Dulce Coelho, Carlos Henggeler Antunes and António Gomes Martins

MULTICRITERIA DECISION SUPPORT IN URBAN ENERGY PLANNING

Dulce Coelho: Dept. of Electrical Engineering, Polytechnic Institute of Coimbra, Rua Pedro Nunes, 3030-199 Coimbra, Portugal, INESC Coimbra; Rua Antero de Quental, 199; 3030-030 Coimbra Portugal, e-mail. dcoelho@isec.pt
Carlos Henggeler Antunes: Dept. of Electrical Engineering and Computers, University of Coimbra, Polo II, 3030-030 Coimbra, Portugal, INESC Coimbra; Rua Antero de Quental, 199; 3030-030 Coimbra Portugal, e-mail: cantunes@inescc.pt
António Gomes Martins: Dept. of Electrical Engineering and Computers, University of Coimbra, Polo II, 3030-030 Coimbra, Portugal, INESC Coimbra; Rua Antero de Quental, 199; 3030-030 Coimbra Portugal, e-mail. amartins@inescc.pt

Overview

Energy has always played an important role in the development of human societies and it is crucial to achieve the interrelated goals of modern civilizations: it helps to meet needs for cooking, lighting and heating or for transportation and industrial purposes. Energy has a prominent role in economic and social development, in the improvement of quality of life and it is a critical factor of environmental sustainability, being often a convenient measure of the liveability and sustainability of communities.

Within the framework of sustainable development, the ongoing trend for market deregulation, the increasing importance of distributed generation technologies based on renewable energy sources and the legislation emanating from the Rio Earth Summit (Agenda 21) and the Kyoto Protocol (requiring reduction of greenhouse gases), meeting the increasing demand of energy in urban areas is an issue of the highest importance.

Since sustainable urban development is closely linked to patterns of energy use and urbanization, local governments all over the world are planning and implementing more sustainable approaches to the production and energy use. Local governments have strong reasons to promote what can be considered as sustainable energy planning practices [California Energy Commission, 2005]. They can engage in sustainable energy planning in three primary ways: within their own operations (local governments are often large users of electricity in buildings and public facilities, in water systems and in other capital infrastructure such as streetlights); can promote efficient energy use and alternative resources in the private sector through their dominant role in shaping the built environment; can help shape long-term development patterns in order to promote location efficiency and reduce the effects of urbanization on the energy system and the environment in general.

In this context, we are aimed at developing a methodological framework for decision support, based on multicriteria analysis that can be used to facilitate decision making in complex Integrated Urban Energy Planning (IUEP) problems (also with impact on land use planning, waste and water management) involving multiple evaluation aspects and multiple stakeholders.

Methods

Urban Energy planning is the decision making process of selecting the preferred local energy infrastructure to invest in. Adequate energy planning gives structure and support to the decision-makers and enables them to match future energy supply with future energy demand [van Beeck, 2003]. The planning of an integrated urban energy system (comprising several energy carriers and energy distribution networks) is a complex process, with many stakeholders involved, influenced by many factors, among which the most important are the

availability of energy resources and the competition between different energy carriers in satisfying energy demand [Maria Catrinu, 2006].
Public involvement in energy decisions serves several purposes: to ensure that public values are reflected in decisions; to obtain information on impacts that might otherwise be overlooked; to inform the public; and to provide "due process" in a way that the public perceives it is fair. The achievement of these purposes helps building public support and confidence both for the decision process and its outcome [Hobbs and Horn, 1997].
IUEP is a complex process inherently involving multiple issues, multiple and conflicting evaluation criteria (economic, technical, political, environmental and social), multiple stakeholders and multiple values. IUEP can be viewed as a political process involving negotiations and trade-offs among key stakeholder groups with an interest in the planning process. Thus, decision problems arising in the realm of IUEP are well suited to be tackled using Multicriteria Decision Analysis (MCDA) methodologies.
We propose the development of a methodological framework for decision support based on multicriteria analysis that can be used to facilitate decision making in complex Integrated Urban Energy Planning (IUEP) problems (also with impact on land use planning, waste and water management) involving multiple evaluation aspects and multiple stakeholders.

Results
Multicriteria decision analysis can be effectively used to facilitate decision making processes in complex problems involving multiple, conflicting and incommensurate evaluation aspects as well as multiple stakeholders. The aim of MCDA is to improve the quality of decisions by providing a rational basis for the comparison of competing solutions, since a prominent alternative does not exist whenever multiple criteria are at stake. This is accomplish by: displaying trade-offs among criteria so that planners, regulators and the public can understand the advantages and disadvantages of alternatives; helping people reflect upon, articulate and apply value judgements, resulting in a choice, ranking or sorting of alternatives.
Decisions apparently take longer when they depend of consensus or negotiations, but if they result from a sound methodological approach, the solution to a specific problem looses importance, if compared to the benefits generated by the systemic learning process. The population, city councillors and developers can take advantage of this learning process.

Conclusions
MCDA applications in energy planning are characterized by a notable involvement of a usually large and interdisciplinary group of stakeholders. This trend is clearly observable in the literature, although their direct participation is not always achieved [Diakoulaki et al., 2006].
The planning of urban energy systems involves complex processes, which inherently have multiple issues at stake (economic, technical, political, environmental and social), multiple stakeholders and multiple values. An Integrated Urban Energy Planning can be considered as a political process involving negotiations and trade-offs among key stakeholder groups with an interest in the planning process. Hence, decision problems arising in the realm of Integrated Urban Energy Planning should be handled through MCDA methodologies.

References
California Energy Commission Sustainable Urban Eergy Planning. A Rodmap for Research and Funding, June 2005.

Catrinu, M. D. Decision Aid for Planning Local Energy Systems. Application of Multi-criteria Decision Analysis. Doctoral Thesis, Trondheim, 2006.

Diakoulaki, D., C. H. Antunes and A. G. Martins. MCDA and Energy Planning. In J. Figueira, S. Greco and M. Ehrogott (eds), Multiple Criteria Decision Analysis: State of the Art Surveys, 859-890. Springer, New York, 2006.
Hobbs, B. F. and G. T. F. Horn. Building public confidence in energy planning: a multimethod MCDM approach to demand-side planning at BC gas. Energy Policy, 25 (3), 357-375, 1997.
Pohekar S. D., Ramachandran, M., Application of multi-criteria decision making to sustainable energy planning — a review. Renewable and Sustainable Energ Reviews, 8(4):365–381, 2004.
Van Beeck, N. A New Decision Support Method for Local Energy Planning in Developing Countries. Doctoral Thesis, Tilburg, 2003