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## **Towards Solar Urban Planning in Europe: The project “POLIS”**

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The European Union has made from the fight against climate change and in favor of sustainability one of its main priorities in the last two decades. In the energy sector the target known as 20/20/20 has been set for the year 2020. The target aims to reduce greenhouse gases emissions by 20% compared to the 1990 levels, to supply 20% of the energy consumption through renewable energy sources and to increase the energy efficiency by another 20%. The Member States have committed to adopt Action Plans that set national targets for the use of renewable energies in the sectors of transport, electricity generation and conditioning of buildings, as well as measures to facilitate their achievement through cooperation between the local, regional and national administrations. On the hand, several municipalities have voluntarily adopted emission reduction targets which are more ambitious than the one mentioned above, advocating a greater energy efficiency and a greater use of clean energy: that is the case of the Pact of Mayors, with the participation of 41 countries, including Spain, with 754 signatory municipalities at the time this article was written.

Cities are nowadays the main focus of development as they concentrate most of the population (about 80% in Europe), goods and activities and, thereby, the energy use (75% of demand). They also concentrate the production of polluting emissions (75%). The change of the energy paradigm that the strategy to fight climate change requires to adopt, in which the renewable energies should have an important influence, constitutes both a challenge and a great opportunity for the cities to take advantage of their local resources (solar, wind, geothermal, etc.) in an efficient way. In this regard, interesting initiatives have emerged in recent years in different European cities to identify the usable solar potential through passive strategies and active technologies (solar photovoltaic and solar thermal), as well as its subsequent transformation through legislative measures. In order to present those experiences, extending its use to other cities and to introduce in the practice of urban planning objectives for solar use, the project POLIS is born at the end of 2009.

POLIS, an acronym for *Identification and Mobilization of Solar Potentials via Local strategies*, is a project co-financed by the Intelligent Energy Program-Europe (reference EIE/08/603/SI2.529237) through which six European cities have committed to develop strategies for urban planning taken into consideration solar criteria, as well as promoting local policies that allow to use the existing solar potential, in the belief that only a local strategic approach will significantly increase the integration of decentralized renewable technologies and the small scale technologies in the cities. The project, coordinated by the consultant company Ecofys, has the participation of municipalities in 5 European countries (cities of Munich, Vitoria-Gasteiz, Paris, Lyon, Lisboa and Malmö) as well as partner technical experts from various disciplines (architecture, urbanism, solar energy and environment, see table). The recipients of the project are all actors involved in the urban planning processes (local authorities, planners, architects, construction companies, investors, developers, community owners, cooperatives, etc.) both



coming from the participating cities as well from all those cities interested in knowing and using its solar potential to supply their energetic needs.

Country	City	Municipal partner + Technical Partner(s)
Germany	Munich	City Hall of Munich + Ecofys Germany
Spain	Vitoria-Gasteiz	City Hall of Vitoria-Gasteiz + Madrid Polytechnic University (Universidad Politecnica de Madrid)
France	Paris Lyon	City Hall of Paris + Atelier Parisien d'Urbanisme Agence Locale de l'Energie de l'agglomération lyonnaise + HESPUL
Portugal	Lisbon	Municipal Agency of Energy and Environment in Lisbon (Agência Municipal de Energia e Ambiente de Lisboa)
Sweden	Malmö	Skåne Energy Agency - Solar City Malmö + Lund University
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This article presents the results obtained so far by the POLIS project, information which is expected to complement in future issues of this magazine, because the project ends in August 2012. Further information on the project website: [www.polis-solar.eu](http://www.polis-solar.eu)



## **Manual of best practices for Urban Solar Planning**

An extensive compilation of good practices related to solar urbanism in European cities, classified into the following categories has been done:

1. Identification of the solar potential and definition of priorities (planning instruments);
2. Transformation of the solar potential (initiatives to use the identified potential: awareness campaigns, subvention programs, local policies, information days, cooperation with existing programs/projects, etc.).
3. Development and implementation of measures of solar planning in new or existent urban planning developments.
4. Development and approval of policies and legislative measures (eg introduction of a solar ordinance for buildings).

These experiences have been published in a handbook edited last September, which is available in different languages (English, German, French, Spanish, Portuguese and Swedish) through the project website.

## **Solar Action Plans and Pilot Actions**

The six cities participating in the POLIS project have committed to adopt long term strategies to integrate solar energy at the urban level which are compatible with the national, regional and local emission reduction of greenhouse gases targets and use of renewable energy. These strategies, called "Solar Action Plans" have been developed by working groups integrated by the municipalities and the local technical partners over several months of work. It is important to mention that, even though the cities find themselves in different situations regarding the use of solar energy (which implies differences between the different strategies adopted), they all share the common goal of introducing the use of solar energy in the urban planning processes.

In the short term, the Solar Action Plans define 63 specific measures belonging to the categories of best practices mentioned above, of which one third were identified as priority "Pilot Actions" and will be implemented throughout the project. Below the main features of the action plans and the pilot actions of the different cities are summarized.

*(Note: For more information, specific documents about the cities, their long term targets for the use of solar energy, action plans and pilot actions can be downloaded on the project website)*



## Munich

The city of Munich is one of the pioneering German municipalities on issues related to sustainability, especially in the efficient energy supply. As the owner of the municipal utility *Stadtwerke Muenchen GmbH* that provides electricity, heating, gas and water, the city has developed very interesting initiatives such as the use of district heating from cogeneration and geothermal energy, the production and marketing of green electricity, the creation of incentives for the adoption of energy saving measures in buildings, as well as the established requirements for public buildings which include the target of installing photovoltaic solar panels for generating electricity by private non-profit organizations. In relation to climate change, Munich has set ambitious targets that include progressive reductions of the CO<sub>2</sub> emissions (by 10% every 5 years and 50% in 2030) and the coverage of the electricity demand from renewable sources (the residential sector in 2015, all sectors in 2025).

Regarding the Solar Action Plan prepared by the City Council (Departments of Planning and Control of the Building Regulations) and the consultant company Ecofys, the following objectives have been defined:

- Exploit the urban solar potential for the photovoltaic use identified by the "Solar Initiative Munich" (300 MW, related to the roofs of buildings) to ensure that in 2015, 3.5% of the consumed electricity proceeds from photovoltaic systems integrated into the urban structure.
- Increase the previous percentage further by 3.5% in 2030 through measures taken at the urban planning level.
- Exploiting the solar potential for thermal use, so that in 2030 the 3% of the heating demand is supplied by solar energy.
- Ensure that, from 2012, in the new residential developments over 100 houses at least 25% of the heating demand is supplied by solar energy (passive strategies).

In the short term, the Plan includes a total of 21 measures, 2 of which are pilot actions to perform under the POLIS project, specifically:

1. Creation of a "Guide for Solar Urban Planning" (2010 -2011). The main objective of the guide is to provide a systematic assessment of plans and planning projects that allows incorporating in the planning practice specific objectives of the Solar Action Plan to ensure a use of the solar potential. The Guide will include regulations, instruments, indicators and specific criteria that provide the stakeholders (public authorities, investors and private companies) with relevant information to identify opportunities in new urban developments as well as to introduce improvements in urban regeneration projects and rehabilitation of the existing developments.
2. Application of the Guide for Solar Urban Planning in a pilot project, the new urban residential development "Bayern Kaserne" (2011-2012). This will include an analysis of the development plans to identify the solar



potential and to optimize the urban structure, the establishment of objectives, legal requirements and incentives linked to the solar use and technical assistance during the planning.



**Figure 1:** Solar heating project in the district of Ackermannbogen, Munich (Source: Michael Nagy, City of Munich)



## Vitoria-Gasteiz

Vitoria-Gasteiz is one of European cities most committed to climate change and sustainability, in fact, was recently chosen as European "Green Capital" 2012. In the past two decades the city has signed various international agreements and approved targets to reduce the energy consumption by 9% over the levels of 2004 (Local Energy Plan 2007-2012). Today, as a signatory city to the Pact of mayors, Vitoria-Gasteiz has approved the "Plan to Combat Climate Change" and is working on a Plan of Adaptation to Climate Change (2010-2020) as well as on an Ordinance for the local energy management. These documents establish the targets of reducing CO2 emissions by 24.6% by 2020 and the installation of 70,000 m<sup>2</sup> of solar thermal collectors and 10 MW of photovoltaic modules. However, the City has identified as top priority to conduct a study on the realistic possibilities of using solar energy in urban areas, both at global level and as detailed level in some areas special interest.

In particular, the Solar Action Plan prepared by the municipal departments of Planning, Environment and Sustainability, in collaboration with the Polytechnic University of Madrid has established the following objectives:

- Identify the solar potential (active and passive) at the municipal level by 2012.
- Integrate solar requirements in the new General Urban Plan and in the future energy ordinance.
- Transform 10% of the solar potential identified in the industrial and services park/polygon Jundiz by 2015.

In the short term, the Action Plan identifies 5 measures, 3 of which are Pilot Actions to implement in the POLIS project:

1. Development of a methodology to identify the solar urban potential, compatible with the local and national regulations (Technical Building Code) and its application in the district Lakua (2009-2010). The methodology, based on an analysis software tool of the solar potential developed by the Polytechnic University of Madrid, will include in a combined way the passive and active solar potential of the buildings, taking into account its location, environment (shadow effect) and its main construction features. The results will be integrated into the geographical information system of the municipality and will consist of a set of drawings/blue prints/layouts accompanied by recommendations for the use of the identified solar potential. The district of Lakua, primarily of residential character (376 hectares), is one of the priority areas for action identified in the Action Plan where the methodology will be applied for validation purposes.
2. Identification of the solar potential of the Jundiz industrial park (2010-2011). Application of the above methodology in another of the priority areas for action, the industrial and service park Jundiz (710 hectares,





located 3 km from Vitoria-Gasteiz), which currently has over 400 companies from different sectors (metallurgy, transport, chemical, timber, food processing, printing and others) as well as a commercial area (170,000 m<sup>2</sup>) and an area managed by the City Council that serves as a business incubator for start-ups business initiatives. In particular, the solar potential for photovoltaic use in the roofs of the industrial and existing buildings will be determined.

3. Identification of the solar potential of the city of Vitoria-Gasteiz (2011). The methodology developed in the Pilot Action 1 will be adapted to the entire city, identifying homogeneous urban typologies in terms of structural characteristics, applicable regulations, etc., that will be analyzed afterward using the developed tools. As in previous cases, the results will be integrated into the Geographic Information System of Vitoria-Gasteiz and will be accompanied by specific recommendations for the use of the identified passive and active solar potential.

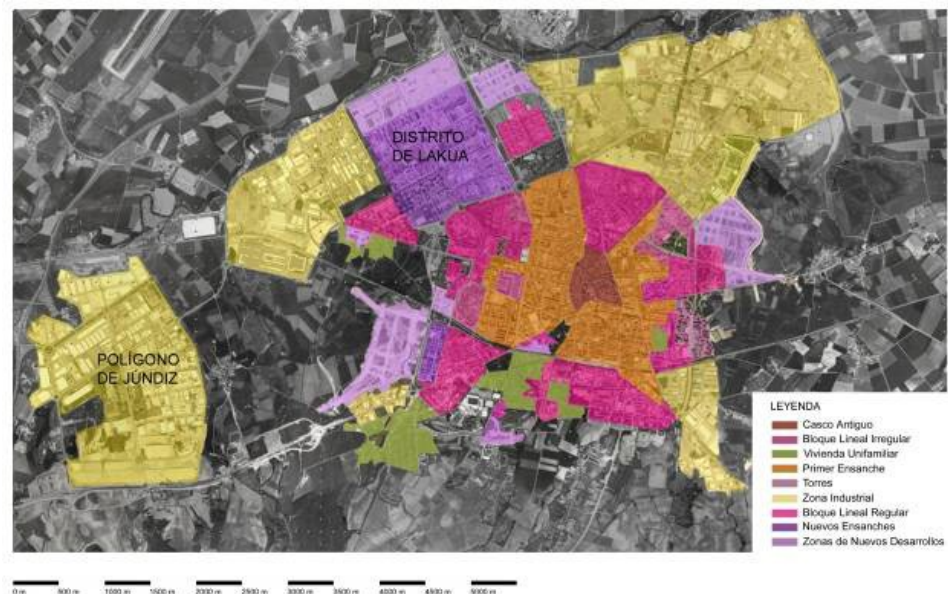


Figure 2: Vitoria-Gasteiz map with identification of homogeneous areas (Source: UPM)



## Paris

Paris adopted in 2007 a Climate Protection Plan which aims to reduce in the year 2050 75% of the CO<sub>2</sub> emissions over the levels of 2004. The plan also establishes for the year 2020 targets of reduction of emissions and energy consumption of 25% and another target for contribution of renewable energy to the consumption of 25%. At the moment, several initiatives related to the Plan are being developed in the field of solar energy, such as the establishment of environmental recommendations within the urban plans (mandatory in projects with public participation and optional for entirely private funded projects) as well as within the social housing projects (use of solar thermal energy) and within the information and awareness campaigns.

The Solar Action Plan, prepared by the City Hall of Paris (Departments of Urban Planning, Social Housing, Public Works and Urban Ecology) and the Urban Planning Agency establishes the following objectives:

- Identify the solar potential of the entire city by 2012, setting realistic targets through the integration of solar thermal and photovoltaic technologies in buildings.
- Install 200,000m<sup>2</sup> of solar thermal and photovoltaic panels by 2014.
- Establish requirements for solar use in the urban planning regulations for 2013.

In the short term, 12 measures are identified, 3 of which are Pilot Actions in the POLIS Project:

1. Identification of the technical solar potential of the entire city (2010-2012). The limited development that the city of Paris has had to date regarding solar energy is partly due to the lack of information on buildings potential. Through the improvement of an existing tool combined with the use of digital ground models (topographical representation of the of the city), data provided by Geographic Information Systems and other software tools (shading analysis, simulation of passive and active solar systems), it is intended to develop a "solar cadastral registry" to identify areas with greater potential where the new legislative actions should be oriented. The results which are offered in the form of interactive maps, will be in the first phase available to professionals in the field of urban development and renewable energies, and then to the general public.
2. Creating a tool for monitoring the solar facilities (2010-2011). Currently, the information about the existing facilities is scattered in various agencies and companies (building permits, contracts with electricity companies that buy the production from photovoltaic systems, operating agreements, etc.). The creation of a tool that centralizes the information of the current and future facilities will facilitate the tracking of the Action Plan targets and will optimize future actions in favor of the use of solar energy.



3. Establishment of solar requirements in the urban planning regulations (2011-2012). Until a few months, the local administrations in France could not dispose measures that could establish legal obligations superior than those set up by national law. This prevented the adoption of initiatives such as the solar ordinances. The approval, by mid 2010, of the new environmental law (national level) opens the possibility of incorporating solar requirements at local level, which is expected to facilitate the integration of solar systems in buildings. In this sense, a proposal to amend the municipal urban plan will be done to incorporate solar requirements in the next revision of the plan.

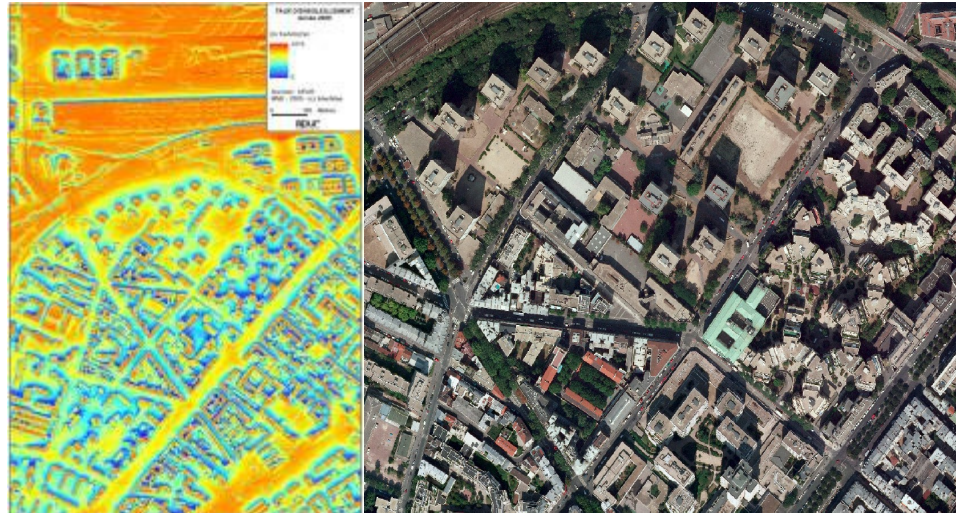


Figure 3: Methodology for identifying the solar potential: Aerial view of the analyzed zone in the District 19 and Methodology for identifying the solar potential: results

## Lyon

Like Paris, the Climate Protection Plan of Lyon shares the targets of reducing by the year 2050 75% of the CO<sub>2</sub> emissions. The plan also aims to increase, by 2020, the use of renewable energy by 20% with respect to levels of 2000. To achieve these and other targets, in recent years studies and real projects of interest such as an identification of the renewable potential in the area of *Grand Lyon* (includes 55 municipalities and a population of 1,4 million), and the project "Lyon Confluence" for regeneration of a degraded industrial area in terms of sustainability, with special emphasis on energy efficiency and renewable energies (objective of supplying 80% of the consumption needs) have been carried out. Emphasis must also be given to the public-private initiatives that facilitate investment in renewable energies and to the companies for collective investment in photovoltaic solar installations.

The Solar Action Plan of Lyon, in which the Urban Planning Agency of Grand Lyon participated together with various municipal departments, the Local Energy Agency and the organization HESPUL, defines the following objectives:

- Ensure that, from 2012, the passive use of solar energy supplies at least 20% of heating needs in the new residential developments with more than 100 houses.
- Contributing to achieve the set targets in the climate protection plan, increasing the surfaces of photovoltaic modules and solar thermal collectors currently installed in 50% and 40% per year, respectively.

In the short term, 11 measures have been defined, 3 of which are Pilot Actions in the POLIS Project:

1. Creation of an interactive tool with information about the solar potential of the district of Sainte Blaindine (2010-2011). This district, belonging to the historic center of the city, is undergoing an ambitious rehabilitation program, under which the existent solar potential in public and residential buildings was identified. The results of this "solar cadastre" will be disseminated in a public web site in order to facilitate the use of the identified potential and enhance the integration of photovoltaic solar systems in buildings, under the current legislation (bonus for renewable electricity production).
2. Promote the collective investment in solar energy facilities (2010-2011). In compact cities, many citizens do not have sufficient surface area for single installations, so the participation in a collective installation is the only alternative to invest in renewable energy. It is intended to draw lessons from the experience in France with this type of investments (results of the European project "deSOLaSOL") to facilitate the collective investment in a photovoltaic system with a minimum of 300 m<sup>2</sup>, and to develop a guide for the citizens with specific recommendations.



3. Integrating solar energy into planning documents (2010-2011). The experience gained in the "Lyon Confluence" project (funded by the European program "Concerto") has demonstrated the importance of considering energy issues since the early stages of the urban planning processes. Through this pilot action a study in an area subject to rehabilitation is intended to be conducted, comparing the resulting scenarios of using traditional methodologies that do not take into account criteria for solar utilization with other methodologies that do incorporate them.



*Figure 4: Virtual image of the "Lyon Confluence" Project (Source: Asylum)*



## Lisbon

The Energy and Environment Strategy of Lisbon, approved in 2008, has set the target to reduce by the year 2013 the energy consumption by 9% with respect to the 2004 levels. Moreover, as a signatory city to the Pact of Mayors, Lisbon has committed to reduce CO<sup>2</sup> emissions more than 20% by 2020. In order to help achieve these targets and to promote the efficient use of renewable energies, the city of Lisbon has recently introduced compulsory measures such as the architectural integration of solar panels on buildings, installation of centralized solar thermal systems for the supply of ACS in new buildings and tax incentives to encourage innovative projects that use renewable energies. On the other hand, one of the current priorities of municipal public policies is the urban regeneration and the rehabilitation at urban and building level, through the adoption of best practices combined with new technologies.

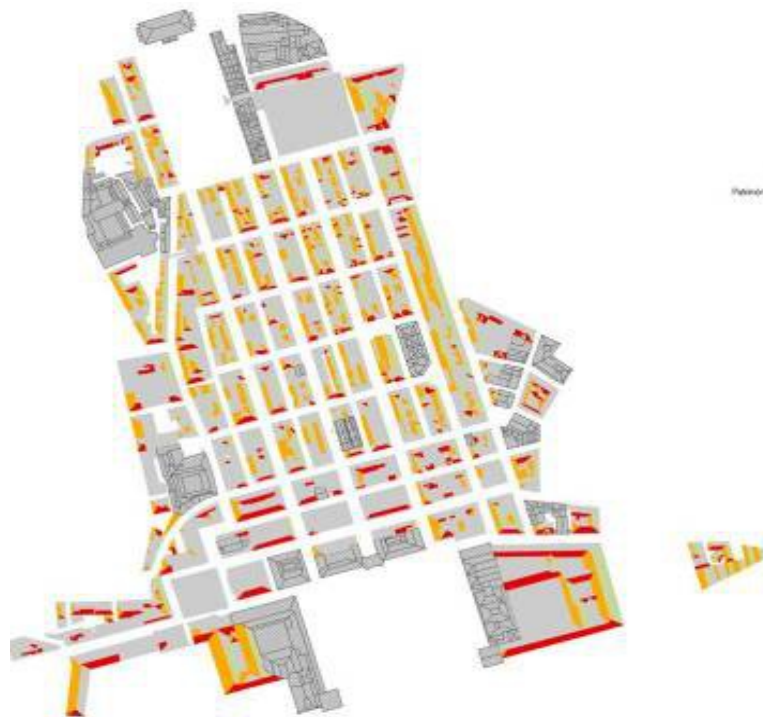
In Lisbon, as well as in Vitoria-Gasteiz, the detailed knowledge of the solar potential at urban level is still unknown and therefore, is a prerequisite for establishing specific targets of solar use and for defining public incentives policies. The Solar Action Plan, prepared by the Lisbon City Hall in collaboration with the Municipal Agency of Energy and Environment and the consultant company Wee Solutions, intends to carry out such works through 5 measures (Pilot Actions) to be carried out under the POLIS project:

1. Assessing the solar potential of Lisbon (2010-2011). Conducting a study of the solar potential for thermal and photovoltaic use, both in existing buildings and in new buildings. The study will include different levels: technical potential (available area for the location of solar panels), technological (under different scenarios of introduction of technologies), economic and market (result of considering different funding possibilities by potential investors).
2. Defining objectives for the adoption of solar technologies (2011). The results of the above mentioned Pilot Action will be used to define objectives which are consistent with the national legislation (National Energy Efficiency Plan) and local objectives (Energy and environmental strategy and the Pact of Mayors). In particular, different scenarios of incentive policies will be analyzed and an observatory of solar energy policy in Lisbon that includes solar thermal and photovoltaic technologies will be elaborated.
3. Assess the potential for integrating solar technologies in the Boavista district (2010-2012). This district is undergoing a rehabilitation program funded with national funds and the incorporation of solar technologies is foreseen. The local development plan will be analyzed to identify the existent potential according to different participation scenarios (for example, for different levels of public funding) and to identify the existing barriers to solar implementation, as well as corrective measures to overcome the identified barriers.





4. Identification of solar potential of the built patrimony of Lisbon, at the level of public service buildings (2010-2012). A detailed study of the solar potential of public buildings in the service sector with medium-voltage power supply, including technical (potential based on detailed simulations of buildings) and economic aspects (impact of public policies and incentives at national level) will be carried out.
5. Municipal training in concepts and solar technologies at urban level (2011-2012). The use of solar energy at municipal level depends largely on the ability of local technicians to detect the added value of solar technologies and their knowledge of the existing integration possibilities. Two training workshops will be done on the integration of solar technologies in the buildings and urban levels, addressed to the departments related to architecture, engineering and planning of the City of Lisbon.



*Figure 5:* Analysis of the solar potential in the Baixa Pombalina District (Source: Lisboa E-Nova)



## Malmö

Malmö is one of the most active and dynamic Swedish cities concerning targets and strategies to combat climate change, including measures related to energy, urban planning and construction, transportation, education and lifestyle. In 2009, the City Council approved relevant initiatives such as the "Energy Strategy" with the aim that by 2030 the city is exclusively supplied by renewable energy sources and adopts a model of safe and sustainable energy use. Among other initiatives is the "Environmental Program 2009-2020" that pretends that by 2020 Malmö is an exemplar city on sustainable urban development. It also important the elaboration of the "South Buildings Environmental Program (Miljöbyggprogram)", in collaboration with the city of Lund, which is conceived as a guide, technical assistance and proposal for incentives for sustainable urban development in the areas of energy, interior conditioning of buildings and urban biodiversity. Currently, this is mandatory document for urban developments located on public land; however the city Malmö aims to extend its use to developments made in private land.

The Solar Action Plan, prepared by the City Hall of Malmö (Department of Environment, Real Estate, Urban Planning and Internal Services), the Energy Agency of Escania and the Lund University includes the following objectives:

- Establish by 2012, realistic and measurable targets for the integration of solar thermal and photovoltaic technologies at urban level.
- Introducing solar requirements in the urban planning processes in 2012, complementing the legislative initiatives mentioned above.
- Carry out purchase and urban land exploitation agreements that incorporate solar requirements from 2011, using the possibilities established in the existing strategic programs (especially the "South Building Environmental Program").

In the short term, 8 measures have been defined, 3 of which are Pilot Actions in the POLIS Project:

1. Urban solar Planning in *Sege Park* (2010-2012). *Sege Park* is an urban area of Malmö, undergoing rehabilitation that is taking into account sustainability criteria including the use of renewable energies. This action aims to introduce solar requirements in the local urban plan that will facilitate the future implementation of solar energy facilities, both regarding the orientation of buildings and in relation to the possible locations of the panels. This concept, for the first time used in Malmö, is expected to be a model for other urban developments in the city, as well as for other cities with similar legislation.
2. Detailed study of the solar potential in *Sege Park* (2010-2011). The objective of this action is to develop a methodology for identifying the solar potential in the city of Malmö based on data provided by Geographic Information Systems and other tools (digital ground models and associated programs). The validation of the methodology will take





place in the area of *Sege Park*, so that the results can be incorporated in the previous pilot action.

3. Solar requirements in purchase and exploitation agreements (2011-2012). In Sweden, the municipalities have the possibility of establishing specific requirements in the agreements of purchase and of urban land exploitation. This action intends to be a pioneering experience, linking solar requirements to such agreements, in connection with the set aims of recently approved strategic programs. It is expected that this act facilitates the integration of solar energy in the planning and installation of solar systems.



*Figure 6:* Photo of Sege Park (Source: Department of City Planning, Malmö) and Photovoltaic solar facility in the Mellanhed School (Source: Anders Ekström)

## Conclusions

Six European cities have committed themselves to develop long term strategies to integrate solar energy at the urban scale, as well as specific measures in short and medium term to achieve the targets set out in these strategies. The results of the POLIS Project will be disseminated in seminars held in the participating countries during 2011 and 2012, which will be duly announced on the website of the project. Specifically, in April 2011, a seminar on Solar Urban Planning will be organized at the Polytechnic University of Madrid, with two main objectives: to disseminate methodologies for calculating the solar urban potential and to present experiences from Spain about solar planning, so that the exchange of knowledge contributes to overcome existing difficulties and so that clear objectives linked to key planning documents (General Urban Plan and Environmental Ordinances) can be established. The final challenge is to incorporate the use of solar energy in the planning documents which have a mandatory character. This will be an effective and timely solution to move from general objectives to specific actions, so that the twenty-first century city becomes a new model of generation and responsible use of clean energies.

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