Energy Mapping

Summary

The term “energy mapping” is not really defined. Therefore different techniques, methods, scenarios, etc. are summarised under this term. However, on the one hand energy mapping describes (1) a comprehensive approach (e.g. status quo and potential analysis of energy supply) on the other hand it describes the (2) single description of possible renewable energy sources (e.g. solar resource assessment).

1. Comprehensive approach: One of the main challenges facing developers during the planning and design of plants for the production of renewable energy is the lack of accurate resource assessment. Energy mapping works to provide municipalities and utilities with a way to evaluate existing energy use in a community and plan to improve energy efficiency through the use of better building standards and alternative energy sources. This approach builds on accepted practices for the reduction in energy use in efficient ways such as through reduced demand for transportation, and space heating and cooling. The mapping process also incorporates the idea that to maximize the energy efficiency of urban form requires going beyond integrating transportation issues, improvements to and orientation of the built environment, as well as ensuring that “unavoidable” energy needs are met in the most effective way possible, such as obtaining the highest and best use from a given primary-energy input. Energy mapping includes the e.g. annual or seasonal energy use (electricity and/or heat) to identify neighbourhoods, building types, and building vintages with high energy consumption. However, 80 percent of the domestic energy consumption is for heat.

2. Energy mapping can also have a single focus on mapping of potentials for the use of renewable energies (e.g. roofs for installation of PV or solar irradiance models or wind farm capacities) or the energy consumption. For example a solar map is mostly an internet-based tool that helps educate and inform users about solar technology by estimating the solar energy potential of building sites or open land and providing information about associated benefits. The purpose of a solar map is to promote greater public awareness about solar energy, enable consumers to discover the solar potential of their own properties, and facilitate increased solar usage among property owners.

Mapping renewable energy resources is a crucial step in expanding investment into clean energy, by providing governments with the information necessary to strategically guide commercial development, establish pricing incentives, and take account of environmental and social constraints. Some maps were developed which show existing examples for the production of renewable energies and efficiency. Such maps create synergies in awareness rising between various energy actors and facilitates information exchange for renewable energies and energy efficiency. Energy maps are also used as main information for so called “Energy Mapping Studies” which could help local planners to integrate renewable energy and efficiency in planning procedures (see good practise examples).

Planning relevant issues

The mapping tools help planners for understanding the energy consumption of the building stock as well as potentials which can be used for sites, quartiers or regions. Mapping can
include renewable energy but also data to efficiencies - for example existing waste heat streams. Existing tools are quite different; therefore it is important to choose the right tool depending from the information needs of the planner. Often GIS systems are in use for mapping. Models can compute renewable energy potentials, energy demand, energy consumption, analyse socio-economic issues, data bases on social information, renewable energies, environmental parameters....For planners the following parameters can play an important role for planning procedures:

- Sun radiation
- Geothermal potentials
- Building stock (location)
- Building efficiency
- Infrastructure
- Demographic change
- Transportation
- Existing infrastructure
- etc.

Local authority planners can use the maps for improvements of the building stock as well as for the development of new areas. Following uses are possible e.g.

- location of new building (sun oriented)
- shape of new buildings (use of solar power)
- analysis of energy supply in the building stock
- analysis of the demand in the building stock
- analysis of potentials for increasing the efficiency (e.g. waste heat)
- analysis of potentials of integration of renewable energies (e.g. geothermal, sun, wind)
- analysis of traffic
- ...

Energy mapping results can be main content of a so called “Energy Mapping Study” studies can content the following issues (City of Calgary – see good practise examples):

1. Impact of Energy on Future Development - Why Is it Important?
2. Calgary’s GHG Goal – A Measure For Success
3. Local Energy Profile
4. Achieving Calgary’s GHG Goal Through The Built Environment
5. The Need For Alternative Energy Sources

**Details, core technical specifications**

GIS: A **geographic information system (GIS)** is a system designed to capture, store, manipulate, analyze, manage, and present all types of geographical data. The acronym GIS is sometimes used for geographical information science or geospatial information studies to refer to the academic discipline or career of working with geographic information systems and is a large domain within the broader academic discipline of Geoinformatics.

Mapping examples:
• UK-Planning Database project. It can be used for the indication of data for wind farm capacities. See: http://restats.decc.gov.uk/app/pub/map/map/

• iguess - Integrated Geospatial Urban Energy Information and Support System – from the project MUSIC: integrate energy as a layer in urban planning, it gives an insight in the energy consumption of buildings and suitable locations for energy saving. The comprehensive geospatial data and additional IT tools can be used for the development and implementation of their carbon-reductive planning and policies and to monitor the progress. With this system, cities are able to make energy maps, visualise their CO2 emissions, identify opportunities for energy exchange and monitor the effects of energy saving measures in their city. See general information: http://www.themusicproject.eu/content/gis see the iguess tool: http://iguess.tudor.lu/

• GIS grid-based map of the annual energy demand for room heating and hot water in a city. The aim of the tool is to generate a map that localises the otherwise accumulated heat demand. It is based on a polygon layer of building outlines, together with information about their heights (number of floors), their use (building type) and their age (year of construction). From this data, a grid map of heat demand densities per raster cell in MWh/a is estimated, as described in the following paragraphs. Please see the source: Dorfner, 2011 GIS-BASED MAPPING TOOL OF URBAN ENERGY DEMAND FOR ROOM HEATING AND HOT WATER


• New York City map which estimated the annual block energy consumption: http://modi.mech.columbia.edu/resources/nycenergy/ Ms. Schwartz says: "Knowing which areas of the city consume more energy could also inform future decisions about local energy generation. Maybe a landlord with some glaringly inefficient buildings will want to install some solar panels, or perhaps building tenants will band together to work on other energy-efficient options (i.e., capturing and reusing building waste heat)." Source: http://www.planetizen.com/node/54226

Figure 1: New York - Block Level Annual Energy Consumption.

Source: Modi research group, Columbia University

• Los Angeles County solar map tool from the Department of Regional Planning:
The Los Angeles County Solar Map gives every resident or business a simple and fast way to find out whether you can save money and the environment installing solar panels. The information provided includes the impacts of trees, roof features, and nearby buildings, and covers over 3,000 square miles of Los Angeles County. See: http://planning.lacounty.gov/solar/

Innovations and social aspects

For example a solar map can serve as a single place to store complete information on solar resources. Like the concept of a "onestop shop" for permitting, solar map portals can store all federal, state, and local information regarding available solar incentives and programs. Solar maps are user-friendly, allowing users to make quick and easy assessments of the solar potential of their properties. When given minimal information such as a street address, the map can instantaneously generate data about potential costs, potential cost savings through incentives and rebates, and energy usage for that property. Additionally, solar maps are interactive. They can include tools to draw potential PV-system layouts or estimate shading from nearby structures or vegetation, providing a level of detail that allows users to assess an open space on a specific property or rooftop and take into account any obstructions that reduce usable area for panel placement. Finally, solar maps generate quantifiable outputs that can inform decisions made by government officials and the general public.