

SOLAR URBAN PLANNING IN EUROPEAN CITIES

**Sigrid Lindner^a, Andreas Hermelink^a, Angela Saade^b, Estefanía Caamaño-Martín^c, Joana Fernandes^d,
Ester Higuera^c, Ignacio Useros^c, Fiorella Tortora^c**

a: Ecofys Germany GmbH, Am Wassermann 36, 50829 Köln, Germany

b: HESPUL, 114 boulevard du 11 novembre 69100 Villeurbanne, France

c: Universidad Politécnica Madrid, Avenida Complutense nº 30, E - 28040 Madrid, Spain

d: Lisboa E-Nova, Agência Municipal de Energia-Ambiente de Lisboa, Rua dos Fanqueiros, 38 - 1º 1100-231 Lisboa, Portugal

1. Introduction

With respect to the composition of buildings and urban structures the importance of solar energy is evident, since the shape of constructive structures and relevant surfaces are the basis for application of solar systems and also for receiving passive solar gains. Therefore, solar energy is more connected to the form and function of buildings than other renewable energy sources. To assure the ability of new structures fitting a solar energy supply, certain requirements need to be included in development planning and building legislation. Also existing buildings need to be qualified for the application of solar systems; the knowledge of adequate building types and structures is therefore an essential requirement to improve strategic actions to mobilise the solar potential of existing built areas. To keep the current situation in numerous cities in perspective, the planning process is missing a detailed knowledge of solar requirements concerning density, levels and orientation. As a result solar energy is added to structures matching the needs by chance.

2. Background

To ensure the viability of solar energy for new structures and existing buildings in the urban environment, certain requirements need to be included in development planning, building legislation and solar potential identification and mobilisation.

Therefore a specific approach was set up together with several European cities within the framework of a European cooperation project (Intelligent Energy) named POLIS. The aim of the project is to present and evaluate current developments and bring together key stakeholders of this process to improve planning and legislation practice towards a solar development, with the conviction that urban approaches are essential to enhance the integration of small-scale solar energy applications in the built environment. Therefore POLIS brings together local authorities with different experiences and varying states of urban development from France, Germany, Portugal, Spain and Sweden, to share their knowledge on solar town planning and encourage further activities within the scope of an expert network for cities. Several instruments are available to promote solar energy such as municipal agreements or private law commitments. Six European cities (Munich, Germany, Lisbon, Portugal, Lyon and Paris, France, Vitoria-Gasteiz, Spain and Malmö, Sweden) are cooperating in order to set up action plans and pilot actions at a local level and promote solar urban planning. The approach of four POLIS cities (Munich, Lisbon, Lyon, Vitoria-Gasteiz) and the connected pilot actions are presented within this document.

3. European cities engaged in solar urban planning

Within the framework of a cooperation project, the six cities have committed to long-term strategies to integrate solar energy at an urban level. These strategies are consistent with existing CO₂ mitigation targets in Solar Action Plans embedded in local planning. Although the cities have different climates and hence different solar strategies, a common objective is shared, namely, to steer the future development of solar energy with respect to urban planning through the assessment of existing climate strategies and targets at city levels, the evaluation of solar potential in city areas, the development of solar targets and the definition of possible measures in diverse planning areas connected to general renewable energy targets. Only a strategic approach by the municipality can enhance the increasing integration of small-scale, decentralised energy applications into the built environment.

The Solar Action Plans, developed by Local Working Groups composed of municipalities and technical partners of the project, have been developed using information about the existing local background. Each city has developed long-term solar targets, as well as identified main areas of interest (focus areas), relevant stakeholders for the implementation of solar energy in connection with urban approaches (target groups) and short-term measures to support the uptake of solar energy and reach the proposed targets. Through the cooperation of those cities that are currently engaged in solar urban planning, the mobilisation of solar urban potential can be promoted at a local level.

4. Munich - Development of a “Solar Guideline for Urban Planning”

The City of Munich has committed to meet climate protection targets as agreed in various national and international initiatives. Through the POLIS solar Action Plan the Urban Planning Department of Munich has set measurable targets for solar energy (Photovoltaic power generation measured as share of overall electric power demand in Munich: 7% by 2030 and solar thermal heat production as share of heat demand of all buildings in Munich: 3% by 2030. And from 2012 a coverage of heating demand by passive solar gains with a share of 25% in all new development areas with more than 100 housing units). A successful implementation of the POLIS solar Action Plan as well as other existing initiatives (e. g. Solar Initiative Munich) requires that actors of urban development and planning get involved in solar energy issues. In this sense, knowledge about possible instruments and methods to integrate relevant aspects of solar energy into planning practice is needed.

The development of a solar guideline for urban planning aims to facilitate a criteria-based assessment of planning documents and projects. A guideline with concrete standards, indicators, and measures makes it possible for those involved in planning procedures to identify opportunities for the realisation of solar urban development. It creates a common basis for communication with other departments, stakeholders and decision-makers. Moreover, by using indicators the degree of solar energy use can be measured and targets for solar optimised planning can be agreed. Specific topics to be covered in the guidelines are:

- Urban competitions for new development areas: definition of criteria and instruments to include solar requirements in tendering, assisting jury members in their assessment of solar aspects of projects and providing know-how for the drafting of council resolutions for the implementation of solar planning.
- Planning instruments: compilation, analysis and improvement of instruments to facilitate the aims of the solar Action Plan.
- Criteria for the sale of municipal real estate to implement solar architecture: the existing Catalogue of Ecological criteria will be extended to include aspects of solar energy use, so that the improved regulation can become part of urban contracts and other binding agreements.
- Urban regeneration and refurbishment: mobilisation of solar thermal energy use in existing buildings.
- The information needed for developing this Pilot Action is existing and planned instruments of urban planning with regard to the use of renewable energy (guidelines, expertise, manuals), information about planning procedures and links to already used instruments and fields of activities. Several software tools will be also used, such as Solarin (Shading simulation) and PHPP (Passive house planning tool).

With the proposed guideline, requirements and necessary conditions to implement strategic objectives regarding solar into urban planning and design will be effectively embedded in daily practice. The effectiveness of existing and new solar optimisation tools will also be enhanced.

5. Vitoria-Gasteiz - Methodology and Assessment of the Detailed Solar Potential of Lakua district

Vitoria-Gasteiz has signed several commitments related to energy and sustainability. In addition, due to the signing of the “Covenant of Mayors” document in 2009, the city has to adapt its targets to the new commitment of going beyond the 20% CO2 emission reduction and the promotion of renewable energies. For this reason, Vitoria-Gasteiz is currently working on a new “Fight against Climate Change Plan”, a “Climate Change Adaptation Strategy” and an “Energetic Ordinance” where new targets and actions will be set to reduce CO2 emission and promote renewable energies. A detailed study to quantify the urban solar potential is considered of highest priority within the solar Action Plan in order to identify the realistic possibilities of solar energy use in Vitoria-Gasteiz.

Besides local requirements related to solar passive and active technologies, national requirements (Technical Building Code) must also be considered in the solar potential assessment. A methodology combining both types of requirements does not exist yet. The district of Lakua (north of the city, area of 376 Has.) is one of the priority areas defined in the solar Action Plan; the results of the Solar Master Plan will be used to identify the best buildings where PV can be installed.

A methodology for the identification of the solar potential of urban areas of Vitoria-Gasteiz has been developed, which is compatible with local and national requirements (“Energy Ordinance of Vitoria-Gasteiz” draft and “Technical Building Code”). This methodology to identify the detailed solar potential is applied to the district of Lakua together with the integration of results in the Geographical Information System of the municipality. Specific tasks of this Pilot Action are:

- Methodology for the identification of the solar potential of urban areas in Vitoria-Gasteiz: analysis of local climate and identification of micro-climatic differences; analysis of the morphological characteristics of the city areas; determination of solar potential categories and assignment criteria.
- Identification of the detailed solar potential of Lakua district.
- Development of recommendations for the strategic mobilisation of the solar potential identified in Lakua district.

The information needed for developing this Pilot Action is the General Urban Distribution Plan (2007 edition) and meteorological data of Vitoria-Gasteiz. In addition, a tool previously developed by the technical partner (Universidad Politécnica de Madrid) to perform the solar potential analysis of buildings and non-building areas will be adapted to elaborate different solar maps. Complementary tools will be developed to estimate the output of solar photovoltaic and thermal installations leading to comply with local and national requirements.

The methodology for the identification of the solar potential will provide a reference framework for the city strategies related to an extensive use of solar energy in Vitoria-Gasteiz.

The detailed solar potential of the Lakua district will enable the municipality of Vitoria-Gasteiz to focus subsequent strategies for CO₂ reduction, based on the use of solar technologies in the buildings with the best potential and adequate constructive characteristics.

6. Lisbon - Evaluation of solar potential in Lisbon at parish level

Although an initial assessment has been done to extrapolate national targets for micro-production and solar thermal systems to the city of Lisbon, the definition of more specific targets for the adoption of solar technologies has to take into account the actual urban potential based on existing conditions, which is unknown yet.

A realistic assessment of the solar potential of Lisbon built environment is based on estimates of the net available roof area and solar technologies implementation ratios (e.g. solar thermal vs. PV). Geographical disaggregation will go down to the parish level, to which pertain well defined boundaries within the city. A top down approach will be followed (from technical to market potential) for both solar technologies, considered independently. Scenarios of different mixes between solar thermal and solar photovoltaic technologies will then be constructed based on the individual potentials and on policy considerations.

- For existing buildings the solar potential will be estimated in terms of technical potential (net available area for hosting solar facilities), technological potential (estimate of installable capacity and annual energy yield according to different technology implementation scenarios), economic potential (obtained from applying scenarios of willingness to pay to the technological potential estimates) and market potential (obtained from applying scenarios of affordability to the economic potential estimates).
- For new buildings, potential estimation departs from existing urban planning instruments for estimating technical potential, while applying the same methodology and scenarios as described for existing buildings when determining technological, economic and market potentials. Scenarios will be further exploited by introducing potential modifications to existing urban planning instruments. Special attention will be given to the instruments that are currently under revision. The information needed for developing this Pilot Action is data on existing building stock, meteorological data and 3D city models.

Estimation of potentials under distinct scenarios will provide the basis for the establishment of goals for solar technologies adoption in the city of Lisbon, while assisting the implied policy decision process.

7. Lyon - Solar planning scenario for a new development area

The city centre of Lyon is concerned by a large urban regeneration project called Lyon Confluence (150 hectares) that will extend the city centre by means of high-quality development projects that meet stringent quality criteria in terms of urban planning, architecture, environmental impact and landscaping. In 2004 an EU-funded Concerto program called “Lyon Confluence” was set up on this area with the aim of introducing energy considerations (consumption and renewable production) in the first phases of the urban planning. This project has made urban developers think differently about energy aspects related to the urban design and enhanced an urban rehabilitation of an area called Ste Blandine, nearby the confluence area. However, many aspects need to be improved in the Confluence project: energy considerations haven't been introduced early enough and the urban planning could have been even more adapted to solar energy.

- This Pilot Action is a follow-up to the experience of the Lyon Confluence project by giving more importance to energy aspects in the very beginning of the urban planning process. The main objective is to experiment urban planning methodologies that take into account solar radiation as the main criteria for planning, by proposing two different scenarios for an urban planning area in Lyon to be restructured (to be identified by Lyon Urban Agency):
 - The first scenario represents the usual one used by urban planners (not taking into account solar energy);
 - The second one places the optimisation of energy inputs as main criteria. The results obtained in both scenarios will be presented to the city of Lyon by the Urban manager of the area to give an alternative study of the area development. Necessary information for this Pilot Action is plans of the selected urban area and specifications of the urban developer in terms of building use. Special urban design software will be used.

This Pilot Action will allow methodologies to be developed and to be integrated into the urban planning of Grand Lyon, in order to optimise the solar contribution on a district scale.