URBAN ACCEPTABILITY OF SOLAR INSTALLATIONS:
LESO-QSV GRID, A SOFTWARE TOOL TO SUPPORT MUNICIPALITIES

P. Florio[1]; C. Roecker[1]; M. C. Munari Probst[1].

[1]LESO-PB, Laboratoire d'Énergie Solaire et Physique du Bâtiment, École Polytechnique Fédérale de Lausanne (EPFL), Station 18, CH-1015 Lausanne, Switzerland

ABSTRACT

The "LESO-QSV Acceptability" tool is a decision-supporting aid for municipalities in charge of approving new active solar installations. It does not bar any urban zone from being targeted, but requires architectural integration quality, as a function of the "criticity" of the intervention area, i.e. the architectural sensitivity of the local urban zone, combined with the visibility of the proposed solar plant on the building.

This tool includes several elements: the software "LESO-QSV GRID", a detailed description of the approach, documentation on active solar integration in architecture, and finally, an application form for new installations.

The LESO-QSV GRID program fulfils three complementary functions:

- Support municipalities to set their specific levels of required quality for the different "situations" (zones and visibility) of their territory – in practice selecting a grid (GRID).
- Educate architects, installers and building owners through a very large palette of evaluated solar integration examples (positive and negative), that can be filtered according to different criteria (context specificities, solar technology, system size, integration approach …) ,.
- Help municipalities to explain in an interactive and visually convincing way how the method works and justify potential rejections to users

The main purpose of the software tool is to simulate the effect of different severity policies (from lenient to strict) on the existing examples (more than 90 cases). These simulations allow to check in real-time which installations would be approved or rejected and to choose the most suitable severity degree for the municipality.

A difficulty in the application of this approach lays in the "objective" evaluation of the architectural integration quality of a solar plant. LESO-QSV constitutes a simplified method based on objective criteria, which have been synthetized in three questions. All examples in the software database include the answers given by experts to these three questions, allowing the user, in association with the documentation accompanying the method, to understand how to use these criteria.

Additionally, the examples of the database itself provide an important inspiration source to help realize successful architectural integrations in different configurations.

Keywords: architectural integration, BIPV, solar refurbishment, solar planning, criticity

1. INTRODUCTION

The recast of the Energy Performance of Buildings Directive – EPBD [1] pushes towards the implementation of the "nearly zero energy building" concept by stating that by 2020 "the nearly zero or very low amount of energy required should be covered to a very significant extent by energy from renewable sources, including energy from renewable sources produced on-site or nearby".

Solar energy is a key factor to meet these targets, and new technologies such as BIPV (Building Integrated Photovoltaics) and BIST (Building Integrated Solar Thermal) allow a good exploitation of solar potential in a densely built environment [2]. When cities undertake massive solar refurbishment though, the urgency of the production goals should not exempt them from trying to keep the quality of their urban, landscape and cultural environments as high as possible. The responsibility of preserving this quality within a solar expansion scenario is

- with public authorities, who need to adopt a wise incentive policy to exploit the potential of the territory;
- with solar panels manufacturers, who need to improve the market offer in terms of products for architectural integration;
- with architects and engineers, who need to deal with the energy related constraints and aesthetic impact.

Solar panels should not be considered just as pure technical components for energy production but also as architectural elements.

The LESO-QSV method [3], [4] has been developed to assist authorities on decisional, educational and urban planning aspects of solar integration. This paper focuses on the specific software tool (LESO-QSV GRID), designed to meet the first two goals in a practical way.

2. "LESO-QSV ACCEPTABILITY" TOOL

The "LESO-QSV Acceptability" tool is a decision-supporting aid for municipalities in charge of approving/denying new active solar installations. To help maximizing solar use in cities, it does not bar any urban zone from being treated, but helps users set requirement levels of architectural integration quality. The quality that is requested for a new solar plant depends on the "criticity" of the intervention area, i.e. the socio-cultural value of the local urban zone (its sensitivity), combined with the visibility of the proposed solar plant on the building.

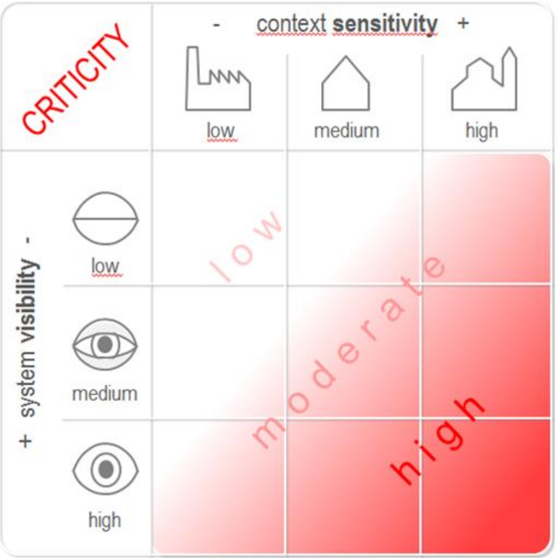

Figure 1: Criticity grid: 9 "situations" defined from 3 sensitivity by 3 visibility levels [4]

In the present method, both the architectural sensitivity of a zone and the visibility of the plant can assume 3 discrete values, high, medium or low. The combination of sensitivity and visibility values results in a 9 cells matrix, representing different "criticity" levels (*Figure 1*).

The authorities can select the minimum level of integration quality expected for each “situational cell” this process implying a way to assess this quality.

In this method, the quality of integration is evaluated through a simplified procedure, based on existing literature [5]. The coherence of the following 3 installation characteristics are judged in relation with the hosting building architecture: the shape and size of the field, the colour and texture of the materials and the modules details (size, jointing, connections). The resulting evaluation is graphically synthesized in a disk, composed of 3 sectors, whose colour depends on the coherence of the associated characteristic: green for high, yellow for medium and red for weak coherence (*Figure 2*).

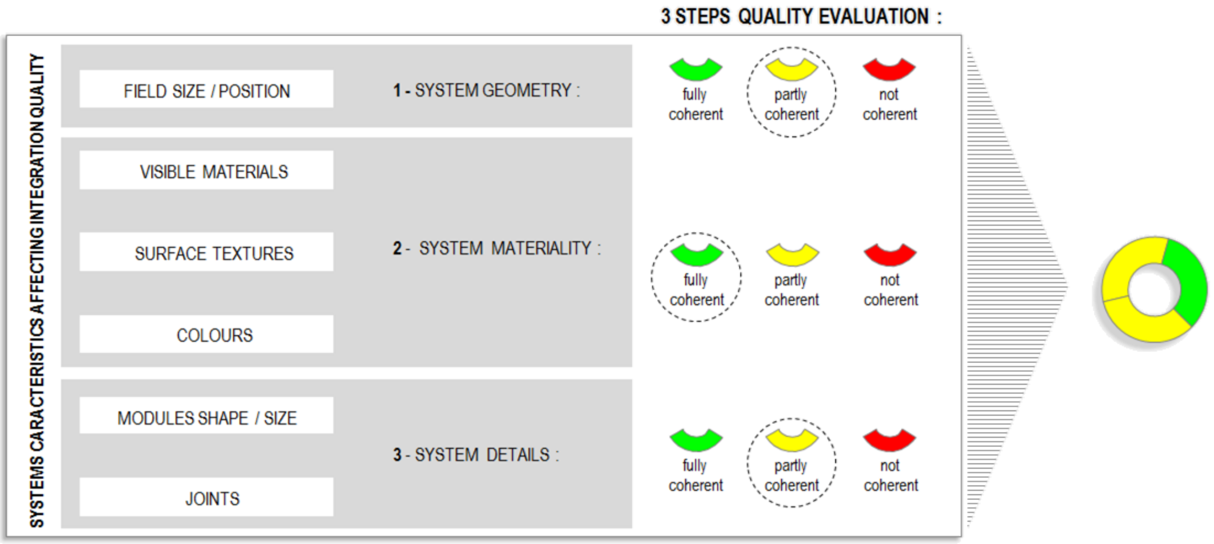

Figure 2 : “Quality disk” resulting from coherence evaluations of 3 global criteria [4]

Using this colour code, the authorities can define the level of quality they require for each “situation”. The LESO-QSV GRID tool described hereafter is designed to assist them in this process with immediate feedback as to the effects of their choices over a collection of examples.

3. LESO-QSV GRID TOOL

The LESO-QSV GRID software tool, as stated above, has been conceived to fulfil complementary functions. The first function is to act as a decisional support tool, to help the municipalities set the levels of required quality for the different configurations of “criticity” (visibility + sensitivity) on their territory, selecting acceptability thresholds for every “situation”. The second function is to serve as an educational tool by presenting several integration examples, with their positive or negative quality evaluations, in different urban contexts. These examples are provided as references for the process of quality evaluation, through appreciations given by experts, and as inspiration for architects and professionals of the solar industry.

The main window (

Figure 3) shows the acceptability grid (top right), the examples viewport (center), the detail panel (bottom right) and the selection filters (bottom left).

The software tool is in its last stages of development. A first French release is foreseen in 2015 and pilot collaborations with voluntary municipalities and local communities will be initiated in the French-speaking part of Switzerland. The functionalities and components of the tool are described in detail below.

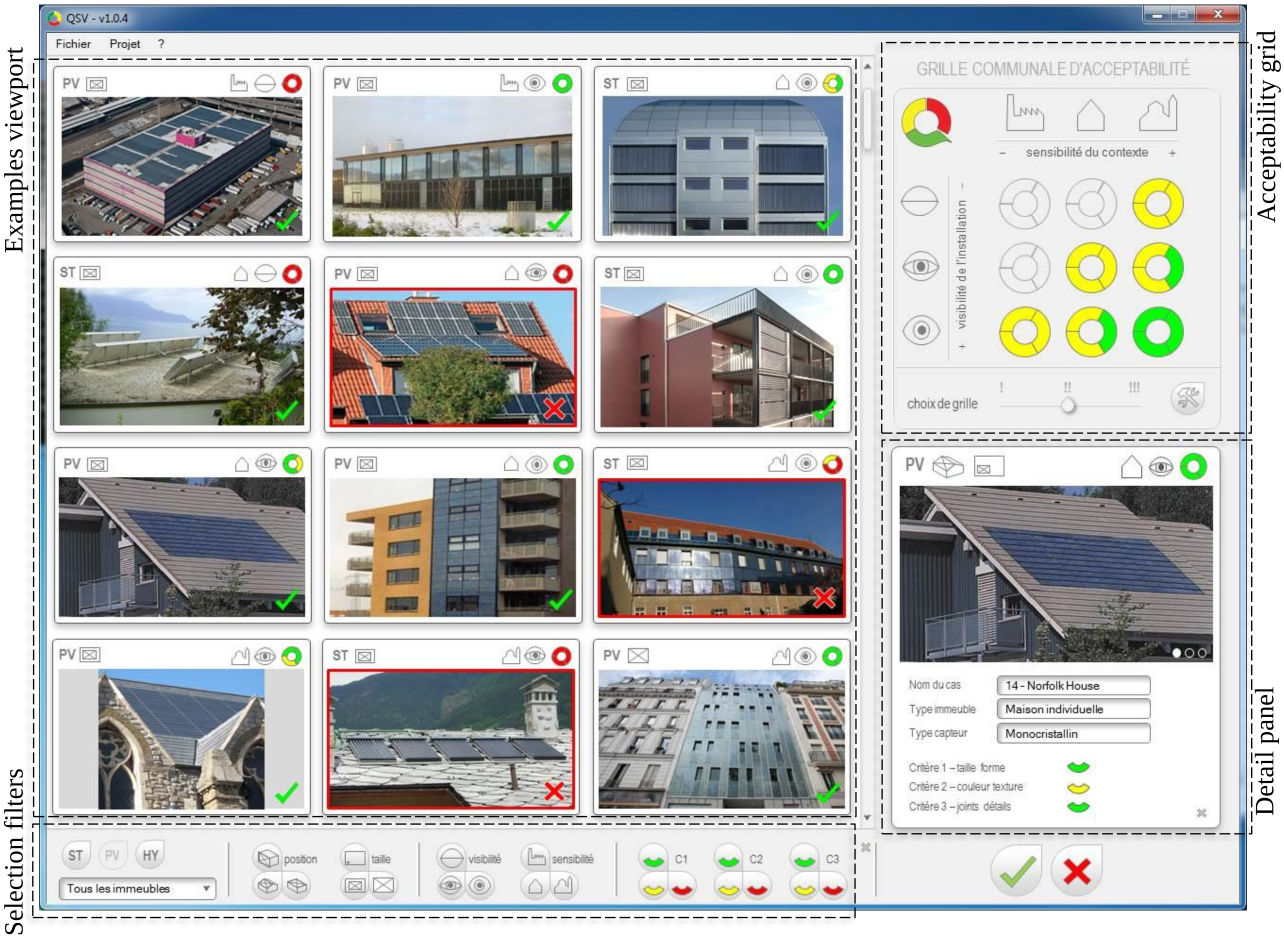

Figure 3: screenshot of the software tool LESO-QSV GRID, main window.

3.1 The acceptability grid: concept, principles and functioning

The core of the tool is the acceptability grid (*Figure 4*), which allows the users to set, for every "situation", the minimum required quality to accept a proposed installation. This grid should be defined at the municipality level by a person or group of persons entitled to manage the assigned territory and its architectural assets (municipal architects, urban planners, architectural commission…).

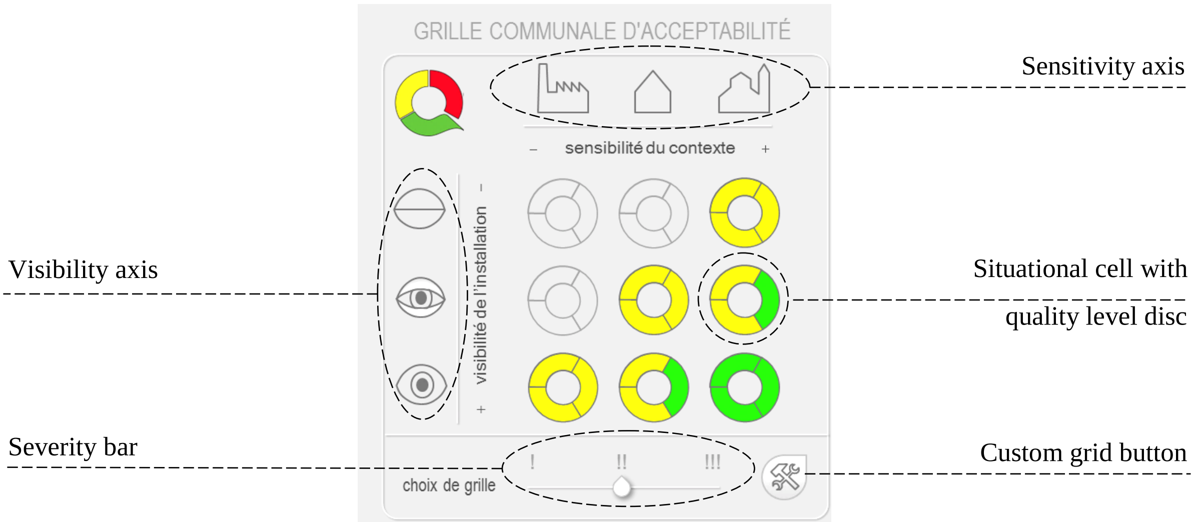

Figure 4: screenshot of the software tool LESO-QSV GRID: the acceptability grid.

The acceptability grid is based on the "criticity" matrix: the 3 sensitivity levels are indicated on the top horizontal axis, whereas the 3 visibility levels are shown on the left vertical axis, and represented by an icon each. Every "situational cell" has its own acceptability threshold, expressed through the colour code assigned to the disk sectors, considering the following conventions:

- The position of each sector does not represent any specific integration criterion, only the number of yellow and green sectors is relevant. A yellow threshold is respected by a yellow / green mark; a green threshold is only respected by a green mark.

- If the situation does not require a specific quality level, the sectors are left blank. In this case, installations with one or more red sectors will be accepted.

The 9 cells of the grid can be either independently set (custom grid), or adopted from one of 3 pre-selected grids, via the selection bar. This bar allows the user to quickly choose out of 3 "severity" degrees and check the effects on the examples catalogue (see below).

3.2 The buildings catalogue: composition and classification

The tool includes a database of both coherent and incoherent architectural integrations of solar plants, in various context and "criticity" situations, to illustrate the LESO-QSV various concepts with practical examples. The database can be fully scrolled through and twelve examples are simultaneously displayed in the examples viewport. Their main characteristics are summarized in the thumbnail showing the system picture (*Figure 5*). The quality appreciations of each example are compared to the thresholds of the selected acceptability grid and the results are instantly displayed, accepted cases marked with a green V mark, rejected ones with a red X and a red framing.

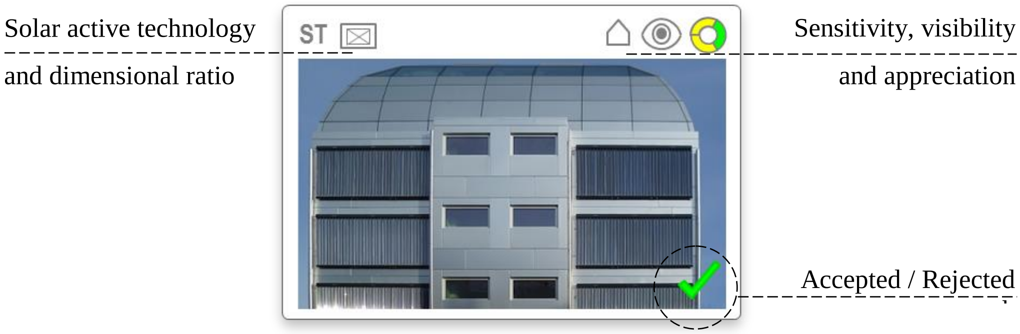

Figure 5 : screenshot of the software tool LESO-QSV GRID, case study thumbnail.

Currently the building database includes 95 sample case studies, from different European countries. Each entry of the database includes different information, the most important marked by different icons in the thumbnail picture, from left to right: the type of solar active technology (glazed, unglazed, evacuated tubes for solar thermal and monocrystalline, polycrystalline, thin film for photovoltaic); the dimensional ratio of the solar field in relation with the building support; the sensitivity of the urban zone; the visibility of the solar plant from the public space; the appreciation of the solar installation under the three criteria. Additionally some more information is available in the detail panel, by clicking on one example: the GPS location of the building site; the category of the building, as used for energy classification [6] with a mention for heritage classed buildings; the material and the type of support where the field is located (pitched roof, flat roof, skylight, glazed façade, sun protection devices, opaque façade) and finally the used products and the producer's contacts when available. By double-clicking on the picture, a pdf sheet appears with all the details, including a map of the building location, detailed pictures of the installation (when available) and a few explanation lines over the case study appreciation made by the expert evaluators.

3.3 The selection filters

The small area at the bottom of the screen allows the user to select various filters and to visualise only the cases matching the chosen features: in this way detailed considerations and studies can be conducted on targeted categories of buildings and solar plants. This feature is especially useful for an educational purpose.

4. THE AUTHORISING PROCESS WITH LESO-QSV GRID

Once the urban planners and the municipality officers have defined the acceptability grid for their territory with the software tool, they can communicate their decision to architects, installers and citizens. The chosen severity will give different acceptability thresholds in each “criticity” situation. When a citizen applies for a solar installation on his building, he will be aware of the expected quality according to the “criticity” of the site and select a suitable solution with the installer. Then, the installer will submit a form to the local authority, describing the chosen solution in detail (by attaching pictures and simple photo-edited simulations). The municipality will analyse the proposition and find whether it is compliant to the relevant acceptability threshold, by assessing its integration quality level (by using the case studies provided in LESO-QSV GRID if needed). The municipality might add its own selected case studies to create a customised database. The proposed installation is then either accepted or rejected, and a notice with evaluation comments and recommendations for improvements is sent to the applicant.

5. CONCLUSION AND EXPECTED DEVELOPMENTS

Given the huge increase of solar installations in urban settings, the presented tool, associated to the QSV-method, offers a valuable way to take into account the formal and aesthetic aspects. It can be used as a protecting tool, blocking inappropriate designs in sensitive areas, and as an educational tool, helping improve the architectural integration quality. This software, with accompanying documents and support, allows municipalities defining the conditions to control the impact of the development of solar in a built context. Further work will be devoted to the elaboration of a proactive tool to tailor solar energy policies to local urban specificities by mapping the architectural “criticity”, and crossing this map with the solar irradiation data [4].

REFERENCES

[1] *Directive 2010/31/EU of the European Parliament and of the Council of 19 May 2010 on the energy performance of buildings (recast)*. European Parliament, 2010.

[2] M. C. Munari Probst and C. Roecker ed., *Solar energy systems in architecture*. IEA SHC Task 41 D.A. 2, 2012.

[3] M. C. Munari Probst and C. Roecker, “Urban acceptability of Building Integrated Solar Systems : LESO-QSV approach,” in *proceedings Eurosun 2011*, 2011.

[4] M. C. Munari Probst and C. Roecker, “Solar energy promotion & urban context protection: LESO-QSV (Quality - Site - Visibility) Tool,” in *proceedings 31th PLEA Conference*, 2015.

[5] M. C. Munari Probst, “Architectural Integration and Design of Solar Thermal Systems,” EPFL Thesis 4258, 2009.

[6] *SIA 380/1 L’énergie thermique dans le bâtiment*. Switzerland: SIA, Société Suisse des Ingénieurs et des Architectes, 2009.