

# PHOTOVOLTAIC

# MATARÓ (Spain)

*Photovoltaic energy is not new technology. Although it was first discovered several years ago, there are still obstacles impeding its market penetration. One possible remedy, until new advances bring down production costs, might be mass production of solar panels or policy innovations in urban areas, with the aim of making this technology available to the public at large. The city of Mataró took advantage of the construction of a new library to experiment with this type of renewable energy and to create a prototype building to demonstrate this growing technology.*

## GENERAL ASPECTS

Mataró is a municipality located 20 km north of Barcelona, on the central coast of Catalonia. It is a city of 105,000 inhabitants, is particularly sensitive to environmental issues and actively supports projects such as the Pompeu Fabra public library.

### Climatic Data :

Yearly hours of sunshine: 2,360  
Average annual temperature: 15.7° C



## CONTEXT

In 1996, the city of Mataró joined the Charter of European cities for sustainability, known as the Aalborg Charter. Through that undertaking, Mataró joined the European campaign to initiate sustainable development, simultaneously with other committed cities. Mataró had already started the process with the publication of its Strategic Plan in 1994. The first action under these commitments was the development of policy instruments for sustainability. One major component was the Municipal Environmental Hearing that was set up in 1997. The Hearing led to a debate and the agreement of the Municipal Action Plan and the Monitoring Plan, which were proposed during the hearing, all of which gave shape to the Mataró Agenda 21.

More specifically, in the Strategic Line III, devoted to energy, of the Environmental Action Plan, Mataró undertook to develop the use of clean and renewable energy sources. Municipal actions in support of energy conservation are also being considered. These would include the drafting of a management plan for public lighting using energy-saving lamps, energy diagnoses of public buildings accompanied by improvement plans, the incorporation of low-energy systems in city buildings and an examination of energy efficiency as an important factor for the awarding of public projects. There is also a plan to promote the efficient use of energy in the various sectors of activity: the promotion of reduced energy consumption in industry, the encouragement of biofuels in public transport and incentives for improved use of energy in housing and private installations.

# EXPERIENCE OF MATARÓ

The city of Mataró has sought to demonstrate through its prototype building that the use of solar energy is not only feasible but in addition is profitable.

The project has been well received by the citizens. The city has continued to promote and support it, including via publications such as the one in Catalan entitled *The Little Story of the Pompeu Fabra Library*, which explains through pictures and an educational style how solar energy sources and photovoltaic cells work and it also touches on the virtues of solar energy.



## The Building's General Design

A library is a place where strong, high quality light must be a focus of attention. This building's design helps the public to enjoy the library's books and the knowledge they contain without any additional cost to the environment.



The building was designed with the idea of incorporating a two-fold energy system for the production of electricity using photovoltaic cells and thermal energy for purposes of space heating. The library is rectangular in shape, its principal facade, measuring 225 m<sup>2</sup>, faces south and is made up of semi-transparent multifunctional thermo-PV modules that contain blue polycrystalline silicon solar cells. The facade is semi-transparent owing to the position of the square

polycrystalline cells that leave a 1.4 cm space between the horizontal lines. This transparent horizontal band runs the length of the entire facade, thereby producing a particularly beautiful effect from the inside.

These modules are installed leaving a 15 cm space between them and the roof, which provides for a ventilated chamber that helps to cool the photovoltaic cells and at the same time produces hot air. By using natural convection, the warm air circulates wherever it is needed: during the summertime the warm air is released to the outside, thus increasing the insulation effect of the roof and in the wintertime the warm air is blown by fans into the

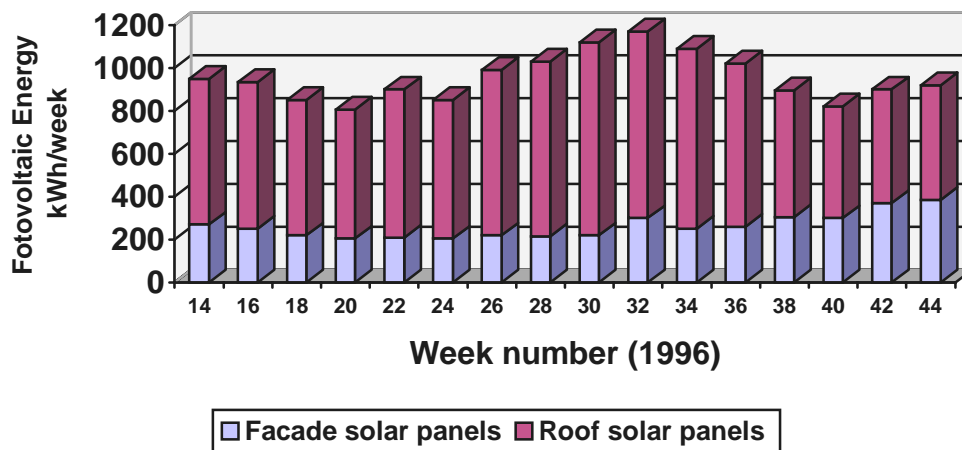


conventional heating system. This design provides energy savings of around 30%. In the roof there are 4 linear skylights measuring 4 x 94 m<sup>2</sup>. They are sloped at 37° thereby allowing indirect light to enter on the northern side. Some of the modules are made of semi-transparent amorphous silicon. Each skylight has 13 multifunctional opaque thermovoltaic modules and 6 semi-transparent ones in the central section that provide light for the entrances. There are two types of opaque modules: the first consists of BP monocrystalline photovoltaic solar cells and the second are Photowatt poly-crystalline photovoltaic cells. In both cases, the ventilation chamber is lined with insulating panels. The semi-transparent modules apply the same ventilation system as the façade and are equipped with Phototronics Solar Technik GmbH (PST) amorphous silicon solar cells enclosed in double glazing. This innovative double-glazing enclosure technology was developed by Teulades Multi-Funcionales (TFM) as part of the European Union's Joule II programme.

### **The building's energy efficiency**

The University of Barcelona, in co-operation with ZSW of Stuttgart, has developed a computerized monitoring system that enables them to gather precise data. An analysis of 7 months of data indicates that the library's photovoltaic installation operates at a 62% efficiency coefficient, which is a satisfactory rate bearing in mind the current state of photovoltaic technology.

**Weekly electricity production sold to the grid**



In the diagram we contrast energy production in the facade with that of the skylights, which differs owing to the modules' angle of exposure. Consequently, this example shows that the installation of the panels is crucial for the system's efficiency. In the winter, when the sun is low, the facade achieves a yield similar to that of the skylights, but in the summer, when the sun is high, the production of the roof's panels is nearly three times that of the facade. The building meets a large portion of its energy needs throughout the year. Two meters have been installed, one that measures the energy produced and another that measures the energy consumed by the building.

The following table shows total annual production (façade and skylights) since the start of operations on May 1, 1996 (source: the ENHER electricity company).

Period	1996 (7 month)	1997	1998	1999
Production (MWh)	29,6	40,6	47,2	42,5

This means that the building is environmentally-friendly and is also profitable; or to be more precise, it would be profitable if it were not for the high cost of this technology today. To this should be added the input from the heat production system which provides an estimated 30% savings in space heating costs.

Connection to the grid is accomplished by 2 and 5 kVA Solwex oscillators, which were selected bearing in mind their capacity, compatibility and reliability. The photovoltaic system has a maximum output of 53 kWp, i.e. 20 kWp for the façade and 33 kWp for the skylights.

## EVALUATION AND PERSPECTIVES

Today, photovoltaic electricity is still the most expensive. As long as it is cheaper to use oil and as long as society accepts pollution from fossil fuels, and even the hazards of a source of energy such as uranium, reluctance to accept photovoltaic electricity, in particular in financial circles, will persist. The electrical system installed in the Mataró library prevents the pollution caused by the 55 tons of CO<sub>2</sub>, 500 kg of SO<sub>2</sub> and 200 kg of nitrates that a conventional system would have released into the atmosphere.

Mataró is planning to build a new *Zona Esportiva Municipal del Sorral*, which is now in its initial stages. Systems and techniques for the rational use of energy, energy conservation and renewable energy will be applied in that project. Any innovation has to deal with scepticism, but projects, such as the one undertaken by the municipality of Mataró, makes optimism and with other similar projects, the city of Mataró will move forward into the future. Technological successes are necessary, but the right attitude on the part of society and the public authorities is just as crucial.

### FOR FURTHER INFORMATION

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