

SEMANCO Semantic Tools for Carbon Reduction in Urban Planning

A research project co-funded by the 7th Framework Programme of the European Union within the program "ICT for Energy Efficiency" (2011-14)

Introduction

The purpose of SEMANCO (www.semanco-project.eu) is to provide semantic tools to stakeholders involved in urban planning (architects, planners, engineers, local administrators, policy makers and citizens) to help them make informed decisions about how to reduce carbon emissions in cities. The tools are being applied in demonstration scenarios in Copenhagen (Denmark), Newcastle upon Tyne (UK), and Manresa, Barcelona (Spain).

Activities and goals

The problem of CO₂ emissions reduction cannot be constrained to a particular geographical area or scale nor does it concern a particular discipline: it is a systemic problem which involves multiple scales and domains. This systemic view is necessary for stakeholders to take better informed decisions particularly in urban planning. Nowadays, such comprehensive approach is not feasible because energy related information is dispersed in numerous databases and open data sources from different domains. Due to lack of federation technologies these data are isolated from each other and accessible only by proprietary applications fulfilling specific requirements of various tasks and domains. Thus, collaboration amongst different stakeholders involved in planning energy efficient urban areas becomes difficult since each party works with particular data sets and applications.

To solve these problems, SEMANCO has developed an integrated platform which facilitates unified access to energy related data from multiple domains and scales. Data integration is carried out using semantic technologies. The platform includes tools to visualize, simulate and assess the semantically modelled data.

The networking session will focus on the demonstration of the two major components of the project: the Semantic Energy Information Framework (SEIF) which facilitates the methods and tools to integrate data; and the integrated platform.

1. Semantic energy information framework

The main goal of the SEIF is to enable the energy assessment and analysis tools integrated within the SEMANCO platform to access the distributed data sources that hold the data they require. The SEIF mediates between tools and data sources at two levels: first, conceptually, by providing a semantic energy model shared by tools and data; and second, technically, through a federation of related data sources and answering data queries. The platform tools interrogate the SEIF by means of SPARQL queries which are devised according to the semantic energy model.

The core component of the SEIF is the semantic energy model, a formal global ontology embracing the terminology and relations needed to integrate the data sources and query them in a unified way. The ontology has been created following a methodology devised in the project based on existing methodologies such as Neon. The ontology has been coded as a formal ontology based on the *DL-Lite_A* formalism. The coding has been carried out with an ontology editor specifically created for this project (<http://semanco->

project.eu/ontology%20editor.htm). The outcome of this task has been the creation of a global ontology based on the SUMO upper-ontology encompassing 983 concepts and 789 relations implemented with 6755 axioms.

The data sources have been migrated to RDF using RDB-to-RDB technologies based on the definition of mappings between a relational database and the ontology. The mappings have been coded in R2RML language, and the SPARQL-SQL rewriter implemented is Sesame/Quest. The creation of such mappings is a complex process which involves experts from different domains having different skills. To support their work, an environment has been developed in the project which provides a graphical interface to assist non-ontology experts to implement the R2RML mappings (<http://semanco-project.eu/ontology%20mapping.htm>).

2. Integrated Platform

The SEMANCO platform (<http://semanco-project.eu/integrated%20platform.htm>) uses Semantic Web technologies to integrate data from different domains (GIS, cadastre, economic and social data) and scales (building, neighborhood, district, city) into a common urban energy model. The visualization and analyses tools operate on data interlinked through an ontology which represents the semantics of an urban energy system. Semantically represented and interlinked data is accessed by different user profiles (architects, planners, engineers, local administrators, policy makers and citizens) to take informed decisions aimed at improving energy efficiency and reduce carbon emissions in cities.

The visualization tools combine interactive 3D models, tables and diagrams. Analysis tools using data mining techniques and multi-criteria decision methods enable experts (consultants, policy makers, planners) to analyze energy performance indicators. The open structure of the platform enables an urban energy model to be enhanced when new tools and data –either from existing data sources or from the data generated by the different applications such as simulation software and assessment tools– become available. The tools integrated in the platform are being applied to in demonstration scenarios.

Networking

In February 2014, the SEMANCO project has organized the VoCamp on “Integrating multiple domains and scales” in Barcelona. VoCamps is an initiative of the European Commission carried with the support of the ADAPT4EE project. Thirty-three researchers from twenty-three institutions in Europe representing eight research projects participated in this event.

The following topics were identified in the discussions held during the VoCamp. They could also be topics to be discussed in the ESCW networking session.

1. Shared vocabularies in energy related data at building and urban level.
2. Ontology building: methods and tools
3. Ontologies and their relations with existing standards
4. Technologies for data integration
5. Applying ontologies to create urban models including multiple scales and levels of details.