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Visual prominence vs architectural sensitivity of solar applications in existing urban areas: an experience with web-shared photos.

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Abstract

Architectural integration of solar technologies in the built environment is a challenge: one of the key tasks is the identification of homogeneous zones of intervention as a function of the solar energy potential and "criticity", a combination of the socio-cultural value of the urban context (sensitivity) and the visibility from the public space [1].
This paper explores possible relations between highly sensitive urban areas and their visual prominence in the public interest: a study is performed, as an example, in the city of Geneva. A false-color "heat map" is built through GIS techniques by extracting photo shooting locations from the Flickr public repository, and overlapped on the ISOS Swiss cartography.
This method can be used to establish a hierarchy of the viewpoints in the public space.

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1. Introduction

Solar energy qualifies as one of the most wide-spread renewable sources, and its conversion efficiency increase coupled with a reduction of installation costs [2] makes it attractive even for small applications on less exposed buildings.

A report of 2002 highlights how the solar energy potential from photovoltaic roofs and façades could cover between 15% and 60% of the electricity demand in IEA countries [3]. It is foreseen that more than half of the global PV capacity from now to 2050 will be installed on buildings, producing a little less than half the total PV electricity needed [4]. Such a massive deployment requires a rational method to properly organize the arrangement of the installations according to the site characteristics, implying a concertation between heritage protection, energy and spatial planning. A match between building energy needs, solar energy potential and site identity has to be targeted. Architectural integration quality can be a driving force to solar development through coherent strategies of refurbishment, by setting appropriate requirements within homogeneous zones of intervention [5].

This identity feature has been named "criticity" in a recent paper [1], a combination of the socio-cultural value of the urban context (sensitivity) and the visibility from the public space of the building envelope component that will potentially host the solar power plant (visibility). It is clear that a historical city center rich in cultural heritage will require a much higher architectural integration quality of the solar plants on its envelope to be commonly accepted (high sensitivity), compared to a residential post-war development area (medium sensitivity) or an industrial district (low sensitivity). Similarly, the more a building is visible from the public space, the more impact a solar plant applied on its envelope will have on social acceptance.

Currently, "criticity" has never been systematically mapped. The scope of the work hereby introduced is to propose a methodology to assess visibility levels in an urban context according to the spatial planning scale and an exemplifying framework to classify sensitivity zones. Specifically in this paper, the Canton of Geneva is analyzed as a case study for a large strategic planning area: the aim is to understand which the most visual prominent areas are, and to compare them with high sensitive areas to identify hotspots of high needed integration quality to meet social acceptance. This was made by matching a false-color "heat map" issued by the location of pictures taken in Geneva with the Federal Inventory of Swiss Heritage Sites of national importance (ISOS), as further described below.

2. Objective

Spatial planning is a complicated task that embraces different scales from large territorial areas to small neighborhoods: more and more frequently it is not a mere spatial distribution optimization, but it deals with many factors often lying outside traditional urbanism problematics, such as energy supply, facilities access, etc.

Sometimes it might be difficult to mediate among so many different competences, especially when a deep technical knowledge is necessary, i.e. for energy planning (energy sources extraction and generation, distribution, storage). Multi criteria analysis can help to achieve compromises [6] with a higher accuracy, when some criteria are somehow quantified, or translated into quantitative indicators.

"Criticity" cannot be quantified with a universal method, since it depends on the unique nature of each site and relies also on political and subjective appreciation. Some considerations can be made though, to find effective proximity indicators of sensitivity and visibility appropriate to the planning scale.

At the strategic planning level, visions and strategies to reach certain goals in the political agenda are developed and connected to land use and zoning. Priorities in urban growth, mobility axes and vocations of main areas are identified. At this scale, ranging from around 1:100 000 to 1: 25 000, buildings and neighborhoods are dissolved into districts, which represent the granularity of the map. Hence, particularly sensitive (or non-sensitive) districts are relevant as "emerging peaks" regarding sensitivity over a uniform medium-sensitive territory. Visibility instead can vary a lot from building to building and even from façade to façade, making it meaningless to estimate a "district average" visibility index. Nevertheless, it is evident that some precincts are more prominent in public perception as they are simply more frequented or because they benefit from a more focused interest by the visitors (e.g. see some patterns of interest by Cullen [7]).

This paper investigates the relation between highly sensitive urban areas and their visual prominence in the public interest, in order to identify possible matches. Highly sensitive areas are usually denser in cultural heritage and / or in