Carrots, Sticks and Tambourines:

How Upper Austria became the World's Leading Solar Thermal Market

LAND OBERÖSTERREICH

OEKOENERGIE CLUSTER

O.Ö. ENERGIESPARVERBAND

Authors of this publication
Christiane Egger
Christine Öhlinger
Bettina Auinger
Brigitte Brandstätter
Gerhard Dell

Copyright and further information
O.O. Energiesparverband
Landstrasse 45, 4020 Linz, Austria
+43-732-7720-14380, office@esv.or.at
www.esv.or.at
www.oec.at
ZVR 171568947

www.esv.or.at

Carrots, Sticks and Tambourines:

How Upper Austria became the World's Leading Solar Thermal Market

List of contents

Solar energy

Solar energy is free and available in practically unlimited quantities. The installation of a solar thermal system ensures independence, stable energy costs and is environmentally friendly.

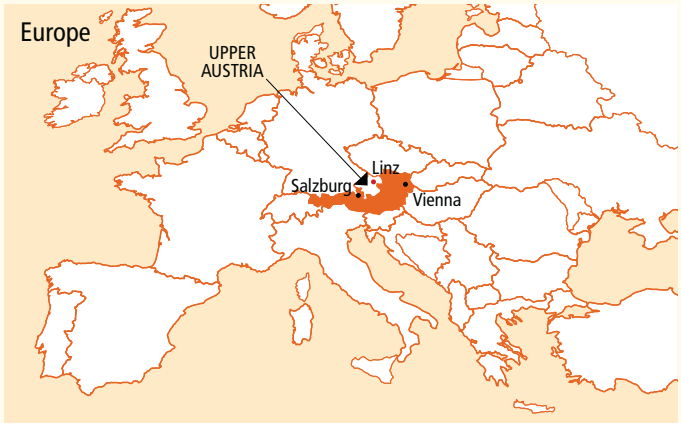
Solar thermal systems are commonly utilized for producing domestic hot water but are increasingly being configured to provide space heating as well. In the future, solar process heat and solar cooling will also play a more prominent role.

Upper Austria has a leading position in Europe with 0.7 m^2 of collector surface per inhabitant compared to 0.062 m^2 of average surface in the rest of the European Union. More than 1 million m^2 of solar collectors are installed in this region with 1.4 million inhabitants. Solar market development in the region is supported by a state energy strategy and an action plan which targets 3 million m^2 solar thermal collectors by 2030.

The O.O. Energiesparverband is the energy agency of Upper Austria which also manages the state's sustainable energy business cluster (the Okoenergie-Cluster).

Upper Austria – key facts

- **Country:** Austria
- **Population:** 1.4 million
- **Surface area:** 12,000 km^2
- **Capital city:** Linz (population: 190,000), situated on the banks of the Danube



The region of Upper Austria

Upper Austria is one of Austria's nine federal states and is located in the northern part of the country, bordering Germany and the Czech Republic. The region is highly industrialized and accounts for more than 25% of national exports. Upper Austria's primary industrial sectors include machinery, automotive industries, metal production, wood processing, information/ communication technologies, and renewable energy. Upper Austria has enjoyed steady economic prosperity, and has had the lowest unemployment rate of all Austrian states during the past 10 years (at consistently below 5%). Upper Austria's Gross Domestic Product (GDP) is 44,748 million €, which ranks it second in Austria behind the state of Vienna.

Climate

The climate is temperate continental (mean temperatures: 13.9° C daily high, 5.9° C daily low).

Sunshine hours

Upper Austria	1,770
Berlin	1,738
Rome	2,583
Washington, D.C.	2,601
Boston	2,739
San Francisco	3,037

Renewable energy in Upper Austria - an economic engine

Since the mid-90s, the government of Upper Austria has prioritized energy efficiency and renewable energy. Renewable energy currently supplies more than 33% of the total primary energy demand in the state, of which 15% comes from hydro power, 15% from wood biomass and about 4% from solar and other renewable energy sources.

The impressive share of renewables in the energy mix was achieved through comprehensive regional energy action plans that laid the foundation for more than a decade of steady progress. Building upon the success of its policies to date, Upper Austria has set a target to meet 100% of its electricity and space heat demand with renewable energy sources by 2030.

The O.O. Energiesparverband, the state agency for energy efficiency and renewable energy, supports the state government in developing and implementing these policies. The O.O. Energiesparverband also manages the "Okoenergie-Cluster", the network of renewable energy and energy efficiency companies in the state. There are currently 150 companies and institutions in the network, which employ more than 6,200 people and generate annual revenues of more than 1.6 billion € (~ 3.5% of state GDP).

Although the network members represent the full spectrum of sustainable energy products and services, Upper Austrian companies are leaders in the fields of automatic biomass heating, solar thermal energy, and high-efficiency building technologies. In recent years, companies in these fields have experienced strong growth and have added more than 500 new in-state jobs.

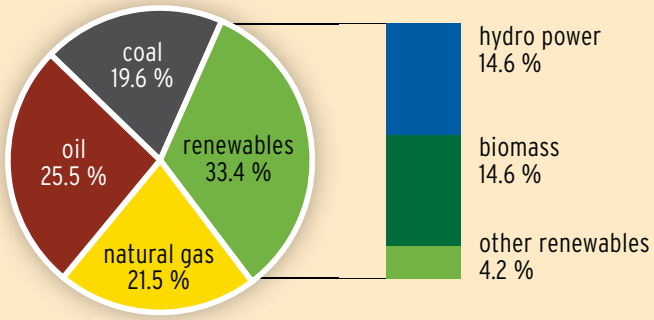
Renewable energy sources in Upper Austria

- **Share of renewable energy sources:** 33.4% of total primary energy demand
- **Share of renewable heating:** 45.6% of total heating demand
- **Share of renewable electricity:** 78.4%
- **Annual investment in new installations:** 210 million € (of which 50 million is in solar thermal)
- **Avoided CO_2 emissions:** 7.4 million tons per year
- **Avoided imports of fossil fuels:** 1 billion € per year

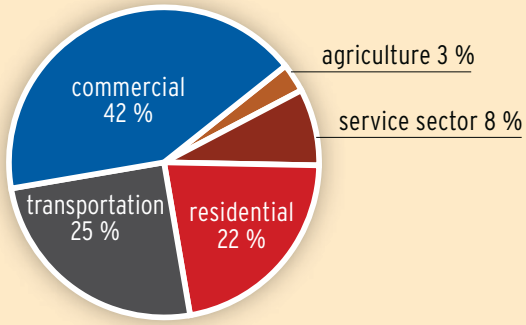
data: 2009

Energy production and consumption in Upper Austria

Energy Sources



Energy Consumption per Sector



Solar thermal market development in Upper Austria

Solar thermal has always been considered an energy technology of strategic importance in Upper Austria: solar energy is free and available in unlimited quantities.

Solar thermal systems meet several policy objectives:

- they stabilize volatile energy costs
- they promote energy independence by replacing fossil fuel-based systems
- they contribute to climate and environmental protection

Given these benefits, Upper Austria has consistently supported solar thermal market development through a grant program that has been in operation - without interruption - since 1981, making it one of the longest-running renewable energy programs in the world.

Driven by state support and a very active solar thermal industry, solar thermal has become a standard solution for the housing sector in Upper Austria. The state is one of the leading solar thermal regions in the world, with 0.7 m^2 of solar thermal installed per capita, Upper Austria has committed to installing 3 million m^2 of solar thermal by 2030, which will equate to 2.2 m^2 per capita.

Solar thermal targets in Upper Austria

2000 - 2010	1 million m^2	achieved in May 2009
2010 - 2030	3 million m^2	

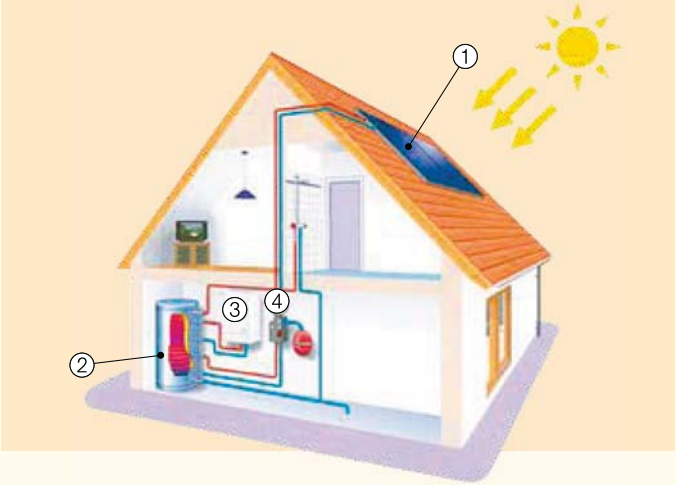
Total solar thermal surface areas installed per capita (2009)

Upper Austria	0.765 m^2
Austria	0.430 m^2
Germany	0.155 m^2
United Kingdom	0.008 m^2
European Union	0.062 m^2

The primary solar thermal application in Upper Austria is domestic hot water, although solar systems are also used for space heating in the spring and autumn. Solar systems are also becoming increasingly popular in recreational and tourism buildings such as hotels and sport centers.

How does solar thermal heating work?

Solar thermal systems capture the heat of the sun and use it to drive a range of heating applications. Solar radiation is collected by systems that are typically rooftop mounted, and the resulting heat is conveyed to a heat transfer medium. The heated medium is used directly, or indirectly by means of a heat exchanger, to transfer the heat to its final destination.



Main components of a typical solar thermal system in Upper Austria

① Solar collectors
Glazed flat-plate collectors are the solar thermal system design dominant in Upper Austria (both in production and use). These collectors are encased in a weather-proofed, insulated box that contains a dark absorber plate under a transparent cover.

Unglazed flat-plate collectors are mostly used for solar pool heating in Upper Austria. They have a dark absorber plate, are typically made of plastic, and do not have a cover or insulation.

Evacuated-tube solar collectors, which consist of parallel rows of transparent glass tubes, have a vacuum between the absorber and the covering to minimize convection losses. These systems have only a small market share in Upper Austria (around 2%).

② Storage with integrated heat exchanger
A dedicated storage tank stores the hot water from the solar collector for use at times with less sun or increased demand. A heat exchanger - which is integrated into the buffer storage - transfers heat from the hot water which comes from the collectors to the water which flows into the home.

③ Backup system
Solar thermal systems generally do not cover 100% of the heating needs of a building and therefore require a backup system for cloudy days or periods of high demand. Typical backup strategies include using the building's conventional heating system or using a dedicated electric heating system to replace the normal solar contribution.

④ Circulating pumps & heat meters
A non-freezing heat-transfer fluid is circulated through the collectors and the heat exchanger using high efficiency pumps. Heat meters allow for system performance monitoring.

When installing a solar thermal system, the following requirements should be met

- an appropriate site for the collectors, which means that they can be oriented south, southeast or southwest, are exposed to minimal shading, and can be installed to have a tilt of 30°- 50°. Systems can be façade-integrated, with a tilt of 90° (i.e. vertical), but this results in a reduction in output of about 30% over optimally oriented systems.
- appropriate system size, depending on the fraction of thermal demand to be covered by the solar collectors.
- space for a storage tank (including space sufficient to transport it into the building)
- installation of a solar performance meter
- the use of certified collectors only (e.g solar keymark)
- design, installation and regular maintenance (every 2-3 years, more often for large-scale installations) performed by a qualified company

Typical solar thermal applications

Single-family homes

Single-family homes are the largest market for solar thermal in Upper Austria, and more than 50% of all new homes install a solar thermal system. The average residential solar thermal system is 13 m² in size.

Domestic hot water heating is the primary solar thermal application in Upper Austria, but 62% of all new systems are also configured to supply space heating in spring and autumn (so-called "combi-systems").

Other popular applications include swimming pool heating (using unglazed collectors), pre-heating water for washing machines and dish washers and warming cold basements in summer months.

In low-energy homes (which are required by the building code in Upper Austria) energy demand for space heating is the same order of magnitude as for domestic hot water.

Example: New low-energy home (150 m² in size, 4 occupants)

		Annual energy demand
Hot water consumption	2.5 kWh/ person and day	3,650 kWh/ family and year
Space heating requirements	25 kWh/ m² and year	3,750 kWh/ family and year

Parameters for cost-efficient solar thermal systems for single-family homes in Upper Austria

Hot water production:

- daily hot water demand: 30 – 50 litres per person
- required collector size: 2 m²/person (flat-plate)
- storage volume: 2 – 3 days hot water demand, 60 – 80 litres/m² collector

Space heating:

- high-efficiency buildings with heating loads below 50 kWh/m² and year
- a sufficiently large site, ideally with an incline of 55 – 65°, or facade integration
- sufficient space (height) for storage tanks
- dimensions (for flat-plate collectors, excluding hot water):
  - collector area: floor area (m²) x 0.07 (typically 16 - 20 m² of collectors)
  - storage: 50 litres per m² collector area (typically 1,000 – 1,500 litres hot water storage tank)

Apartment buildings

Solar thermal systems are particularly well-suited for supplying hot water in apartment buildings. Larger, centralized solar thermal systems are a cost-effective solution because the construction costs per square foot of collector area decrease as system size increases.

The recommended system sizing in Upper Austria is 2.5 m^2 per apartment or 1.5 m^2 per unit in assisted living facilities. Starting in 2008, new apartment buildings in Upper Austria are eligible for housing subsidies only if they install a solar thermal system. Installed collectors must have the "Solar Keymark" certification, a European solar thermal quality certification scheme, and must be monitored by solar heat meters.

Public & institutional buildings

Upper Austria and its municipalities count on solar energy: a large number of public buildings are equipped with solar thermal systems, especially in establishments with consistently high demand for hot water, such as nursing homes, hospitals, sports centers and boarding schools. In fact, legislation mandates that solar thermal energy (and other renewable heating resources) must be given priority for hot water and space heating in the construction or renovation of public buildings.

Currently, there are 26 solar thermal systems with a total surface of 1,308 m^2 operating on state buildings, and more projects are planned. In 2006, a pioneering solar cooling system was installed on the new state administrative office in the town of Rohrbach (further information on solar cooling and this project at page 19).

Hotels, restaurants, and swimming pools

The demand for hot water in hotels and restaurants is usually highest when the sun is out. Large-scale installations that can supply about 30 – 50% of the demand are very cost-effective. Solar thermal systems are also profitable for preheating indoor and outdoor swimming pools, and unglazed solar collectors typically have a 3-5 year payback.

Furthermore, many companies are finding that their customers appreciate efforts to "go green" – so solar thermal also makes sense from a marketing point of view. In Upper Austria, more than 100 hotels and restaurants have already installed solar thermal systems.

Business & industry

The possibilities for using solar thermal systems in business and industry are varied: apart from hot water and space heating, there is a considerable potential of solar thermal in the area of low temperature process heat.

Process heat is required for a wide range of activities such as drying, washing, bleaching, dyeing, and pasteurising, and can also be used to pre-heat boiler feed water.

Examples from Upper Austria

Single family homes

Family home in Ried

- application: hot water
- collector surface area: 7.4 m²
- storage: 400 litres
- solar fraction: 57%
- annual solar output: 2,589 kWh
- main heating system: oil
- installed cost: 5,900 €
- incentives (% of system cost): 31%

Family home in Perg

- application: hot water, space and pool heating
- collector surface area: 28.21 m²
- swimming pool serves as storage
- solar fraction: 15%
- annual solar output: 15,960 kWh
- main heating system: natural gas
- installed cost: 16,000 €

Family home in Thening

- application: hot water, space heating, solar cooling
- collector surface area: 36 m²
- storage: 6,000 litres
- solar fraction: 50%
- annual solar output: 7,380 kWh
- main heating system: wood pellets
- installed cost: 24,000 €
- incentives (% of system cost): 13%

Family home in Schwertberg

- application: hot water, space heating
- collector surface area: 25.2 m²
- storage: 3,000 litres
- solar fraction: 28%
- annual solar output: 9,500 kWh
- main heating system: cord wood
- installed cost: 18,500 €
- incentives (% of system cost): 18%

Family home in Lichtenberg

- application: hot water
- collector surface area: 14 m²
- storage: 500 litres
- solar fraction: 73%
- annual solar output: 3,610 kWh
- main heating system: oil
- installed cost: 10,000 €
- incentives (% of system cost): 21%

Family home in Grein

- application: hot water, space and pool heating
- collector surface area: 49.43 m²
- storage: 3 x 5,000 litres
- solar fraction: 75%
- annual solar output: 14,130 kWh
- main heating system: district heating system
- installed cost: 36,000 €

Apartment buildings

Apartment buildings in Leonding

- 83 apartments
- application: hot water, space heating
- collector surface area: 230 m²
- storage: 11,000 litres
- solar fraction: 43%
- annual solar output: 84,450 kWh
- main heating system: district heating
- installed cost: 105,500 €
- incentives (% of system cost): 27%

Apartment building in Steyr

- 40 apartments
- application: hot water
- collector surface area: 62 m²
- storage: 2,600 litres
- solar fraction: 29%
- annual solar output: 23,420 kWh
- main heating system: oil
- installed cost: 37,200 €
- incentives (% of system cost): 30%

Solar City apartment building

- 151 apartments
- application: hot water, space heating
- collector surface area: 392 m²
- storage: 49,000 litres
- solar fraction: 17%
- annual solar output: 125,000 kWh
- main heating system: district heating
- installed cost: 180,000 €

Lenaupark apartment building in Linz

- 163 apartments
- application: hot water
- collector surface area: 439 m²
- storage: 19,000 litres
- solar fraction: 52%
- annual solar output: 200,000 kWh
- main heating system: district heating
- installed cost: 175,000 €
- incentives (% of system cost): 39%

Noitzmühle apartment building in Wels

- social housing
- 296 apartments
- application: hot water
- collector surface area: 112 m²
- storage: 4 x 1,500 litres
- solar fraction: 60%
- annual solar output: 50,000 kWh
- main heating system: natural gas
- installed cost: 68,000 €
- incentives (% of system cost): 50 %

Examples from Upper Austria

Hotels & restaurants

Hoisn Restaurant

- application: hot water, space heating
- collector surface area: 80 m²
- storage: 5,000 litres
- solar fraction: 75%
- annual solar output: 20,500 kWh
- main heating system: oil
- installed cost: 70,700 €
- incentives (% of system cost): 30%

Franzl im Holz Restaurant

- application: hot water, space heating
- collector surface area: 40 m²
- storage: 2,500 litres
- main heating system: cord wood
- installed cost: 21,500 €
- incentives (% of system cost): 38%

Mostheuriger Gassner Restaurant

- campground, restaurant, cider production
- application: hot water, space heating and cider production
- collector surface area: 20,26 m²
- storage: 2,000 litres
- solar fraction: 28.2%
- annual solar output: 7,536 kWh
- main heating system: automatic wood chip boiler
- installed cost: 12,000 €
- incentives (% of system cost): 34%

Hotel Haagerhof

- application: hot water, space heating, swimming pool
- collector surface area: 50 m²
- storage: 2 x 1,400 litres
- solar fraction: 50%
- main heating system: wood chips
- installed cost: 25,000 €
- incentives (% of system cost): 30%

Hotel Almesberger Mesical & SPA

- application: hot water, space heating, swimming pool
- collector surface area: 157 m²
- storage: 3 x 1,500 litres
- solar fraction: 50%
- annual solar output: 70,000 kWh
- main heating system: oil
- installed cost: 48,000 €

Public & institutional & commercial buildings

Frankenburg sports center

- sports center and public swimming pools
- application: hot water for showers and pool heating
- collector surface area: 150 m²
- storage: 2 x 2,000 litres
- solar fraction: 69%
- annual solar output: 62,000 kWh
- no other heating system
- installed cost: 80,000 €
- incentives (% of system cost): 45%

Vocational college in Linz

- vocational college for plumbers and metal workers
- application: hot water, space heating, swimming pool
- collector surface area: 46 m²
- storage: 3 x 3,000 litres
- annual solar output: 12,000 kWh
- main heating system: district heating
- installed cost: 75,800 €

Water rescue services in Nußdorf

- application: hot water, space heating
- collector surface area: 34 m²
- storage: 3,000 litres
- solar fraction: 40%
- annual solar output: 13,500 kWh
- main heating system: oil
- installed cost: 26,000 €
- incentives (% of system cost): 40%

Christkindl assisted living facility

- application: hot water
- collector surface area: 150 m²
- storage: 3 x 2,000 litres
- solar fraction: 43%
- annual solar output: 70,000 kWh
- main heating system: oil, biomass district heating

Einfinger metal working

- application: space heating
- collector surface area: 180 m²
- storage: 47,000 litres
- solar fraction: 44%
- annual solar output: 22,220 kWh
- main heating system: heat pump
- installed cost: 69,300 €

Helmberger farm

- farm and single-family home
- application: hot water, space heating
- collector surface area: 54 m²
- storage: 3,000 litres
- solar fraction: 22%
- annual solar output: 13,520 kWh
- main heating system: wood chips
- installed cost: 25,000 €
- incentives (% of system cost): 15%

Solar thermal sticks, carrots and tambourines

Solar energy plays an important role in the renewable energy mix of Upper Austria. The state has successfully driven its transition toward a solar economy by using a comprehensive plan since 1994.

To achieve its ambitious goals, Upper Austria has developed policy packages for different target groups. These packages consist of financial incentives (mostly investment grants), legislation to remove administrative barriers and to mandate installation obligations, and promotional activities (energy advice, outreach campaigns, training). The types of support mechanisms can be thought of, respectively, as carrots, sticks, and tambourines (see figure below). Most support mechanisms are adopted for the long-term: the solar thermal grant program, for example, has been in place continuously since 1981.

The O.O. Energiesparverband is in charge of implementing many of these programs and providing related services.

"stick"

Legal measures

- Renewable heating mandate
- Simplification of permission procedures
- Minimum requirements heating & cooling
- Inspection of heating systems

"carrot"

Financial measures

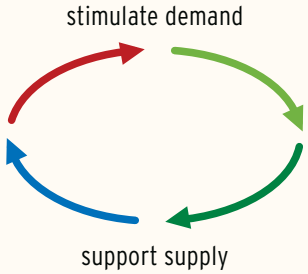
- Investment grant programs
- Solar thermal as a program requirement
- Pilot projects, contracting, regional R&D program

"tambourine"

Information & training

- Energy advice
- Training & education programs
- Publications, campaigns & competitions
- Local energy action plans
- Sustainable energy business network

Policy Packages



Source: Christiane Egger

Main policy instruments

Financial support & quality requirements

The primary incentive for the solar thermal market has been a residential grant program that has been in place since 1981. Upper Austria now provides incentives for a broad range of solar thermal installations beyond just those for residential systems.

Examples of current incentive levels include:

- 2,100 € for a 10 m^2 installation on a private home
- 200 €/m^2 for multi-family homes & assisted living facilities
- 8,000 € for a 50 m^2 solar system on a commercial building

Quality assurance is an important element of all programs: the installation of a solar meter (measuring the output of the solar system) is a requirement for all subsidized solar installations. Performance monitoring empowers end-users to understand, assess and compare the output of their systems. In most programs, only collectors that have been certified with the Solar Keymark (a European quality scheme) are eligible.

Solar mandates & simplified permitting

Since 1999, all new or renovated public buildings must use solar thermal or another renewable thermal technology for heating and hot water. Since 2008, all new private sector buildings larger than 1,000 m^2 must also use renewable energy for heating and hot water.

All new apartment buildings that participate in the state housing subsidy program must install a solar thermal system (at a minimum of 2.5 m^2 per apartment). New homes that receive funding from the state housing program (i.e. 95% of all new single-family homes) must also install a renewable heating system. The only fossil fuel-based heating systems that are allowed are gas condensing boilers, which must be combined with a solar thermal system of at least 4 m^2 in size.

The state action plan also simplified the permitting procedures for installing solar thermal systems. For any system smaller than 20 m^2, no permits are required, whereas larger systems need only be reported to the building authority. There are no permitting fees.

Billboard campaign "Use the heat of the sun"
(500 large-scale billboards in Upper Austria in summer 2007 and 2008)

Advice, information & awareness campaigns

The O.O. Energiesparverband supports homeowners, public agencies, and businesses with **energy advice** when they are making building or energy-related investment decisions. Each year, the O.O. Energiesparverband provides 15,000 free face-to-face energy consultations to homeowners and public agencies. Businesses must pay 25% of the cost of their own energy consultations, with the remainder covered by state and federal funding.

The O.O. Energiesparverband has also carried out a number of **information campaigns** to promote solar thermal utilizing the media, billboards and other advertising strategies. Competitions have also proven to be a powerful tool for drawing people's attention to solar thermal. **"Solar leagues"** have been organized in which municipalities have competed for the highest amount of solar thermal capacity installed per capita. Successful solar thermal photo competitions have also been carried out.

Promotial material
produced by the O.O. Energiesparverband

Education & training

A vibrant solar thermal market requires a **highly skilled workforce** across the entire value chain - from equipment manufacturers to contractors that design, install and service solar systems.

The **Energy Academy,** which is managed by the O.O. Energiesparverband, offers more than 30 technical training seminars on sustainable energy every year, many of which cover solar thermal. The target groups include companies that manufacture renewable energy and energy efficiency technologies, public agencies, architects, HVAC designers and installers, energy managers in companies and institutions, energy service company staff, energy auditors, and others interested in the sustainable energy field.

The 2010 curriculum of the Energy Academy includes, for example, a specific training program on solar thermal for businesses and apartment buildings, which require skillsets beyond those needed for residential installations.

One of the main challenges encountered in all emerging solar thermal markets is that heating contractors generally lack confidence in, and knowledge of, solar thermal systems. As a result, many contractors may not offer solar thermal systems, or may actively discourage potential clients from investing in them. To overcome this market barrier, a vocational training for **"eco-installers"** was developed in cooperation with the state school for installers that allows young professionals to specialize in renewable energy systems at the beginning of their training. The curriculum includes designing, installing, and servicing solar thermal, biomass and geothermal heat pump systems. More than 200 installers have been trained in this program in the last few years.

Support to solar manufacturers

Several state programs support solar collector manufacturers. The most important is the **"Okoenergie-Cluster",** a renewable energy and energy efficiency industry network in Upper Austria that supports business development, networking and cooperation, joint marketing, and export activities. A regional R & D program supports product development and ensures the competitiveness of the solar industry in Upper Austria.

Success factors for solar thermal programs & action plans

- **"policy packages"** (consisting of a mix of regulatory, financial and training/awareness programs) are likely to deliver the fastest market growth by stimulating demand for solar thermal systems while simultaneously supporting the development of cost-effective and good-quality products

- clearly defined **quantitative targets,** supported by well-developed action plans, give confidence to solar thermal businesses

- regular **market intelligence** is necessary to understand progress, communicate success, and take corrective action when necessary

- quality is key: **solar metering,** combined with a well-recognised **quality standard** (such as Solar Keymark), is crucial for sustainable solar thermal markets.

- understanding and effectively **communicating the benefits** of solar thermal market growth is critical (e.g. stable and predictable energy costs for the next 20 years, local employment, climate and environment protection, energy affordability, etc.)

- as a starting point, the **most promising market sectors** for solar thermal (e.g. single-family homes, apartment buildings, assisted living, sports facilities, hotels, etc.) should be targeted in a way that takes the quantity and timing of hot water demand, the availability of current funding programs, and the relevant decision making processes into account

- despite the fact that the largest potential for solar thermal is in existing buildings, it is generally easier to **start with new construction,** and then to move to renovation after an initial learning period. Solar thermal in new buildings is usually simpler to implement and often less expensive to install than it is in existing buildings

- **demonstration programs** (e.g. the first 10/100/1000 solar thermal systems in a specific market segment) are very useful, especially if the findings are used to design training and funding programs

- **training** needs to be proactively offered to all actors along the value chain as a part of any policy package; it should target producers, installers and users of larger systems

- **local solar information campaigns** can be very helpful to kick-start markets, especially for private homes or public buildings

- **a longer term perspective** on market development, which takes into account the learning curves of different market actors and the expansion of production and installation capacities, is important for developing a healthy industry. In the long run, it is better to have only a few installations in the first years that work well than it is to risk faulty installations during rapid market growth.

Solar thermal innovation

Technical innovation is critically important to solar thermal market development, and to businesses competing in the global solar thermal marketplace. A state R & D program in Upper Austria, known as the Energy Technology Program (ETP), supports innovative projects aimed at increasing energy efficiency and the use of renewable energy. In total, 24 solar thermal R & D projects, totalling over 2 million €, were supported by this program over the past few years.

An R & D center - the Austrian Solar Innovation Center (ASiC) - was also established to support in-state solar companies in their research activities. Current research projects include new collector development, large-scale solar thermal plant designs, solar cooling, and thermal storage. The ASiC boasts a solar R & D laboratory and is also an accredited Solar Keymark certification body.

Examples for solar thermal innovation

Solar thermal R & D projects

- product development, focusing for example on increased output, new collector materials, optimized glazing, and combined biomass-solar thermal systems
- optimization of production processes for solar collectors (e.g. automation, production technologies)
- thermal energy storage projects
- optimized building integration (e.g. into facades, novel mounting systems)
- solar testing methods, standards and services
- demonstration projects (e.g. solar cooling, solar district heating, different storage solutions)

Solar cooling

Solar energy can also be used for cooling: the energy produced by the solar thermal system is converted by a chiller into cooling energy. Two systems are used (closed and open systems): closed systems ("cold water concept") which are based on the same concept used for refrigerators (the solar system replaces the compressor pump, usually either absorption or adsorption chillers are used). Open systems ("cold air concept") use air instead of fluids (dessicant systems).

The hot days that drive demand for cooling are the same days that offer the maximum possible solar energy gain. In many cases, the same solar thermal system can serve three purposes: water heating, space heating, and cooling. In general, solar cooling only makes economic sense for efficient buildings.

Even though the solar cooling market remains small (a few hundred systems are installed in Europe), solar thermal stakeholders in Upper Austria have recognized its strategic importance. Several companies now offer products and services for solar cooling. The state government has also installed the first solar cooling system in the region on one of its buildings.

Examples from Upper Austria

Office building in Rohrbach

- office building of the state administration
- application: hot water, solar cooling
- collector surface area: 124 m²
- absorption chiller: 30 kW
- storage: 2 x 4,000 litres
- solar fraction: 25% (heating), 13% (cooling)
- annual solar output: 39,600 kWh
- main heating system: natural gas condensing boiler
- installed cost: 262,500 € solar cooling system, 138,300 € solar collectors

Kreuzroither Metallbau in Schörfling

- office building and production of façades, energy façades, windows
- application: space heating, solar cooling
- collector surface area: 160 m²
- adsorption chillers: 2 x 7.5 kW
- storage: 15,000 litres
- solar fraction: 41%
- annual solar output: 15,000 kWh
- main heating system: natural gas
- installed cost: 285,500 €
- incentives (% of system cost): 12%

Solar process heat

While the market share for residential and commercial solar thermal applications is increasing across Europe, solar process heat remains in its infancy.

The potential for solar process heat, however, is enormous: about 30% of the total industrial heat demand is at temperature levels which can be provided with commercially available solar thermal collectors (i.e. below 100°C). The greatest obstacle to faster market growth is system economics, but technical and information barriers also exist.

Upper Austria is aiming to be a pioneer in this sector by implementing an ambitious market development strategy within the framework of a European Union funded project. The focus of the project is on industry processes that require hot water at temperature levels below 50°C, such as for industrial washing processes, baths, and raw materials production.

Examples from Upper Austria

Leitl Beton

- production of building materials
- application: solar process heat for drying of prefabricated concrete components
- surface area: 315 m²
- storage: 3 x 12,000 litres
- solar fraction: 30 %
- annual solar output: 157,500 kWh
- main heating system: oil
- installed cost: 75,000 € (storage not included)
- incentives (% of system cost): 44 %

Eisvogel Hubert Bernegger

- fish farming, processing and trading
- application: solar process heat for fish processing
- surface area: 44 m²
- storage: 2,500 litres
- main heating system: heat pump
- installed cost: 30,000 €
- incentives (% of system cost): 19%

Solar thermal district heating

Biomass district heating systems are a success story in Upper Austria. More than 300 such systems have been built in the last 20 years, with a total installed capacity of 225 MW and an annual heat production of 78 GWh. These systems supply heat to approximately 8,000 buildings.

Most of the systems were built and are operated by cooperatives of forest owners from local farming communities. The district heating projects create a market for local forestry residues, which in turn ensures a steady supply of biomass fuels.

In the summer months, when heating demand is limited to domestic hot water, the combination of biomass and solar thermal in district heating systems can be an interesting solution. In well-designed systems, the biomass boiler can be switched off (thereby ensuring a much longer life-time of the equipment) and valuable biomass fuels can be saved for other uses.

Examples from Upper Austria

Solar biomass district heating in Saxen

- biomass district heating cooperative, supplying 20 buildings with heating and hot water
- application: supply of district heating grid
- surface area: 300 m²
- storage: 24,000 litres
- solar fraction: 70% (hot water in summer), 12% in total
- annual solar output: 110,000 kWh
- main heating system: wood chip boiler
- installed cost: 78,000 €
- incentives (% of system cost): 50%

Biomass district heating "Almtalwärme"

- biomass district heating cooperative, supplying 220 buildings with heating and hot water
- application: supply of district heating (in support of the biomass boiler)
- surface area: 225 m²
- storage: 20,000 + 28,000 litres
- annual solar output: 70,000 kWh
- main heating system: wood chip boiler
- installed cost: 80,000 €

Ensure quality & performance of solar thermal systems

Solar Keymark

The Solar Keymark is the most recognized quality label for solar thermal products in Europe. To obtain the Solar Keymark label, the collector has to be tested at an accredited test laboratory, for example, by the ASIC in Wels (Upper Austria). Physical inspections of keymarked products are carried out every second year, and checks on the quality management system documentation are performed annually.

In Upper Austria's funding programs for apartment and commercial buildings, only collectors with Solar Keymark certification are eligible. For private homes, the financial support is reduced if collectors without Solar Keymark are used. A list of certified collectors and more information is available at: www.estif.org/solarkeymark

Solar heat metering

As a result of Upper Austria's climate, all solar thermal installations require back-up systems in order to cover hot water and heating demands during periods without sufficient sunshine. As these systems usually operate automatically, the owner does not get continuous feedback on the performance of the solar system and thus may be unaware that the system is not working well for a long period of time. Therefore, the funding programs in Upper Austria require that a solar heat meter be installed. These meters serve the dual purpose of encouraging better products and improving the design and installation of solar thermal systems.

A solar heat meter costs about 200-300 €. The meter is mounted in the return flow and connected to the control system. On the display screen, customers can easily check the function of the solar system via readings of temperatures, solar gains and operating hours.

Solar contractor guarantees

One option to ensure solar thermal system performance is to have the installer or an energy service company (ESCO) guarantee a minimum level of energy generation. This is particularly appropriate for larger systems. In most cases, the projected solar output (kWh/m^2 and year) is calculated using simulation software during the design phase, and based on the climate and hot water demand at the client's location. The actual solar gains can be metered and then compared to the predicted results.

In solar performance contracting projects, large-scale solar thermal systems can be built without any capital investment from for the building owner. An ESCO designs, installs, finances, and operates the solar thermal system, while the building owner or user buys solar energy at a fixed price.

Solar thermal industry

A grassroots solar thermal movement, combined with innovative entrepreneurs and long-term state policy support, has resulted in a vibrant solar thermal industry in Upper Austria.

Over the last few years, solar thermal has grown into a flourishing part of Upper Austria's economy. In 2009, the in-state solar thermal industry produced approximately 300,000 m² of solar collectors. The export share of these companies amounts to over 70% of their production. Austrian collector manufacturing companies play an important role on the European market - more than a third of all solar collectors installed in the European Union were "made in Austria".

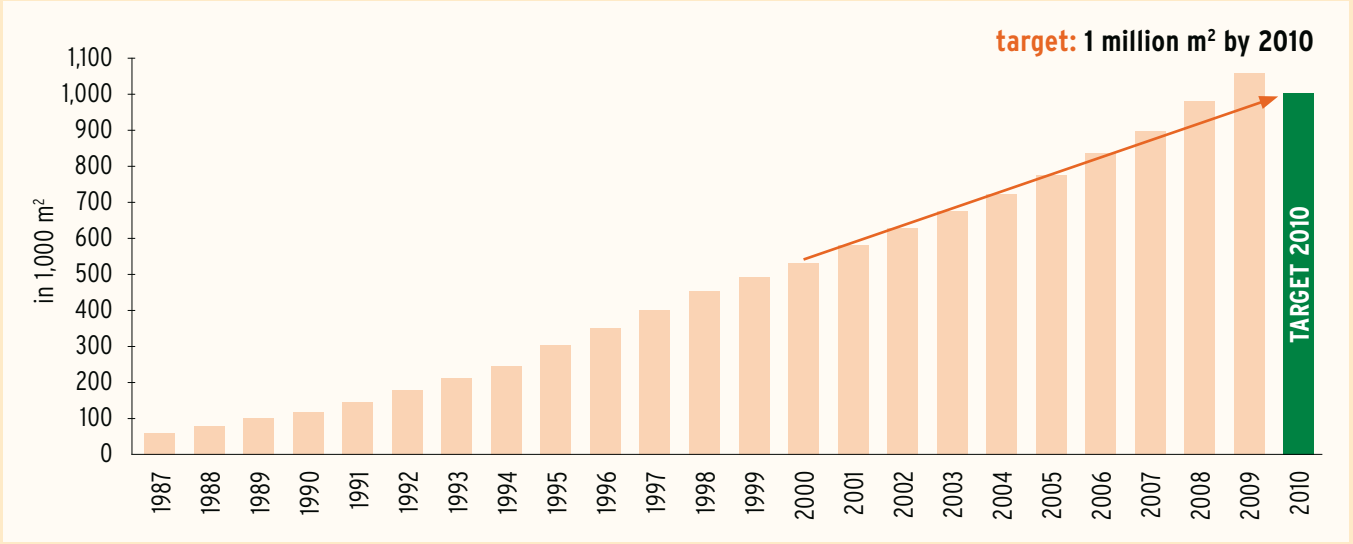
The most important market for solar thermal in Austria is single-family homes (67% of the installed collector area in 2009). However, of growing interest are apartment buildings (21%), followed by industry applications (7%) and hotels and restaurants (5%).

For nearly a decade, all heating installers have included solar thermal in their product and service portfolio in response to customer demand. The transformation in contractor services and consumer awareness has been supported by industry training programs, the vocational school for installers, energy awareness campaigns, and counselling services provided by the O.O. Energiesparverband.

Solar thermal business in Upper Austria

- **revenue in 2009 (from production, sales, installation):**
  - 125 million €
  - 300% increase since 2002
- **employment in 2009 (from production, sales, installation):**
  - 1,800 jobs
  - 200% increase since 2002
- **annual investment in solar thermal:** 50 million €

Solar thermal in Upper Austria (installed, cumulated)



Upper Austria's solar thermal market has seen a steady growth in the last decades. Currently, there are more than 1 million m² installed (this target was set for the end of 2010 but was already reached in May 2009).

The "Okoenergie-Cluster"

The "Okoenergie-Cluster" plays an important role in supporting industry development. Solar collector manufacturers, installers, ESCOs, designers, architects and many other stakeholders cooperate in this network to improve products and services, and to increase solar thermal market share. Activities include joint promotional campaigns, export activities (for example, market exploration tours or group stands at trade shows in new markets) and training activities. The network is managed by the O.O. Energiesparverband on behalf of the state government. In total, more than 150 companies are partners of the network which employ more than 6,200 people and achieve a turnover of more than 1.7 billion €. More information, including a product and partner database in English, can be found at www.oec.at.

Solar thermal manufacturers in Upper Austria

	Main products & services	Export countries	
Gasokol	solar thermal systems for heating and hot water: solar collectors and complete solar systems, storage tanks and solar cooling systems	European Union, US, Central & South America	www.gasokol.at
SOLution	complete solutions for heating and hot water: solar thermal systems, heat pumps, storage systems, solar cooling and photovoltaics	European Union, Australia, US, Central & South America	www.sol-ution.com
Sun Master/ Xolar	OEM producer of solar thermal collectors and absorbers	European Union, US, Central & South America	www. sun-master.at
Solarfocus	CPC ("Compound Parabolic Concentrator") collectors, swimming pool heating collectors, storage tanks and biomass boilers	European Union	www.solarfocus.at
SunWin Energy Systems	OEM producer of solar thermal collectors for on-roof and roof-integrated installation	European Union	www.sunwin-energy.com
SOLARier	solar thermal collectors for hot water and heating	European Union	www.solarier.at

World Sustainable Energy Days & trade show Energiesparmesse

The World Sustainable Energy Days are an annual conference organized in Wels, Upper Austria in March by the O.O. Energiesparverband. Every year, several conference topics are selected to reflect important trends; topics range from wood pellets, to solar process heat, to energy-efficient building renovation. In the last 12 years, the conference has attracted more than 10,000 participants from 98 countries. A trade show ("Energie-sparmesse") is held in parallel with the conference, and attracts 100,000 visitors and over 1,000 exhibitors, making it one of the largest sustainable energy trade shows in the world. Solar thermal is well-represented, with more than 100 companies exhibiting solar thermal products and services. Further information: www.wsed.at

Why solar thermal energy?

Solar energy is free and available in practically unlimited quantities. The installation of a solar thermal system ensures independence, stable energy costs and is environmentally friendly.

Solar thermal systems are commonly utilized for producing domestic hot water but are increasingly being configured to provide space heating as well. In the future, solar process heat and solar cooling will also play a more prominent role.

The advantages of solar thermal energy are clear:

- solar thermal systems deliver clean, safe and renewable energy
- the heat from the sun is free and does not produce any CO_2
- solar collectors have low maintenance costs and high durability
- solar space heating can extend a conventional heating system's service life while lowering energy costs

The region of Upper Austria & the O.Ö. Energiesparverband

Upper Austria is the number one solar region in Austria and also has a leading position in Europe with 0.7 m^2 of collector surface per inhabitant compared to 0.062 m^2 of average surface in the rest of the European Union. More than 1 million m^2 of solar collectors are installed in this region with 1.4 million inhabitants.

Solar market development in the region is supported by a state energy strategy and an action plan which targets 3 million m^2 solar thermal collectors by 2030.

The O.Ö. Energiesparverband is the energy agency of Upper Austria and was set up by the state government in 1991. The agency, which is funded by the state, promotes energy efficiency, renewable energy and innovative energy technologies. The agency's main target groups are private households, municipalities and businesses. The O.Ö. Energiesparverband manages the state's sustainable energy business cluster (the Okoenergie-Cluster) and cooperates with national as well as international energy institutions.

O.Ö. Energiesparverband
Landstrasse 45, 4020 Linz, Austria
+43-732-7720-14380
office@esv.or.at
www.esv.or.at, www.oec.at
ZVR 171568947

This publication is produced in the framework of the export and internationalization programme of the state of Upper Austria.

export center OBERÖSTERREICH
Eine Initiative der WKOÖ und des Landes OÖ
Hessenplatz 3, 4020 Linz, www.exportcenter.at