

CHALLENGES IN SUSTAINABLE ENERGY PLANNING: A MULTIDISCIPLINARY PERSPECTIVE

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Overview

One major objective of energy decision making is to ensure that sustainability goals are effectively taken into account and properly considered on the design of strategic energy scenarios and on the evaluation and selection of technologies and projects. However, this quest for sustainable development requires traditional approaches to energy planning to expand beyond pure financial analysis and even beyond direct environmental impact analysis. In fact, many impacts of the energy sector involve moral concerns and economic valuation provides an insufficient basis for social choice. The social analysis hardly can be addressed with the same analytic toolbox as the environmental and economic ones and the importance of taking into consideration the public opinion in the energy decision making process is well established.

The design of optimal strategies for the electricity sector, is a clear example of the complexity of the decision making process often leading to problems requiring a multidisciplinary approach. This paper aims to critically analyse the challenges which the decision makers' have to face when looking to energy models and resulting plans, strategies or scenarios. The study will address challenges related to the quest for social equity, for minimization of environmental impacts, for economic competitiveness, for security of supply in a highly volatile environment characterized by energy prices uncertainty, political and market instability, increasing social awareness and intervention and rapid technological development. A few practical examples from different regions (European and non-European) will be described to illustrate some of the outlined challenges including technical, social, environmental and economic factors. Different modelling and approaches will be discussed opening avenues for future energy research.

Methods

The proposed approach combines different methods and is supported on an interdisciplinary approach combining:

- Cost optimization under environmental, technical and regulatory constraints for long term planning and giving rise to strategic power scenarios.
- Expert interviews and multicriteria methods for the evaluation of electricity future scenarios and technologies. The criteria used in the evaluation cover a large spectrum of sustainable development (social, cost and environmental) factors under both production only and life-cycle perspectives.
- Large scale survey to assess public opinion on energy technologies (statistical significance envisaged), including the perception about cost, environmental impacts and contribution to local development.
- Interviews with local representatives to assess local population acceptance of particular energy projects (no statistical significance envisaged) as local impacts, although affecting a small group of people may be of extreme importance.
- Local population survey to complement information on local's perception (statistical significance envisaged).

Results

The proposed methods were tested and implemented resulting in an integrated framework to be used for sustainable energy planning. The particular case of the Portuguese was considered in the initial implementation, although other countries were already included in the research. The cost optimization problem for electricity planning was translated in GAMS codes allowing to design different scenarios for high renewable energy sources (RES) testing even the case of 100% RES in islands or interconnected systems [1]. The obtained scenarios were then evaluated against a set of sustainability criteria and under a multi-criteria approach relying on experts' opinion, allowing to demonstrate the importance of renewables for sustainable development for different countries [2]. However the social assessment must go beyond the experts' feedback and understanding the public perception of energy related activities is increasingly important in securing a sustainable energy system. As such large scale surveys were implemented also in

different countries to test awareness and public perception for different renewable technologies relating these outcomes with socio-economic-demographic characteristics of the target population [3, 4].

Conclusions

Designing a sustainable energy plan, is a multidisciplinary process and implies addressing and integrating technical, environmental, economic and social dimensions. However, the integration of the relevant dimensions of sustainable energy planning poses an important challenge to researchers and goes beyond the scope of a single discipline. A multidisciplinary approach is required to ensure the adequate expertise from all-encompassing fields of research. This study proposed a possible framework in which all these dimensions are included and fully integrated, merging mathematical evidence based on optimisation procedures with value judgments and public opinion. The research demonstrated the applicability of the new framework to different regions and countries targeting different stakeholders and addressing both local and national perspectives.

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