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Opening the black box of energy security: A study of conceptions of electricity security in the United Kingdom

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ABSTRACT

Despite much literature on energy security, the term continues to resist a commonly-accepted definition. Nevertheless, policy decisions are frequently made on the basis of 'improving energy security', despite the lack of any clear understanding of what improving energy security actually means. Therefore this paper explores the meaning of energy security for key experts in the UK energy sector, with a particular focus on the security of electricity systems in the context of a low-carbon transition. A set of 22 energy security issues is discussed with 25 experts from across the energy sector in the UK, in order to get a grasp on which aspects of energy security are felt to be most important, and to discover the underlying concepts which are used by experts when making or justifying these choices. The results from the interviews show that there is a real need to attempt to take into account multiple competing and context-specific views on energy security, instead of trying to close the discussion down around a small number of simple quantifiable indicators or metrics. The results also show that there is no clearly discernible alignment between experts' perspectives and the type of organisation for which they work.

1. Introduction

The term 'energy security' has become commonplace in both academic and policy discussions. However, there exists a considerable array of overlapping and competing conceptualisations, and despite much literature on the subject the term resists a commonly-accepted definition [2,13,24,50,97]. Nevertheless, energy security has become a key driver and justification of much energy policy in recent years, driven by concerns over resource nationalism and instability in key export regions such as the Middle East, China and Russia, concerns over fossil resource concentration, and increasing pressure on energy systems to undergo a fundamental transition in order to reduce carbon emissions [12,13,21,47,68]. Therefore this paper explores the meaning of energy security for key experts in the UK energy sector, with a particular focus on the electricity system in the context of a low-carbon transition. The aim is to get a grasp on what aspects of energy security are felt to be most important, and to discover the underlying concepts which are used by experts when making or justifying these choices. This paper thus aspires to generate an in-depth and transparent discussion which does not seek to close down the diversity of views, but instead seeks to open them up to debate and to policy attention.

As shall be elaborated in the following section, energy security issues are often context-specific, therefore it makes sense for the analysis to focus on one specific country [13]. The UK is chosen for the focus of this paper because its energy system is in a major period of transition, driven by a number of factors. The UK is entering a new phase of net fossil fuel imports due to declining domestic production, which has increased policy concerns regarding resource nationalism and resource concentration globally [68,74]. The electricity supply infrastructure is ageing and will require a significant proportion of electricity supply capacity to be replaced by the mid-2020s; the retirement of older fossil fuel power plant capacity has led to an erosion of capacity margins in the power sector [89,94]. Additionally, the UK is under pressure to decarbonise its energy system: the 2008 Climate Change Act established the world's first legally-binding climate change target [32]. These multiple issues have meant that energy security has risen extremely rapidly up the public and policy agenda in the UK in recent years, and unlike many other European countries, the UK has a specific energy security strategy [34]. Nevertheless, many other industrialised countries, both in Europe and further afield, are experiencing similar pressures on their energy systems, meaning that the UK can act as a useful basis for exploring energy security in other national contexts.

The following section of the paper introduces the literature on energy security, with a focus on conceptualisations and the evolution of the term in recent years, and also introduces the focus on the

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security of electricity systems in a low-carbon context upon which this paper is based. Section 3 then outlines the methodology used for conducting and analysing interviews with energy experts. Section 4 presents the results from the interviews in two parts: firstly focusing on seven central themes which were identified from the qualitative interview data, and secondly focusing on the quantitative results and the degree of alignment between respondents' views and the organisation for which they work. Section 5 discusses and analyses the results in more detail and in relation to the wider literature, and also outlines some limitations of the study and areas for further research. Finally, Section 6 concludes and offers recommendations for policy.

2. Literature review

2.1. Conceptualising energy security

Energy security is a politicised and multifaceted topic [22,24,25,97]. There is a considerable array of overlapping and competing conceptualisations, and despite much literature on the subject the term resists a commonly-accepted definition. There are some widely-cited definitions available, including that of the International Energy Agency (IEA) which states that energy security denotes "the uninterrupted availability of energy sources at an affordable price" [57: 1]. However, as pointed out by Müller-Kraenner [82], when it comes to such definitions the devil is in the details: for instance, what exactly does 'affordable' mean? The concept of energy security is frequently used to justify various policies simultaneously, even if these policies appear to be contradictory [73]. As pointed out by Joskow:

> There is one thing that has not changed since the early 1970s. If you cannot think of a reasoned rationale for some policy based on standard economic reasoning then argue that the policy is necessary to promote 'energy security' [63: 10].

Because of the challenges that this creates for both academic and policy discussions, multiple approaches for defining energy security have been proposed. For example, several earlier papers (e.g. [5,53,67]) proposed analytical frameworks based around a set of core goals of 'secure' energy systems, often highlighting the importance of dimensions such as availability, affordability and accessibility. However, soon numerous similar yet distinct frameworks existed, with no real means of reaching consensus on which was deemed most useful [97]. An inductive attempt to identify key energy security indicators by asking experts came up with a rather unmanageable total of 372 possible indicators [98]. Despite these "growing pains", Cherp and Jewell [22: 420] suggest that conceptual and practical attempts should still be made to move towards a useful universal definition. Meanwhile, others have argued that the complex and contested nature of energy security means that a universal definition is probably not a practical goal [24,97]. It is this latter view which informs this paper, the aim of which is not to generate an agreed-upon definition of energy security, but rather to shed more light on the diversity of perspectives amongst key energy experts. In doing so, this paper aims to demonstrate not only that energy security means different things to different people, but also to show *what* it means and *to whom.*

As pointed out by Cherp and Jewell [22], vital energy systems and their vulnerabilities are not just objective phenomena; they are also political constructs which are defined and prioritised by different social actors. It has been shown that energy security concerns are dynamic and evolve as circumstances change over time, reflecting dominant discourses and political economic trends [2,25,29,74]. However, it is important to emphasise that despite different understandings, there still exist certain physical, geographical and system characteristics which somewhat constrain the socially and politically constructed nature of what we understand by 'energy security'. To use the phraseology of Stirling [103,104], a complex and contested topic such as energy security does not necessarily mean that 'anything goes'. Because of such constraints, conceptions of energy security tend to be highly context-dependent, and are strongly correlated with national energy policies and state imperatives [2,12,100]. As stated by Ciuta [25], we now need to consider the manner in which different actors and assumptions cluster around different meanings of energy security.

2.2. The security of low-carbon electricity systems

The security of electricity systems is important because of the central nature of electricity systems to society, not only in the UK but everywhere in the world. The energy security literature still tends to display a prevalent focus on securing supplies of oil and gas [22,24]; this is largely due to the fact that the literature addressing energy security in the sense that we know it today first appeared as a response to the second oil shock in 1979 [37,38,96]. However, electricity now represents an equally significant (and growing) proportion of energy use [24]: projections suggest that electricity will be the fastest growing energy sector in the future [56], and electricity and heat production is the largest single source of greenhouse gas emissions globally [58]. Efforts are already underway to electrify heating and transport systems in order to make deeper cuts to emissions from these sectors in the future, meaning that findings relating to electricity security could eventually become a key component of efforts to decarbonise heating and transport. The need for second-by-second balancing of electricity supply and demand means that electricity security operates on extremely short timescales, usually addressed in the physical sciences and engineering literature; however, electricity is simultaneously subject to longer-term risks such as resource concentration and climate change, usually addressed in the social sciences literature [21]. Electricity is therefore an interesting case in that it encompasses the range of disciplines within which energy security is rooted, as well as the full range of timescales across which energy security operates.

Conceptions of energy security have recently become linked to environmental issues, in light of an emerging new paradigm of environmental and social concerns, and numerous conceptions of energy security now include an 'environmental sustainability' dimension [42,55,67,83]. Emerging normative and legislative imperatives to cut carbon emissions are having a fundamental impact on the context in which energy security is now viewed, and understandings of energy security in the future will likely need to exist within this emerging new paradigm. It is also widely understood that there may be certain synergies and trade-offs between various objectives when attempting to move towards energy systems which are low-carbon, secure and affordable [28,47,59,91,99]. However, there have been few attempts to explore conceptualisations of energy security in a low-carbon context, and to attempt to identify which aspects of 'security' are prioritised by energy experts when considering the imperative to meet affordability and low-carbon objectives.

3. Methodology

Semi-structured face-to-face interviews were conducted with 25 experts from the UK energy sector. Experts were selected from six different types of organisation within the UK energy sector: