



ELSEVIER

Contents lists available at ScienceDirect

Technological Forecasting & Social Change



Long-term energy scenarios: Bridging the gap between socio-economic storylines and energy modeling

Patrícia Fortes ^{a,*}, António Alvarenga ^{b,1}, Júlia Seixas ^a, Sofia Rodrigues ^c

^a CENSE – Centre for Environmental and Sustainability Research, Faculdade de Ciências e Tecnologia, Universidade Nova de Lisboa, 2829–516 Caparica, Portugal

^b Agência Portuguesa do Ambiente, Av. Almirante Gago Coutinho 30, 1049-066 Lisbon, Portugal and CEG-IST, Centre for Management Studies, Instituto Superior Técnico, Universidade Técnica de Lisboa, Av. Rovisco Pais, 1049-001 Lisbon, Portugal

^c Agência Portuguesa do Ambiente, Av. Almirante Gago Coutinho 30, 1049-066 Lisbon, Portugal

ARTICLE INFO

Article history:

Received 29 May 2013

Received in revised form 6 January 2014

Accepted 9 February 2014

Available online xxxx

Keywords:

Storylines

Participatory process

Quantitative scenario

Energy modeling

Energy scenario

ABSTRACT

The development of scenarios to explore energy and low carbon futures has been widely applied. Although some studies combine qualitative scenarios with quantitative outcomes from modeling exercises, the two approaches have been extensively and separately used. Many energy scenarios are sustained only by the results of the models, which allow great technological details but neglect the interaction with social and economic factors. Using Portugal as a case study, this paper presents a framework to link socio-economic storylines, sustained by national stakeholders' workshops, with the development of quantitative energy scenarios through 2050, generated by the technology-based TIMES_PT model. The storylines highlight different visions of the country's development, including the energy system. A comparison between the energy profile from the storylines and the energy modeling outcomes was performed to assess the extent of their differences. This analysis revealed generally similar visions, with the exception of the importance of some technologies, which may affect future energy planning. We conclude that a combined method that links socio-economic storylines and energy modeling increases the robustness of energy scenario development because providing a coherent context for modeling assumptions allows better reasoning, which is most valued for the decision-making process.

© 2014 Elsevier Inc. All rights reserved.

1. Introduction

In a world that is in constant change, forecasting the future can be a Sisyphean task. In this context, scenario analysis has appeared as a means of characterizing the future and its uncertainties through a structured and imaginative process [1]. Scenarios help explore the what, how and/or if in

future pathways and allow to understand how different key driving forces might lead to different outcomes. However, scenarios are not predictions or forecasts but rather are a collection of futures that establish the boundaries of uncertainty and the limits within plausible futures [2].

Since the sixties, scenario analysis has gained increasing importance in future planning. Back then, scenarios arose as a military planning tool, evolving later into the context of public policy and as a strategic management tool for the business community [3]. With the use of scenarios by the Royal Dutch/Shell group [4], the approach was diffused to a wider group of audience and became a popular and recommended method to address uncertainty and to improve decision making [5]. Currently, scenario analysis is associated with an extensive variety of users and disciplines, ranging from policymaking, to business planning, to local management, and to global

* Corresponding author at: Centre for Environmental and Sustainability Research, Faculdade de Ciências e Tecnologia, Universidade Nova de Lisboa, 2829–516 Caparica, Portugal. Tel.: +351 21 294 83 97.

E-mail addresses: p.fs@fct.unl.pt (P. Fortes), antonio.alvarenga@apambiente.pt (A. Alvarenga), mjs@fct.unl.pt (J. Seixas), sofia.rodrigues@apambiente.pt (S. Rodrigues).

¹ Previously Departamento de Prospectiva e Planeamento e Relações Internacionais, Av. D. Carlos I 126, 1249-073 Lisbon, Portugal.

environmental understanding [6]. Because of this broad use, a wide range of scenario methodologies and classifications have emerged, as indicated by the extensive scenario planning literature (e.g., [3,7–11]).

A common classification is related to the type of questions to which scenarios respond. Explorative (or descriptive) scenarios answer what can happen and explore plausible futures, whereas normative scenarios show how a specific goal can be accomplished and identify the conditions that must be fulfilled to achieve the goal. Moreover, some authors consider the existence of forecasting scenarios [8,12], which answer what will happen, and assume that the past trends will continue for the future. Scenarios can also be classified according to the nature of their data: qualitative or quantitative [7,13,14]. The former represents visual symbols or narrative stories (“storylines”), creating images of the future and expressing the drivers of change without issuing numerical figures. Qualitative scenarios are generally a result of stakeholders workshops, interviews or other participatory methods and play an important role in situations with high levels of uncertainty or when the information cannot be entirely quantified, such as human values, emotions and behavior [7]. However, qualitative scenarios are often criticized for being “unscientific” because most of their assumptions are derived from stakeholders’ thoughts and are not documented, resulting in an irreproducible developmental procedure [14]. Quantitative scenarios, however, describe the future with numerical figures. These values are generally obtained by complex modeling tools, requiring assumptions and simplifications that tend to highlight the research team’s own expertise [15]. Since the models and their assumptions are often published, quantitative scenarios are more subject to scientific scrutiny. However, the exactness of their numbers can give the illusion of certainty, which contradicts the fact that models only capture a part of “reality”, providing a narrow view of the future [14].

The development of scenarios to explore alternative energy pathways and low carbon futures has been widely applied (e.g., [16–21]). One of the most well-known energy and greenhouse gas (GHG) emission scenario exercises, which combines both qualitative and quantitative approaches, is the *Special Report on Emissions Scenarios* (SRES) from the Intergovernmental Panel on Climate Change [16]. The SRES was composed of four storylines, each exploring different economic, technological, environmental and social realities. These were translated into quantitative scenarios through integrated assessment models, illustrating how divergent realities may influence energy consumption and GHG emissions. The SRES attempt to bridge qualitative and quantitative scenario approaches was not entirely successful, since they kept developing in a great extend separately [22], existing little evidence of the combination of narratives and modeling on energy and low carbon scenario development [21]. Many energy scenarios result from ‘desk research’ [7] and thus essentially represent quantitative outputs of model runs (e.g., [17,20,21,23,24]). Although some studies, such as the *EU Roadmap for moving to a competitive low carbon economy* [23] and the *Energy Roadmap* [20], had a consultation process, these studies do not clearly show how this procedure influenced the

final outcomes, nor describe the storyline behind each scenario.

Qualitative scenarios from a participatory process embody the views of different stakeholders/experts and generally focus on describing social, political and cultural developments [21] that have influence on energy and emissions scenarios. Yet, most of the energy scenarios do not consider all these aspects. They show great technical details, but neglect the entire interaction between social, economic and technological factors. To accommodate the uncertainty that is associated with socio-economic development, some scenario exercises assume different population and/or gross domestic product (GDP) growth paths (e.g., [20,23]). However, these socio-economic figures are enclosed in a higher structure of economy and society with impact on the entire energy system, such as the economic profile (e.g., energy intensive industries versus energy extensive services), territorial organization (associated with lower or higher mobility demand), and social behavior (e.g., higher or lower demand for energy services), which are not generally considered, causing these quantitative energy/emissions scenarios to capture only a narrow view of how the future may unfold.

To explore plausible futures for Portugal, a participatory process with national stakeholders was conducted within the research project HybCO2.² Two distinct qualitative socio-economic scenarios were designed, in which crucial fields for national development, i.e., the evolution of the economy and its specialization profile, social capital, educational system, spatial planning, environment and energy, were identified. Thus, the two storylines have highlighted different visions for the country’s economic and social development, including the evolution of the energy system with its key technologies and energy sources. For both scenarios, quantitative socio-economic indicators, i.e., population, GDP and sectoral gross value added (GVA), were also built, characterizing the alternative country development pathways. Driven by these indicators and sustained by selected assumptions of the storylines, i.e., social and environment behavior, two quantitative energy scenarios for Portugal through 2050, were generated using the energy model TIMES_PT.

This paper has a threefold objective: i) to present the participatory process that was used to build qualitative scenarios for Portuguese socio-economic development and the resultant future images of the energy system; ii) to demonstrate how the qualitative socio-economic scenarios can be linked in a comprehensive framework with energy modeling to overcome social and economic aspects that are generally ignored by current energy modeling exercises; iii) and to assess to what extend the energy profile outcomes from narrative storylines and quantitative modeling match or diverge, identifying the strength and weakness of each approach and their impact on energy planning.

The next section presents the scenario development framework, including the design of storylines, an overview

² HybCO2 Project: “Hybrid approaches to assess the economic, environmental and technological impact of long term carbon reduction scenarios – the Portuguese case-study” (<http://hybco2.cense.fct.unl.pt/>).

Download English Version:

<https://daneshyari.com/en/article/7256894>

Download Persian Version:

<https://daneshyari.com/article/7256894>

[Daneshyari.com](https://daneshyari.com)