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ANALYSIS

Energy security matters in the EU Energy Roadmap

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ABSTRACT

Energy security has gained increasing prominence on the EU political agenda, but is often framed narrowly, in terms of import dependency or security of supply. In this paper we screen and scope out a more comprehensive suite of energy security aspects to be considered when assessing low-carbon energy scenarios and apply it using the EU Energy Roadmap as an example. Availability and affordability issues as well as security of demand matters and geopolitical security aspects are identified and discussed. External factors, e.g., future international climate treaties and international relations, are important for some energy security outcomes. A broader framing of energy security together with structured assessments on the security implications of energy transitions would benefit future EU energy policy.

1. Introduction

The climate change challenge requires a transformation of the energy system from conventional fossil fuels to low-carbon alternatives and high energy end-use efficiency. The EU Energy Roadmap for 2050 and its impact assessment [1,2] illustrates, in the form of scenarios, alternative development paths, for the European energy system that are consistent with the EU ambition to reduce greenhouse gas emissions by 80% by 2050. The scenarios vary in terms of energy sources and technologies, level of demand reductions, and costs. The impact assessment [2] addresses the three overarching energy policy objectives, i.e., sustainability, competitiveness, and energy security, but with different levels of ambition and stringency.

Since the early 2000s, energy security has gained increasing prominence on the EU political agenda [3], and even more strengthened due to the recent developments in the Ukraine and the strained EU-Russia relations. Energy security is a multidimensional concept including aspects such as security of supply, security of demand, affordability issues and revenues from energy, geopolitical considerations associated with security and defense policy, other political risk factors, economic risk factors and energy poverty, as well as technological and environmental risk factors. However, in most EU policy documents the main energy security aspect discussed is security of supply. This is true also for the EU Energy Roadmap [2] where a limited set of issues of security of supply are raised, only two of which, i.e., import dependency and more variable electricity production, are described in any detail.

The past decade, import dependency for EU-27 increased from 75.7% (2000) to 84.3% (2010) for oil, and from 48.9% (2000) to 62.4% (2010) for gas [4]. But the extent to which import dependency, as highlighted in the Energy Roadmap impact assessment, is important for energy security can be debated. Furthermore, the results and approach concerning import dependency used in the impact assessment are not entirely consistent with the main report that argues for increased interchange with the Southern Mediterranean, Russia and Ukraine [1, p. 11]. Nor is it consistent with other documents where the international cooperation and partnership dimensions of energy security are underlined (e.g. Ref. [5]).

Framing the energy security concept narrowly when examining the effects of alternative low-carbon scenarios increases the risk of incoherent policy when the broader EU policy arena is considered (e.g. security and defence policy, foreign and neighbourhood policy, critical infrastructure protection,

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economic and social policies, environmental policy, etc.). Conversely, the integration of a broad energy security frame into key policy documents and impact assessments could facilitate increased policy coherence.

2. Methods

In this paper we elaborate and apply a broad approach to energy security in order to identify plausible synergies and conflicts between low-carbon transition strategies and energy security. We use the scenarios of the EU Energy Roadmap as an example and for illustration. The purpose is here to screen and scope what are relevant aspects to study based on assumed policy relevance. Our approach is qualitative and does not provide a conclusive assessment of energy security impacts from low-carbon energy road maps. Our aim is to broaden the perspectives on the relations between climate policy and energy security and identify salient issues and further research needs.

In section 3.1 we describe various energy security perspectives and aspects and assemble them in a framework. In section 3.2, we apply this framework to the EU Energy Roadmap scenarios. In the discussion section 4 we reflect on the framework, the roadmap scenarios and external uncertainties, before concluding in section 5.

3. Results

3.1. Energy security aspects

Energy security is a concept with many meanings. There is no established, all-encompassing definition of energy security partly because the notion of energy security is highly context dependent [6]. Moreover, since security generally is a question of subjective perceptions [7] such definitions would not be universally applicable. In order to facilitate an understanding on the meta-level however, we promote the view that energy security can be regarded from two separate perspectives; 1) when the energy system is *exposed to insecurity*, and 2) when the energy system *generates insecurity*. This view was presented by Johansson [8], distinguishing between security aspects related to either;

1. the *energy system as object* which could be exposed to insecurity and the threats which would disturb the functioning of the energy system (these aspects can be described under the concepts of security of supply and demand), or
2. the *energy system as subject* generating or enhancing insecurity (or security) or functioning as a threat multiplier, which for example include conflicts generated as a side-effect of the economic value of energy, geopolitical considerations, as well as social, political, technological and environmental risk factors.

3.1.1. Security of supply aspects

Security of supply can be interpreted as reliable access for consumers to energy resources (primary energy or energy carriers) at reasonable costs (see e.g. Ref. [9]). Security of supply requires that there are available energy resources, a capacity to exploit and convert these resources to suitable energy carriers, and that there is a secure system for energy distribution. Security of supply includes both physical aspects (e.g. availability of energy to the consumer at the time of demand) as well as economic aspects (e.g. affordable and stable prices) [10]. Generally, much of the discussion regarding security of supply deals with external dependencies [11]. A broader meaning of supply security, however, also includes the character and functionality of the domestic energy system in terms of energy mix, primary resources as well as conversion, infrastructure facilities and end users (see e.g. Refs. [12,13]).

Resource Availability is an important and well described aspect in the energy security field (e.g. Ref. [14]). When it comes to fossil fuels this is often associated with geological existence (e.g. Ref. [6]) whereas a renewable source such as biomass is determined by biological factors. Moreover the availability of non-energy resources (e.g. rare earth minerals) may in some cases be a limiting factor for specific energy technologies [15–17].

Accessibility (e.g. Ref. [14]) can be understood as the aspects necessary to transform and transport the resources to supply energy services to the users. Poor accessibility could result from a number of things ranging from infrastructural disturbances (e.g. broken links) to supply and demand imbalances, perhaps due to lack in investments in energy extraction, non-functioning markets or systemic flaws in terms of bottlenecks [18]. It could also be the result of intentional disturbances of energy flows in order to gain political advantages or unstable political situations in regions of origin and transit (see section below).

When the technical and infrastructural dimensions of accessibility is considered, risks and security aspects related to transport routes, transmission networks and other distribution systems can be relevant to include. It can be a question of systemic vulnerabilities to antagonistic threats (e.g. terrorism) and extreme weather events, or a question of technical system characteristics such as grid stability and power quality (see e.g. Ref. [19]).

From the consumer perspective, diversity is an important security of supply aspect (e.g. Ref. [6]), in terms of *diversity of resources* and *diversity of suppliers*. Stirling in turn identifies three aspects of diversity namely variety, balance and disparity [20]. Diversity reduces the sensitivity to disturbances in the supply of a specific resource from a specific supplier. A related and well described aspect — focussing on the state-level — is *import dependency* which is further elaborated and discussed below.

Affordability aspects in terms of *high costs* and *high volatility* may be considered a threat against a well-functioning energy system. Longer periods of high prices affect industry and the purchasing power of households, thus affecting the overall economy. It can also give direct negative social effects for households subject to energy poverty, i.e., when poorer groups in society have difficulties to afford levels of energy necessary to maintain a minimum living standard (e.g. Refs. [21–23]). Short term volatility in energy prices can also create uncertainty affecting investments decision [24].

3.1.2. Security of demand and revenue aspects

The functionality of the global energy system is also crucial for producers and exporters. From the producer perspective, the most important negative effect of a disturbance in the energy system may be that security of demand cannot be maintained. Security of demand is fundamental for energy exporters in order to be able to sell their product and generate revenue. Security of demand can be seen as the mirror image of security of supply. The basic requirements are thus the same; availability of energy resources and distributional security, associated with the same problems as described previously. In addition, security of demand also needs availability of customers and preferably diversity of customers as well. The profound difference between the consumer and the producer in this context is that energy services are essential to the consuming part, while the revenue from energy is essential to the producing part. Despite different perspectives, it is obvious that there are many mutual consumer and producer interests (see e.g. Refs. [25,26]).

When it comes to security of demand and revenue aspects, it should be recognized that there are different conditions for different actors, e.g. exporting countries, upstream companies (e.g. exploration and extraction of crude oil), producers of energy carriers (e.g. power companies), energy traders and infrastructure owners and operators.

3.1.3. Import dependency and its relation to geopolitical aspects

Import dependency is often considered a risk factor and is probably the main aspect that many intuitively associate with energy security.