Basel Energy Hub Model

Concept

IDEAS4cities (Integration of Decentralized Energy Adaptive Systems for cities) is a research project which aims to investigate the impacts and potential benefits of integrated, decentralized, energy-adaptive systems for cities. Scenario development and modeling is an important aspect of this investigation, particularly in the context of urban and rural agglomerations in Switzerland. Cost optimization models for Swiss case studies can aid in the development of long-term energy strategies to achieve various environmental, energy demand, technology, and sustainability goals.

The city of Basel has been selected as a case study in order to investigate the impacts of implementing decentralized energy strategies in an urban environment. The concept of an energy hub will be investigated, whereby a wide range of energy carriers and networks can be utilized to meet the energy needs of a community. For example, electricity, gas (natural gas, biogas, hydrogen, etc.), solar energy, hydro resources, and other energy carriers can be converted, conditioned, stored, and locally distributed in regional energy networks. Figure 1 illustrates the energy hub concept.

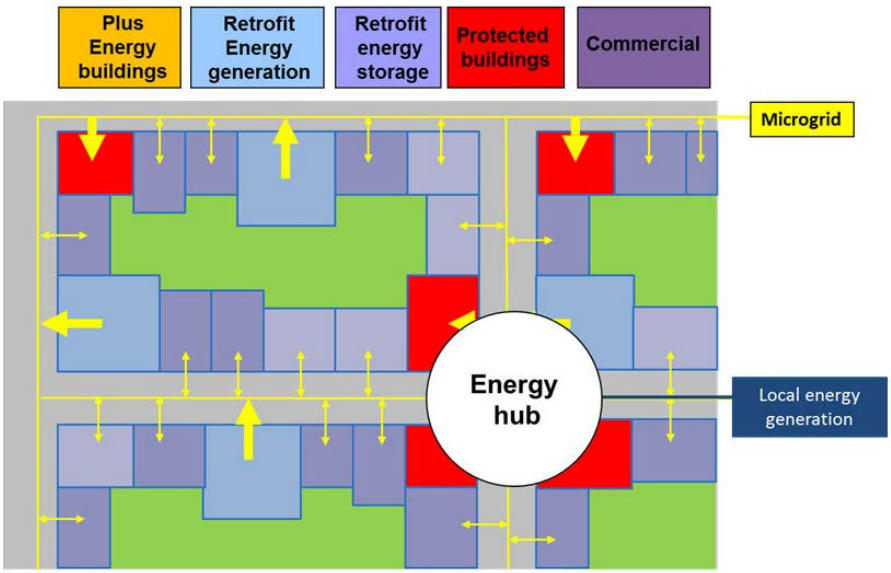

Figure 1: Energy Hub Concept

The impacts of decentralized energy strategies are to be investigated not only on a city-wide scale for Basel, but also at the level of characteristic city quarters, including historic and modern city centers.

Modeling Approach

An understanding of the interactions between city quarters can be gained by modeling Basel as a series of representative segments, covering several end-use sectors. The Basel city model will be developed using the TIMES (The Integrated MARKAL-EFOM System) modeling framework [1], [2]. TIMES is a bottom-up, energy systems, cost optimization modeling tool which provides details on

optimal capacity allocation and dispatch for given scenarios over an extended time horizon (e.g., until 2050). The energy systems model for the city will capture key components of the energy system and conversion chain. End-use energy demand includes space heat, process heat, hot water, and electricity.

A number of scenarios will be evaluated using the model, which are focused on assessing the impacts and potential benefits of integrated, decentralized, energy-adaptive systems in an urban setting. Scenarios consider various technical, environmental and policy constraints, and the model provides a cost-optimal solution which specifies the combination of technologies and fuels required to meet an exogenously given end-use demand. The model accounts for interactions across sectors, as well as competition amongst energy carriers.

Current Status

The project is currently in the phase of data acquisition and processing. The next phase includes model and scenario development. The case study is expected to near completion by the end of 2015.

References

[1] IEA-ETSAP, “TIMES (The Integrated MARKAL-EFOM System).” IEA-ETSAP, Paris, 2011.

[2] R. Loulou, U. Remne, A. Kanudia, A. Lehtila, and G. Goldstein, “Documentation for the TIMES Model,” 2005.