tyne
<b>PV owner:</b>	Newcastle County Council
<b>PV energy user:</b>	Inhabitant



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## PV COMMUNITY DESCRIPTION

### PV Community Brief

25 flats in a low-rise block provide social housing within Westerhope in Newcastle Upon Tyne. Newcastle County Council (NCC) initiated a program of refurbishment which included re-roofing. This posed an ideal opportunity to integrate PV systems at the same time as combining it with other improvement work – including an upgrade of insulation, fire-stopping and an extensive over-hall of the external fabric of the building. The PV systems were installed with support from the Domestic Field Trials (DFT).

### Grid issue

Each flat has an inverter, and 25 inverters were installed in total.

The PV systems are connected into the local DNO's (NEDL) electricity network. NEDL were present on the day of commissioning and approved the connection of the PV systems.

### Urban planning and architectural issues

The laminates are integrated into the roof. They were fitted into each frame as work progressed to ensure that the frames were square to the roofline and adjacent frames. The result is an attractive roof-integrated PV installation on the buildings in this social housing estate.

### Economic / financial issues

The cost of this project was higher than most similar projects in the DFT. This was due to great concerns about security at the site and 7-day out of hours security was provided. Provision of on-site washing, toilet facilities, temporary power supplies and keeping tenants informed also had cost implications. Costs were minimized in some areas: Existing trunking was used to route the AC cables, which saved on installation time, materials and kept disruption to a minimum. The consumer displays showing PV output and export/import meters were located within the meter cupboard on the ground floor instead of inside each flat. This meant all metering could be installed at the same time which reduced installation time and disruption to tenants.

The average electricity cost (excluding project team management and monitoring specific to the DFT) over a period of 25 years is estimated to be 0,31 GBP/kWh. Newcastle County Council is currently looking into green tariffs and options for being paid for any exported electricity.

### Other remarks

Even though the installation itself went smoothly, a number of project management issues were encountered during the lead up time. The timescales for general refurbishment work and DFT requirements did not match, which resulted in the PV and roofing work being completed separately.

A number of lessons were learnt from the project. The project highlighted the importance of using a roofing company which allows retrospective PV integration while honoring the roof's guarantee period. Contractual arrangements need to be in place when obtaining planning permission as detailed design plans need to be provided. Overall the project team needs to be flexible enough to provide solutions to changing circumstances. This was achieved here and one major adoption resulted in locating the consumer displays (showing PV output) and export/import meters within the meter cupboard on the ground floor instead of inside each flat.

## COMMUNITY INFORMATION

**Project leader company:** Newcastle County Council

**Other project company:** Monitoring - Energy for Sustainable Development Ltd  
PV Contractor - PV Systems Ltd

**Project's www:** -

**Contact address:** Ernie Johnson  
Newcastle County Council

## United Kingdom: Campkin Court, Cambridge

### BIODATA

<b>PV community name:</b>	Campkin Court, Cambridge
<b>Kind of urban area:</b>	Residential – urban
<b>Main building type in community:</b>	Houses – multi-story apartment building (social housing)
<b>New/Retrofit/Added:</b>	Retrofit – building integration
<b>Type of project:</b>	Demonstration project
<b>Start of operation:</b>	Year 2004
<b>City, state, etc.:</b>	Cambridge
<b>Country:</b>	United Kingdom
<b>Latitude:</b>	N52 13' 54"
<b>Longitude:</b>	E0 08' 07"

### PV SYSTEM CHARACTERISTICS

<b>Total PV power:</b>	22,1 kW
<b>Number of houses/buildings:</b>	1 building with 23 flats
<b>PV power per unit:</b>	0,96 kW/flat
<b>Energy yield per year:</b>	16 442 kWh/22,1kW (measured)
<b>Main PV system type:</b>	Grid-connected – demand side
<b>Main PV application type:</b>	Flat roof – mounted & ballast fixing
<b>Main PV module type:</b>	Framed regular module
<b>Main PV cell type:</b>	Crystalline silicon - multi
<b>PV module manufacturer/brand:</b>	Kyocera
<b>Inverter manufacturer/brand:</b>	Fronius
<b>Investment for PV systems:</b>	Total cost of approx. 122 500 GBP

### OWNERSHIP

<b>Building owner:</b>	Cambridge Housing Society
<b>PV owner:</b>	Cambridge Housing Society
<b>PV energy user:</b>	Inhabitant



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## PV COMMUNITY DESCRIPTION

### PV Community Brief

Built in 1966 Campkin Court is owned by the Cambridge Housing Society. It is a three-storey brick building with a flat roof and is divided into 23 flats. The building has been refurbished, incorporating energy saving measures such as roof resurfacing and insulation. It is hoped that these energy saving measures and individual PV systems will help to reduce fuel poverty for the low income residents. The building has a large flat roof, with few obstructions, making it suitable for the installation of PV. The PV systems were installed with support from the Domestic Field Trials (DFT).

### Grid issue

Inverters were installed within each flat with the balance of system (BOS) components being housed in a dedicated cupboard within the small entrance hall. However, a neater solution, due to the space restrictions in the entrance hall, would have been to install three larger inverters and house them in the existing plant room. The way the installation was completed however meant little disruption to the tenants.

The PV systems are connected into EDF Energy's electricity network.

### Urban planning and architectural issues

The PV modules were mounted using the SolarMarkt AluStand system, which is specifically designed for supporting tilted modules on flat roofs. Detailed structural engineering calculations were carried out to simulate the worst case of wind uplift expected at the site. This resulted in the stands being screwed to specified concrete slabs. As the PV frame is mounted within the plan of the building, the modules are not visible from street level.

### Economic / financial issues

The average electricity cost (excluding management costs for the project team and monitoring costs specific to the DFT) over a predicted 25 year lifetime is estimated to be 0,30 GBP per kWh. It has been calculated that over the first year of operation 58% of the electricity consumed in the residences was generated by the PV systems.

### Other remarks

For health and safety reasons, a guard rail had to be fitted around the edge of the roof, which means that a number of the modules are shaded, reducing overall output by approximately 5%. Further information is available in publications on the DTI website ([www.dti.gov.uk/publications](http://www.dti.gov.uk/publications)): Photovoltaics in Buildings – Guide to the installation of PV systems, Good Practice Guide Part 1 – Project Management and Installation Issues.

## COMMUNITY INFORMATION

**Project leader company:** Brewer and Jackson Homes

**Other project company:** Dulas Ltd

**Project's www:** -

**Contact address:** Steve Brewer,  
Project Manager,  
Brew & Jackson Homes



## USA: Clarum Homes-Vista Montana

### BIODATA

**PV community name:** Clarum Homes – Vista Montana  
**Kind of urban area:** Residential – urban  
**Main building type in community:** Houses - single houses  
**New/Retrofit/Added:** New district/community – building integration  
**Type of project:** Commercial project  
**Start of operation:** Year 2003  
**City, state, etc.:** Watsonville, CA  
**Country:** USA  
**Latitude:** N36 54' 59"  
**Longitude:** W121 46' 18"

### PV SYSTEM CHARACTERISTICS

**Total PV power:** >300 kW  
**Number of houses/buildings:** 177 single houses, 80 townhouses, and 2 buildings with 132 flats  
**PV power per unit:** 1,2 - 2,4 kW  
**Energy yield per year:** 1 400 kWh/kW  
**Main PV system type:** Grid connected - demand side  
**Main PV application type:** Inclined roof - mounted  
**Main PV module type:** Framed regular module  
**Main PV cell type:** Crystalline silicon – mono  
**PV module manufacturer/brand:** AstroPower  
**Inverter manufacturer/brand:** -  
**Investment for PV systems:** -

### OWNERSHIP

**Building owner:** Inhabitant  
**PV owner:** Inhabitant  
**PV energy user:** Inhabitant



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## PV COMMUNITY DESCRIPTION

### PV Community Brief

Vista Montana is one of many zero energy home (ZEH) developments by the Clarum Homes Development Company. It is the largest ZEH development in the US. Clarum made a commitment to ZEH in 1999 and introduced the [Enviro-Home™](#) in 2004. The program has also earned the U.S. Environmental Protection Agency's ENERGY STAR® seal, ConSol's ComfortWise SM designation, and the California Building Industry Institute's California Green Builder certification.

Between the PV and the energy efficiency features, the homes energy bills are reduced nearly 90%. These features include tankless on-demand water heater, a high-efficiency furnace, a foam-wrapped building envelope, increased insulation, radiant roof barrier, advanced HVAC technology, tightly sealed ducts, and low-E energy-efficient windows, ceiling fans, fluorescent light bulbs. Water conserving plumbing fixtures, and water conserving landscaping are also incorporated, providing homeowners further utility savings. Green building products also provide a healthier living environment.

### Grid issue

There were no specific grid issues. Pacific Gas and Electric is the largest IOU in the US state of California and second utility with the most solar in the US. The systems are interconnected and net metered with the exception of the PV on the apartment buildings, because laws prevent the landlord/building owner from selling electricity to tenants. Instead the PV energy is used for common loads and maintenance fees are reduced.

### Urban planning and architectural issues

The popular California home style is a Mediterranean which includes tile roofs. However, the offset panel mounts have proven successful and works aesthetically with the architectural design.

The development layout is a grid to assure economical land use. In this case the multiple roof lines assist in correct orientation of the PV. The PV was a standard feature to the single family homes and town houses at a level of 1,2 – 2,4 kW per residence.

### Economic / financial issues

The state of California offers substantial rebates for PV systems and has some of the highest utility rates in the US. Additionally, residents of the state experienced rolling blackouts from electric supply problems. Therefore the market for ZEH is strong in the state. However, Clarum was one of the first US developers to enter the ZEH market and also discovered that a home with standard energy efficiency and PV in the design, differentiated the product from other home builders. The homes sold faster so that capital funds were not tied up as long and could be reutilized more quickly, thus increasing profits. In the case of Vista Montana, the development was built and sold out in one year. The original advertised price range was 399 000 – 499 000 USD, but some homes sold for as much as 600 000 USD.

Clarum works with the United States Department of Energy, Building America Program to use their cost and energy savings analysis to point to the most cost-effective combination of features for the climates it builds in. Once a cost-effective combination is chosen, economies of scale can be achieved through volume purchasing and training of subcontractors

### Other remarks

John Suppes, founder and president of Clarum Homes advises other builders to just try solar on site generation with PV. "Solar electric power adds value to the homes we build," said Suppes. "By giving homeowners the tools they need to generate their own electricity, we're enabling them to save money on their utility bills. We're also differentiating our homes in the marketplace. We set out to provide exceptional value for our customers by adding solar power, and in the process we did something exceptional for our business

## COMMUNITY INFORMATION

**Project leader company:** Clarum Homes

**Other project company:** ConSol

**Project's www:** <http://www.clarum.com/>  
<http://www.consol.ws/>

**Contact address:** Corporate Headquarters  
 599 College Avenue  
 Palo Alto, California 94306

## USA: Premier Homes – Premier Gardens

### BIODATA

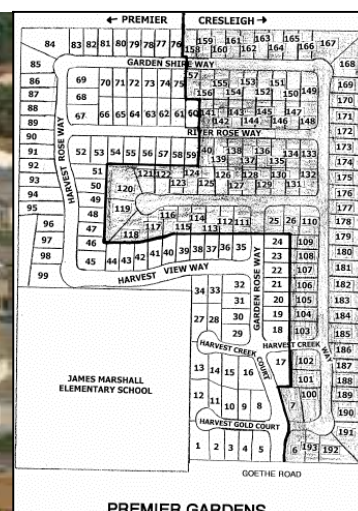
<b>PV community name:</b>	Premier Homes – Premier Gardens
<b>Kind of urban area:</b>	Residential – urban
<b>Main building type in community:</b>	Houses - single houses
<b>New/Retrofit/Added:</b>	New district/community – building integration
<b>Type of project:</b>	Commercial project
<b>Start of operation:</b>	Year 2004
<b>City, state, etc.:</b>	Rancho Cordova, CA
<b>Country:</b>	USA
<b>Latitude:</b>	N38 25' 20"
<b>Longitude:</b>	W121 18' 9"

### PV SYSTEM CHARACTERISTICS

<b>Total PV power:</b>	209 kW
<b>Number of houses/buildings:</b>	95 houses
<b>PV power per unit:</b>	2,2 kW
<b>Energy yield per year:</b>	3 456 kWh per system
<b>Main PV system type:</b>	Grid connected - demand side
<b>Main PV application type:</b>	Inclined roof – integrated: PV roof tiles
<b>Main PV module type:</b>	PV roof tile
<b>Main PV cell type:</b>	Crystalline silicon – multi
<b>PV module manufacturer/brand:</b>	GE/GT-55
<b>Inverter manufacturer/brand:</b>	Sunny Boy, SMA 2500
<b>Investment for PV systems:</b>	10 000 - 15 000 USD for PV and efficiency

### OWNERSHIP

<b>Building owner:</b>	Inhabitant
<b>PV owner:</b>	Inhabitant
<b>PV energy user:</b>	Inhabitant



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## PV COMMUNITY DESCRIPTION

### PV Community Brief

Premier Gardens was the first near Zero Energy home (ZEH community) in the Sacramento area as well as the first for the builder, Premier homes. The plot of land was actually developed by two home builders. Cresliegh homes built 98 high efficiency homes and Premier built 95 near-ZEH homes. As noted by the plot layout the two types of homes are in close proximity allowing the opportunity for extensive energy analysis. The community is considered an entry level home buyer community.

### Grid issue

There were no specific grid issues. The Sacramento Municipal Utility District (SMUD) is notably one of the most PV experienced US utilities. SMUD chose to decommission a nuclear power plant early and meet new demand with alternative energy and efficiency. The Premier Gardens development was part of their new home builder/ZEH program.

The side by side houses provided SMUD with the opportunity to monitor and analyze the energy use in occupied homes. The main utility focus was to decrease energy demand and more specifically the demand caused by air conditioners. Extensive analysis was performed on the side by side developments. The non-ZEH Cresliegh development was designed to surpass California's strict energy code by 30%. The Premier Gardens near-ZEH homes saved an additional 44% over the Cresliegh homes. On average, the demand savings was 60-70% during peaks. However, the broken roofline style allowed analysis of different PV orientations. The difference in annual energy production for different orientations was not more than 5% (decrease from latitude tilt – south). With the late afternoon peak, the west orientation provided an additional 42% demand reduction for a resulting overall reduction of nearly 80% or 1,3 kW peak on average.

### Urban planning and architectural issues

The planning for this development had an energy focus. Yet the aesthetically desirable broken roofline and efficient land use layout was not compromised. The broken roofline once thought to be an orientation barrier for residential PV due to decreased energy production is now considered an asset in the SMUD service area. This is due to the minimal decrease in energy production relative to the substantially higher decrease in demand reduction. In addition to the energy analysis, occupant demographic and attitude analysis was also performed on this development with results of increased occupancy comfort and homeowner satisfaction. The orientation for this development was about 60% South, 24% West and 16% East.

### Economic / financial issues

SMUD provided about 7 000 USD towards the PV and 500 USD towards the efficiency measures. The added cost to the construction for the PV and efficiency combined is 15 000 USD. Additionally, SMUD has tiered residential electric rates. The first 700 kWh per month use are charged 8 UScent/kWh and any use above this pays 15 UScent/kWh. The homes in Premier Gardens electricity use fell well under the first rate tier and the comparable homes at Cresliegh Gardens fell over to the second rate tier. The average bill for Premier Gardens is 40 USD/month, for the Cresliegh Gardens bill is 56 USD/month and the average for SMUD residential bills is 73 USD/month.

### Other remarks

Premier Gardens was the first near-ZEH development for Premier homes and the first development for which PV was a standard and not an option. The builder feels that by making PV a standard, the installation cost would be reduced by 40%. Though overall this is only about 10% of the PV system cost, these homes are mainly first time homeowner, lower cost homes and the builder has a minimal profit margin. Premier has standardized all their homes with PV and feels that the free publicity as well as the product differentiation has been extremely helpful for business now when the home market is at an all time low.

The development was built when the California building market was very strong. However, the Premier Gardens development started later and sold before the comparable Cresliegh Rosewood development.

## COMMUNITY INFORMATION

**Project leader company:** Premier Homes

**Other project company:** ConSol

**Project's www:** <http://www.buildbypremier.com/>  
<http://www.consol.ws/>

**Contact address:** -

## USA: Centex - Avignon

### BIODATA

**PV community name:** Centex - Avignon  
**Kind of urban area:** Residential – urban  
**Main building type in community:** Houses - single houses  
**New/Retrofit/Added:** New district/community – building integration  
**Type of project:** Commercial project  
**Start of operation:** Year 2007  
**City, state, etc.:** Pleasanton, CA  
**Country:** USA  
**Latitude:** N37 39' 44"  
**Longitude:** W121 52' 28"

### PV SYSTEM CHARACTERISTICS

**Total PV power:** 105 kW  
**Number of houses/buildings:** 30 houses  
**PV power per unit:** 3,5 kW  
**Energy yield per year:** 3 456 kWh per system  
**Main PV system type:** Grid connected - demand side  
**Main PV application type:** Inclined roof – integrated: PV roof tiles  
**Main PV module type:** PV roof tile  
**Main PV cell type:** Crystalline silicon – mono  
**PV module manufacturer/brand:** Sun Power/SunTile  
**Inverter manufacturer/brand:** -  
**Investment for PV systems:** 10 000 - 15 000 USD for PV and efficiency

### OWNERSHIP

**Building owner:** Inhabitant  
**PV owner:** Inhabitant  
**PV energy user:** Inhabitant



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## PV COMMUNITY DESCRIPTION

### PV Community Brief

Avignon is a high-end home community, with prices starting at 1,6 million USD. The homes are estate style homes, yet are a Centex "Powersave Plus" community. The homes start at 400 square meters and the land parcels are 1 200 – 2 400 square meters for 28 of the homes. Two homes are on parcels 10 000 – 20 000 square meters and have maintained vineyards. The community was marketed as "Sunshine and Wine". Pleasanton is a highly desirable community because of its public transportation connection to San Francisco, avoiding urban traffic problems.

### Grid issue

There were no specific grid issues. Pacific Gas and Electric has been interconnecting homes since California policy started in the mid 1990's. The homes were design to exceed the aggressive California Building Energy Code, Title 24, by 25%. Between the efficiency options and solar, the average monthly bill is reduced from 134 to 39 USD.

California utilities are most interested in demand reduction and these homes have a peak demand of only 1 kW which is excellent for an estate style home.

### Urban planning and architectural issues

Centex is one of the largest builders in the US, having built more than 33 000 homes in 25 states in 2005. This community was designed as a high end community bordering a California vineyard with very large land parcels. Alameda County also part of the Cool Counties Climate stabilization Initiative.

### Economic / financial issues

Incentives are available to builders and to home owners. In January 2006, the California Public Utilities Commission (CPUC) adopted a program—the California Solar Initiative (CSI) – to provide more than 3 billion USD in incentives for solar projects with the objective of providing 3 000 MW of solar capacity by 2017 from residential and commercial projects combined. Homeowners will receive 2,50 USD/W<sub>AC</sub> for residential systems, with the incentives awarded as a one-time, up-front payment based on expected system performance. Several counties offer incentives to builders including free technical advice and waiving of fees on solar projects; some counties offer rebates to homeowners on solar equipment.

There is also the federal 2 000 USD tax credit for homeowners who purchase solar electric and solar water heating systems as well as a 500 USD tax credit for those who purchase energy-efficient equipment like furnaces, air conditioners and water heaters. Also, many utilities in California offer a rebate for energy-efficient construction, usually 500 USD per house.

### Other remarks

At a time when the housing market in the US is near a standstill, Centex like other builders finds the "Powersave Plus", which is efficiency and PV to differentiate its home product even in the high-end home market. Avignon like other solar communities sold out immediately.

## COMMUNITY INFORMATION

**Project leader company:** Centex Homes

**Other project company:** ConSol

**Project's www:** [www.centexhomes.com](http://www.centexhomes.com)  
<http://www.consol.ws/>

**Contact address:** -



## USA: Grupe – Carsten Crossings

### BIODATA

<b>PV community name:</b>	Grupe- Carsten Crossings
<b>Kind of urban area:</b>	Residential – urban
<b>Main building type in community:</b>	Houses - single houses
<b>New/Retrofit/Added:</b>	New district/community – building integration
<b>Type of project:</b>	Commercial project
<b>Start of operation:</b>	Year 2006 (not yet completed)
<b>City, state, etc.:</b>	Rocklin, CA
<b>Country:</b>	USA
<b>Latitude:</b>	N38 47' 26"
<b>Longitude:</b>	W121 14' 8"

### PV SYSTEM CHARACTERISTICS

<b>Total PV power:</b>	345 kW
<b>Number of houses/buildings:</b>	144 houses
<b>PV power per unit:</b>	2,4 kW
<b>Energy yield per year:</b>	3 531 kWh per system
<b>Main PV system type:</b>	Grid connected - demand side
<b>Main PV application type:</b>	Inclined roof – integrated: PV roof tiles
<b>Main PV module type:</b>	PV roof tile
<b>Main PV cell type:</b>	Crystalline silicon – mono
<b>PV module manufacturer/brand:</b>	Sun Power/SunTile
<b>Inverter manufacturer/brand:</b>	Xantrex
<b>Investment for PV systems:</b>	15 000 USD for PV and efficiency after incentives

### OWNERSHIP

<b>Building owner:</b>	Inhabitant
<b>PV owner:</b>	Inhabitant
<b>PV energy user:</b>	Inhabitant



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## PV COMMUNITY DESCRIPTION

### PV Community Brief

The Carsten Crossings neighborhood is one of 9 developments within the 1 200 acre Whitney Ranch development located in Rocklin, California. The Carsten Crossings project consists of 144 three-to-five bedroom, 2-3½ bath homes on lots that are 6 000 square feet or larger. The Carsten Crossings home designs are inspired by traditional ranch homes built in the area. The homes are considered middle class and market for about 500 000 USD. Grupe submitted the Carsten Crossings project for certification under the U.S. Green Building Council's LEED-H pilot program and is marketed as a "GrupeGreen" development, with many green building options such as soy insulation.

### Grid issue

There were no specific grid issues. Pacific Gas and Electric has been interconnecting homes since California policy started in the mid 1990's. The homes were design to exceed the aggressive California Building Energy Code, Title 24, by 36%. With the PV array when facing south the energy savings jump to 54% better than Title 24.

### Urban planning and architectural issues

Whitney ranch is a 1 200 acre amenity focused master planned community. In addition to the Community Park and Ranch House, Whitney Ranch features an extensive network of hiking and biking trails, acres of preserved natural open space, and neighborhood parks. The Grupe Builders, Carsten Crossings section has received acclaim for the architectural integration into the ranch style homes. Orientation was not an issue with only 5% difference (decrease from latitude tilt) for annual energy production of the PV system orientations other than south at this latitude.

### Economic / financial issues

The energy efficiency and PV measure packages were evaluated using DOE-2 to estimate the value in utility savings and net cash flow to the buyers. Average incremental costs for the Grupe Homes improvements range from 15 064 USD to 15 576 USD after rebates, depending on the size of the home. If Grupe were to pass all of the cost of the energy efficiency measures (with incentives

applied) through to the buyers, the total costs would amortize over 30 years at from 1 203 USD to 1 244 USD per year at 7% interest rate. Utility incentives, including Energy Star Homes and rebates for Energy Star dishwasher and fluorescent lighting, ranged from 1 025 USD to 1 225 USD (depending on the number of light fixtures). The houses also qualify for the 2 000 USD federal energy efficiency 176 tax credit. California State PV rebates were taken by PowerLight and were included in the cost to the builder. The first year energy savings of 1 557 USD are projected, yielding a positive annual cash flow that averages 1 053 USD for the various models and orientations. Including the PV systems, cash flow is still positive at 828 USD per year.

### Other remarks

The Carsten Crossings development is towards the back of Whitney ranch and yet has sold faster than the other developments.

## COMMUNITY INFORMATION

**Project leader company:** Grupe Homes

**Other project company:** US Department of Energy Building America

**Project's www:** [www.grupe.com](http://www.grupe.com)

**Contact address:** -

## USA: Treasure Homes – Fallen Leaf

### BIODATA

<b>PV community name:</b>	Treasure Homes – Fallen Leaf
<b>Kind of urban area:</b>	Residential – urban
<b>Main building type in community:</b>	Houses - single houses
<b>New/Retrofit/Added:</b>	New district/community – building integration
<b>Type of project:</b>	Commercial project
<b>Start of operation:</b>	Year 2006 (not yet completed)
<b>City, state, etc.:</b>	Sacramento, CA
<b>Country:</b>	USA
<b>Latitude:</b>	N38 34' 53"
<b>Longitude:</b>	W121 29' 39"

### PV SYSTEM CHARACTERISTICS

<b>Total PV power:</b>	64 kW
<b>Number of houses/buildings:</b>	32 houses
<b>PV power per unit:</b>	2 kW
<b>Energy yield per year:</b>	3 493 kWh per system
<b>Main PV system type:</b>	Grid connected - demand side
<b>Main PV application type:</b>	Inclined roof – mounted
<b>Main PV module type:</b>	Framed regular module
<b>Main PV cell type:</b>	Crystalline silicon – multi
<b>PV module manufacturer/brand:</b>	BP Solar
<b>Inverter manufacturer/brand:</b>	Xantrex
<b>Investment for PV systems:</b>	15 000 USD for PV and efficiency

### OWNERSHIP

<b>Building owner:</b>	Inhabitant
<b>PV owner:</b>	Inhabitant
<b>PV energy user:</b>	Inhabitant



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## PV COMMUNITY DESCRIPTION

### PV Community Brief

Sacramento area's Fallen Leaf at Riverbend answers the universal problem of urban sprawl through the construction of desirable, attractive, energy efficient, solar homes in an infill area. With Treasure Homes' Award of Merit at the California Building Industry Association's Gold Nugget Awards in 2006, its Fallen Leaf community is one of the most comprehensive energy saving communities in the Sacramento region. The development features 32 energy efficient green homes with on-site solar generation.

### Grid issue

There were no specific grid issues. The Sacramento Municipal Utility District (SMUD) is notably one of the most PV experienced US utilities. SMUD chose to decommission a nuclear power plant early and meet new demand with alternative energy and efficiency. SMUD provides incentives to builders to build near zero energy homes (near-ZEH).

### Urban planning and architectural issues

An infill land parcel is often difficult to develop, because the utility infrastructure was not originally planned for the development and with the surrounding area built out, construction disruption can be expensive for the municipality and the developer. A near-ZEH development that is also green has minimal infrastructure impact and typically does not require any upgrade and the resulting construction disruptions to the urban area.

The modules are mounted very low profile and often referred to as "roof-integrated by the media.

### Economic / financial issues

The estimated builder cost increases required to achieve targeted BA whole house energy savings levels range from 15 180 to 15 286 USD, after SMUD provided about 6 700 USD towards the PV and efficiency measures. Additionally, SMUD has tiered residential electric rates. The first 700 kWh per month use are charged 8 UScent/kWh and any use above this pays 15 UScent/kWh. The homes at Fallen Leaf electricity use fell well under the first rate tier for a resulting electric bill of 34 USD/month or 63% less than the standard home.

### Other remarks

The homes built in *Fallen Leaf at Riverbend* also meet the requirements of the California Green Builder program (CGB). The program was created to encourage greater participation in green building. Developed by the California Building Industry Association as a voluntary, performance-based program, CGB provides quantifiable environmental benefits to all – buyers, builders, and local jurisdictions. It is one of the most comprehensive, builder-driven initiatives in the nation and includes an independent, third party verification of plans and construction.

## COMMUNITY INFORMATION

**Project leader company:** Treasure Homes

**Other project company:** ConSol

**Project's www:** <http://www.treasurehomes.com/>  
<http://www.consol.ws/>

**Contact address:** -

## USA: Shea Homes – San Angelo

### BIODATA

<b>PV community name:</b>	Shea Homes – San Angelo
<b>Kind of urban area:</b>	Residential – urban
<b>Main building type in community:</b>	Houses - single houses
<b>New/Retrofit/Added:</b>	New district/community – building integration
<b>Type of project:</b>	Commercial project
<b>Start of operation:</b>	Year 2001
<b>City, state, etc.:</b>	San Diego, CA
<b>Country:</b>	USA
<b>Latitude:</b>	N32 42' 55"
<b>Longitude:</b>	W117 9' 26"

### PV SYSTEM CHARACTERISTICS

<b>Total PV power:</b>	120 kW
<b>Number of houses/buildings:</b>	100 houses among 306 houses (all have solar hot water)
<b>PV power per unit:</b>	1,2 kW
<b>Energy yield per year:</b>	1 988 kWh per system
<b>Main PV system type:</b>	Grid connected - demand side
<b>Main PV application type:</b>	Inclined roof – mounted
<b>Main PV module type:</b>	Framed regular module
<b>Main PV cell type:</b>	Crystalline silicon – mono
<b>PV module manufacturer/brand:</b>	AstroPower
<b>Inverter manufacturer/brand:</b>	-
<b>Investment for PV systems:</b>	-

### OWNERSHIP

<b>Building owner:</b>	Inhabitant
<b>PV owner:</b>	Inhabitant
<b>PV energy user:</b>	Inhabitant



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## PV COMMUNITY DESCRIPTION

### PV Community Brief

Shea Home builders were in the process of a new development when the western energy crisis hit California in 2000. In some cases, San Diego Gas and Electric utility bills nearly tripled in one month resulting in a very strong market for high efficiency homes. Still at this point PV was not a standard feature in the development and was offered on only 100 residences.

### Grid issue

Standard grid interconnection was not yet well established in California at the time of this development. Input from the builder and the San Diego Regional Energy Office helped develop the standardization of PV interconnection as a result of this project.

### Urban planning and architectural issues

The Shea development is a typical upper middle class residential design for the State of California. The builder worked directly with the manufacturer and yet mounting on the barrel tile roofs was still an issue.

The development layout had already been established prior to the inclusion of the solar options and because of the aesthetically desirable broken roofline, only south exposure orientations were considered for solar orientation. Later developments found the broken roofline to be an asset and that varied orientation of distributed generation helped with the utility's afternoon peak.

### Economic / financial issues

At the time of the Shea development, California offered 3,50 USD per watt for PV installations and towards the solar hot water heat. There were no Federal tax credits available at this time.

### Other remarks

The Shea homes development was the ice breaker for both high performance homes and homes with a standard PV system. The builder discovered that the solar homes sold first and that even the non PV home purchases had some causal effect due to the "solar Community"

## COMMUNITY INFORMATION

**Project leader company:** Shea Homes

**Other project company:** -

**Project's www:** [www.sheahomes.com](http://www.sheahomes.com)

**Contact address:** -



## Sweden: City of Malmö

### BIODATA

**PV community name:** MALMÖ  
**Kind of urban area:** Public - other (museums, schools etc.)  
**Main building type in community:** Non-residential buildings - 3 or 4 floors  
**New/Retrofit/Added:** Added separately to the building  
**Type of project:** Demonstration project, and commercial project  
**Start of operation:** Year 2001  
**City, state, etc.:** Malmö  
**Country:** Sweden  
**Latitude:** N55 35'  
**Longitude:** E12 57'

### PV SYSTEM CHARACTERISTICS

**Total PV power:** 500 kW  
**Number of houses/buildings:** 15 buildings  
**PV power per unit:** 11-166 kW  
**Energy yield per year:** 850 kWh/kW  
**Main PV system type:** Grid-connected - demand side  
**Main PV application type:** Flat roof - mounted & mechanical fixing, Façade - integrated in fixed sunscreens and mounted  
**Main PV module type:** Framed regular module  
**Main PV cell type:** Crystalline silicon - multi  
**PV module manufacturer/brand:** Sharp, Kyocera, Suntech  
**Inverter manufacturer/brand:** SMA, Fronius,  
**Investment for PV systems:** 6 300 EUR/kW

### OWNERSHIP

**Building owner:** City of Malmö  
**PV owner:** City of Malmö  
**PV energy user:** Schools, museum etc



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## PV COMMUNITY DESCRIPTION

### PV Community Brief

The city of Malmö is located in the very south of Sweden and the third largest city in the country. Investment in solar energy is being made to strengthen and market the environmental profile of the city, to reduce CO<sub>2</sub>-emissions and to become more self-sufficient in energy. Malmö has also established the first Solar City Association in Sweden, with the objective to increase the use of solar energy and strengthen the solar energy market in southern Sweden. The work of the municipality has been going since 2001 and includes installation of several large PV plants on public buildings. All plants are retrofit installations. With a total of 15 PV-plants and a total area of 3400 m<sup>2</sup> and a peak power of 500 kW, Malmö is the leading city in Sweden regarding PV installations.

### Grid issue

All PV installations are dimensioned so that the production never exceeds the consumption in the building or the municipal internal grid.

### Urban planning and architectural issues

The city has focused on making investments in well-functioning PV plants that are nicely integrated in the urban environment, at the same time as they are visible to the public to create positive publicity. PV plants have been installed on different types of public buildings like schools, museum and hospital at different locations around the city.

PV plants in Malmö have been awarded PV Plant of the Year by the Solar Electricity Program in 2006 and PV Plant of the Year by the Swedish Solar Energy Association in 2007.

### Economic / financial issues

All electricity producers in Sweden must pay a fee for the metering, calculation and reporting in order to deliver electricity to the grid. The size of the fee depends on the grid owner, but it is approximately 420 EUR per plant each year, which is a significant cost for a small-scale electricity producer. Because of this, a majority of PV installations are dimensioned so that the electricity production never exceeds the consumption in the building or the municipal internal grid, and no electricity is delivered to the external grid. There are no feed-in tariffs in Sweden. Electricity from PV plants can be sold to the grid, but at the same price as other renewable energies like windpower. All systems got a governmental investment subsidy of 70 % for the project.

### Other remarks

The investments in PV have very well succeeded in strengthening and marketing the environmental profile of Malmö. The investments have received attention in media, in newspapers and magazines as well as in television, both nationally and internationally. The City of Malmö has gained a lot of experience the past years thanks to the PV installations made so far and has several successful reference objects to show.

## COMMUNITY INFORMATION

**Project leader company:** Malmö City, Department of internal services

**Other project company:**

**Project's www:** [www.solarcity.se](http://www.solarcity.se)

**Contact address:** Solar City Malmö,  
Nordenskiöldsgatan 17  
211 19 Malmö  
Sweden

**Annex 1 – Barriers**

## Potential Barriers to Residential Grid-Connected PV Systems in Canada

- |  |  |
|--|--|
| 1. Building permits                      | 11. <i>Exporting to the grid</i>   |
| 2. Neighbourhood architectural covenants | 12. <i>Metering</i>  |
| 3. Roof loading                          | 13. System cost, financing   |
| 4. <i>Equipment approvals</i>            | 14. Insurance  |
| 5. <i>Appropriate switchgear</i>         | 15. Residential property taxes   |
| 6. <i>Electrical contractor training</i> | 16. <i>Industrial property taxes</i>   |
| 7. <i>Inspector training</i>             | 17. <i>Interconnection approval process</i>  |
| 8. <i>Antiquated CE Code</i>             | 18. <i>Electric industry regulations (Electric Utilities Act, Power Pool, EUB, System Settlement Code, Wire Owner, Energy Retailer, Load Settlement Agent)</i> |
| 9. <i>Wire Owner personnel</i>           |  |
| 10. <i>Wire Owner operations</i>         |  |

**Most of these barriers are basically related to some aspect surrounding training!**

***Blue (Italic): Issues related to the electric power industry.***

## Annex 2 - PV Community Database Template and Sub-tables

### PV community database template

<b>BIODATA</b>	PV community name
	Kind of urban area <i>(see Sub-table A)</i>
	Main building type in community <i>(see Sub-table B)</i>
	New/Retrofit/Added <i>(see Sub-table C)</i>
	Type of project <i>(see Sub-table D)</i>
	Start of operation
	Location/City, state, etc.
	Country
	Latitude
	Longitude
<b>PV SYSTEM CHARACTERISTICS</b>	Total PV power
	Number of houses/buildings
	PV power per unit
	Energy yield per year
	Main PV system type <i>(see Sub-table E)</i>
	Main PV application type <i>(see Sub-table F)</i>
	Main PV module type <i>(see Sub-table G)</i>
	Main PV cell type <i>(see Sub-table H)</i>
	PV module manufacturer/brand
	Inverter manufacturer/brand
	Investment for PV systems
<b>OWNERSHIP</b>	Building owner
	PV owner
	PV energy user
<b>PHOTO</b>	Photo
	Copyright
<b>PV COMMUNITY DESCRIPTION</b>	PV Community Brief
	Grid issue
	Urban planning and architectural issues
	Economic / financial issues
	Other remarks
<b>COMMUNITY INFORMATION</b>	Project leader company
	Other project company
	Project's www
	Contact address

**Sub-table A: Terms of 'Kind of urban area'**

Residential	- urban - village - other
Commercial	- urban - sub-urban - other
Public	- university campus - other
Mixed	
Other	

**Sub-table B: Terms of 'Main building type in community'**

Houses	- single houses - attached houses - multi-story apartment buildings
Non-residential buildings	- 1 floor - 2 floors - 3 or 4 floors (low rise) - 5 to 12 floors (mid rise) - >12 floors (high rise)
Other buildings	
Structure – non-building	
Farm	

**Sub-table C: Terms of 'New/Retrofit/Added'**

New district/community	- building integration - non-building structure
Retrofit	- building integration - old area with new building
Added	- separately to the building

**Sub-table D: Terms of 'Type of project'**

Commercial project
Demonstration project
Experimental

**Sub-table E: Terms of 'Main PV system type'**

Grid-connected	- demand side - supply side
Off-grid	- professional application - rural electrification
Other	

**Sub-table F: Terms of 'Main PV application type'**

Inclined roof	- integrated - integrated: PV roof tiles - mounted - transparent roof - unknown other or mixed
Flat roof	- integrated - mounted & ballast fixing - mounted & mechanical fixing - unknown other or mixed
Façade	- integrated in fixed sunscreens - integrated in glass system (no see through) - integrated in movable sunscreens - integrated other - mounted - transparent PV façade - unknown other or mixed
Structure	- arcades - building structures with PV: roof - building structures with PV: other - non-building structures
Unknown and other applications	

**Sub-table G: Terms of 'Main PV module type'**

Framed	- regular module - transparent module
Laminates	- regular laminate - transparent laminate
PV building elements	- PV roof tile - other
Mixed	
Unknown	

**Sub-table H: Terms of 'Main PV cell type'**

Crystalline silicon	- mono - multi - unknown other or mixed
Ribbon silicon	
Amorphous silicon	
CdTe	
CIS	
Other	
Mixed	
Unknown	





