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Energy Supply for Buildings with Focus on Solar Power in the Urban Context – an Interactive Webtool for Citizens

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Abstract

Many cities nowadays offer Web-GIS applications to view data about solar potentials for buildings. However, the actual benefit of such solar data can only be investigated, if it is not considered singularly, but in combination with information about temporal appearance of energy demand (heat & electricity), type of heating system, hourly internal consumption of photovoltaic power and other aspects. Hence, the presented analysis tool addresses citizens, who are interested in the integration of solar power in buildings and would like to have an extended view on related impacts. The tool was developed within the Central Europe project „Cities on Power".

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Keywords: Solar thermal; photovoltaic; buildings; web application; heat; electricity

1. Introduction

Considering climate change and an imminent resource scarcity, also cities face the challenge of a shift towards an enhanced use of renewable energies. Today over 70% of the EU's energy is consumed in cities, whereas only a small share of that energy is generated there. The use of renewable energies in urban areas, especially of solar and ambient heat, reduces energy transport distances and therefore energy losses, creates added value and supports

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supply safety. At the same time, people are sensitized through the visibility of the deployed technologies and an increased awareness can be achieved.

Numerous applications for estimating solar potentials in cities are available. However, these services are mostly singular analyses, which supply general information about solar potentials, without assessing the actual ecologic and financial benefits of solar energy installations. Besides from solar potential web maps, there are also heating costs calculators, which serve information about financial aspects of a heating system change, such as amortization times. Yet, integrative, comprehensive calculators, which consider the primary heating system, solar installations (including detailed solar data) and electricity supply by photovoltaic (PV) are hard to be found.

In this paper, an interactive, web-enabled analysis tool for individual buildings is presented, which has been implemented within the EU project „Cities on Power“. Thereby, citizens are given the opportunity to estimate energy gains from fictional solar collectors on their buildings and to assess these in the context of an overall system configuration. An earlier prototype was already presented by Castellazzi et al. [1].

As backend for the web-based analysis tool serves a coupled, case-specific model of heat and electricity supply, in which temporal accordance of potential generation and demand is considered highly detailed, also by incorporating high resolution spatio-temporal solar irradiation data.

The focus of this model is on the combined calculation of a building's energy behavior, while we stress, that the singular model components can be scaled in terms of their complexity. A summary of these components is given below:

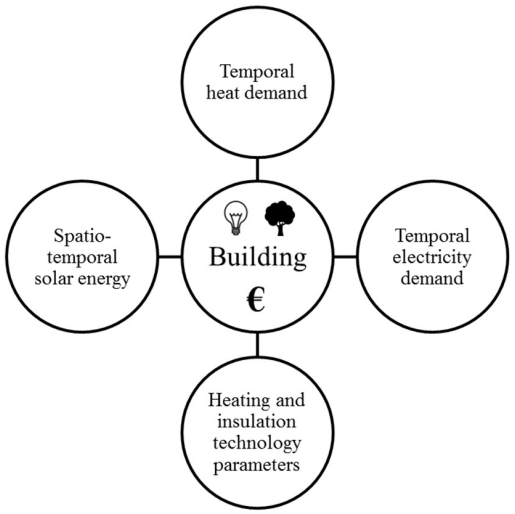

Fig 1. Components of a model to describe a building's energy behaviour

Although a singular simulation of a building's energy attributes can be conducted by executing the presented calculations (p. 3-7), the main purpose of the model is to determine changes of technical, ecologic and economic variables ($\Delta B_{energy,econ,ecol}$) through the installation of renewable energy technologies.

$$\Delta B_{energy,econ,ecol} = B_{non-renewable} - B_{renewable} \quad (1)$$

The building model is executed first for a scenario ($B_{non\text{-}renewable}$) which incorporates only non-renewable resource consuming technologies and second for a scenario ($B_{renewable}$), which also simulates the use of renewable energy technologies, combined with spatio-temporal solar irradiation data.

A wizard style web user interface enables remote access to the model. Thereby, the current status of energy supply (e.g. fossil-fuelled boiler) can directly be assessed and compared to a desired test-configuration of energy supply using renewable energies (solar thermal, PV, ambient heat, biomass, etc.) in terms of economic, ecological and technical aspects.