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Viewpoint

The concept of energy security: Beyond the four As

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HIGHLIGHTS

- Energy security should be conceptualized as an instance of security in general.
- 4As of energy security and related approaches do not address security questions.
- We define energy security as low vulnerability of vital energy systems (VES).
- VES support critical social functions and can be drawn sectorally or geographically.
- Vulnerability is a combination of exposure to risks and resilience capacities.

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ABSTRACT

Energy security studies have expanded from their classic beginnings following the 1970s oil crises to encompass various energy sectors and increasingly diverse issues. This viewpoint contributes to the re-examination of the meaning of energy security that has accompanied this expansion. Our starting point is that energy security is an instance of security in general and thus any concept of it should address three questions: "Security for whom?", "Security for which values?" and "Security from what threats?" We examine an influential approach – the 'four As of energy security' (availability, accessibility, affordability, and acceptability) and related literature of energy security – to show it does not address these questions. We subsequently summarize recent insights which propose a different concept of energy security as 'low vulnerability of vital energy systems'. This approach opens the road for detailed exploration of vulnerabilities as a combination of exposure to risks and resilience and of the links between vital energy systems and critical social functions. The examination of energy security framed by this concept involves several scientific disciplines and provides a useful platform for scholarly analysis and policy learning.

1. Introduction

As a policy problem, energy security emerged in the early 20th century in connection with supplying oil for armies (Yergin, 1991). Academic reflections on energy security date back to the 1960s (e.g. Lubell, 1961) and came of age with the oil crises of the 1970s. In the late 1980s and 90s, the academic interest in energy security declined following the stabilization of oil prices and the receding threat of political embargoes. It re-emerged in the 2000s driven by the rising demand in Asia, disruptions of gas supplies in Europe, and the pressure to de-carbonize energy systems (Yergin, 2006; Hughes and Lipscy, 2013; Hancock and Vivoda, 2014).

However, there is an important difference between contemporary and 'classic' energy security studies. In the 1970s and 80s, energy security meant stable supply of cheap oil under threats of embargoes and price manipulations by exporters (Colglazier and Deese, 1983; Yergin, 1988). In contrast, contemporary energy security challenges extend beyond oil supplies and encompass a wider range of issues (Yergin, 2006). Moreover, energy security is now closely entangled with other energy policy problems such as providing equitable access to modern energy and mitigating climate change (Goldthau, 2011). Thus the concept of energy security implicit in the classic studies has become a subject of intense re-examination.

Energy Policy has published over a dozen articles on the concept of energy security over the past five years. Many of these publications mentioned the "four As of energy security" (availability, accessibility, affordability and acceptability) introduced by the Asia Pacific Energy Research Centre (APERC, 2007). However, there has

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been no academic reflection on this approach except by Jewell et al. (2014) who noted its remarkable similarity to the "5As" of access to health care (availability, accessibility, accommodation, affordability and acceptability) proposed in 1981 by Penchansky and Thomas (1981). It is thus time to ask: have the four As helped to conceptualize the 'new' energy security and if not why and what alternative approaches can be used?

In this paper we seek to answer these questions. Section 2 explains the rationale and the principles for conceptualizing energy security. Section 3 describes the history and the influence of the four As. Section 4 examines the four As in light of key security questions. Section 5 describes alternative approaches and Section 6 presents our conclusions.

2. Why and how to conceptualize energy security?

It is a common observation that energy security means different things in different situations and to different people. There are natural explanations for this variation. First, energy systems vary from one place to another which gives rise to different energy security problems. Secondly, the 'energy security' term is sometimes extended to other energy policy issues ranging from energy poverty to climate change. Does this variety demonstrate "impracticality of seeking a common definition of energy security" (Chester, 2009, 893)?

We do not think so. Indeed, the presence of different *meanings* of energy security do not necessarily mean the existence of different *concepts* of energy security. In some cases it may instead mean that one and the same concept finds different expressions under different conditions. This is what largely explains variations in energy security priorities and policies between different countries. Such differences stress rather than negate the need for conceptual clarity, which can support rational policy analysis, international comparison and learning. Energy security in this respect is not much different from 'justice' or 'minority rights' which despite their different meanings are nevertheless subject to vigorous conceptual debates and policy comparisons.

Different interpretations of energy security may also result from the usage of the term by those who seek to increase the priority of other policy agendas by calling them a matter of '[energy] security'. Such attempts highlight the need to disentangle the debate about the *concept* of energy security from normative and empirical discussions about climate change mitigation, energy poverty alleviation, and other energy policy agendas, however legitimate they may be.[1]

A good social science concept should not aim to eliminate different meanings of a contested term but rather to "reduc[e] the limitations, ambiguities, and inconsistencies …[by enhancing] … the clarity and precision of these meanings as well as their ability to function in hypotheses and theories with explanatory and predictive force" (Hempel, 1964, 12). Thus a better energy security concept is needed not only to enable rational policy analysis and learning by separating energy security from other policy problems, but also to provide a shared language, without which scholars cannot communicate with each other or with policy-makers.

A good starting point in conceptualizing energy security is the observation in Baldwin's seminal article *The concept of security* that "economic security, environmental security, identity security, social security, and military security are different forms of security, not fundamentally different concepts" (Baldwin, 1997, 23). This logically applies to energy security as well, meaning that a valid concept of energy security should be based on a concept of security in general.

Baldwin defines security as a "*low probability of damage to acquired values*", building on a half-century tradition of security studies starting with Wolfers (1952).[2] He then goes on to argue that this general definition should be adopted to specific situations and that such 'closer specifications of security' should answer at least the following questions[3]:

- Security for whom?
- Security for which values?
- From what threats?

These questions have rarely been explicitly asked in the energy security literature, though similar questions (What to protect? From which risks? and By which means?) are briefly mentioned by von Hippel (2011) and used by Leung et al. (2014) to structure their analysis of securitization of energy in China. In the next sections we discuss to which extent the four As and their derivatives contribute to a 'closer specification of energy security' by engaging with these key questions.

3. History of the four As and related thinking

The four As of energy security (availability, affordability, accessibility and acceptability) are a frequent starting point of contemporary energy security studies. Two of the four As – availability and affordability – prominently featured already in the classic energy security studies (Deese, 1979; Yergin, 1988) and still remain at heart of the International Energy Agency's mainstream definition definition of energy security "as the uninterrupted availability of energy sources at an affordable price" (IEA, 2014)[4]. The other two As – accessibility and acceptability – have a more complex history. Both were among the global energy goals proclaimed by the World Energy Council[5] in its *Millennium Declaration* (WEC, 2000) but were not connected to energy *security* until the 2007 APERC report.

It is likely that these terms bled over to the field of energy and later energy security from other fields. The full "A-framework" is first mentioned in a 1981 article addressing the '5As of health care access' (Penchansky and Thomas, 1981). This paper (cited almost 500 times in Scopus and over 1000 times in Google Scholar) was influential beyond its original scope. In particular, similar frameworks were used by the UN, with respect to human rights, education, and food (e.g. Office of the High Commissioner for Human Rights, 2000; UNESCO Secretariat, 2002).

In 2007, APERC used the A-framework, merging the classic 'availability' and 'affordability' with 'acceptability' and 'accessibility' to structure their report on energy security in Asia. The report did not justify the use of the four As by reference to prior literature, empirical observations or logical reasoning. Neither did it laid a claim that the four As constitute a generic concept

[1] As Baldwin argues, one of the problems with "cloaking normative and empirical debate in conceptual rhetoric exaggerates the conceptual differences between proponents of various security policies and impedes scholarly communication" (Baldwin, 1997, 5).

[2] A classic definition of energy security by Daniel Yergin echoes this approach by referring to energy security "assur[ing] adequate, reliable supplies of energy at reasonable prices and in ways that do not jeopardize major national values and objectives" (Yergin, 1988, 111).

[3] Baldwin suggests four more questions: "How much security?", "At what costs?", "By what means?" and "In what time period?" but contends that it may not be necessary to answer all of these if only more general specifications of security are sought.

[4] A 2010 version of the IEA's definition cited by Hughes (2012) included a clause "while respecting environmental concerns".

[5] 'Accessibility' in this context meant access to (modern) energy in developing countries and included affordability.

or essential characteristics of energy security. Nevertheless, the mnemonic of the four As was taken up by the energy security literature. Kruyt et al. (2009) grouped their indicators of energy security by the four As, which they called 'a classification scheme' (but did not explain whether it is a classification of values, threats or something else). Chester (2009) mentioned the APERC report in her influential article addressing four 'dimensions' of energy security (availability, adequacy, affordability, and sustainability), similar, but not identical, to the four As. She argued that the concept of energy security was 'slippery' (i.e. impractical to universally define or conceptualize) and 'multi-dimensional'. Some scholars interpreted this argument as both a discouragement to search for a rigorous concept of energy security and as green light to propose their own 'multi-dimensional' definitions. Subsequently many studies have 'conceptualized' energy security by liberally adding or modifying dimensions to the four As, thus making Chester's argument a self-fulfilling prophecy: the concept of energy security has indeed become both 'slippery' and 'multi-dimensional'.[6]

For example, Hughes' (2012) 'generic framework for the description and analysis of energy security' contains three indicators: availability, affordability and acceptability.[7] The 'new comprehensive energy security paradigm' by von Hippel et al. (2011) contains six dimensions and Vivoda (2010) adds five more. Sovacool (2011) proposed 20 dimensions of energy security including availability and affordability. Winzer's (2012) conceptualization stands apart in that it reflectively mentions but does not directly uses the four As ('availability' and 'accessibility' are identified with 'natural' and 'human' *sources of risks* and 'affordability' and 'acceptability' with economic and environmental *impacts* of energy).

4. Analysis of the four As

The following three sub-sections discuss whether the four As and related literature deal with the three fundamental security questions: Security for whom? Security for which values? and Security from what threats?

4.1. Security for whom?

Baldwin concurs with another prominent security scholar, Barry Buzan, that a concept of security that fails to ask *Security for whom?* "makes little sense" (Baldwin, 1997, 13). In Buzan's terminology, asking this question means pointing to the 'referent object' of security (typically the state but can also be other entities) (Buzan et al., 1998). The four As do not answer or even ask *Security for whom*?, most likely because this question is not explicitly present in either classic energy security or access to health care studies.

Indeed, in the classic energy security studies the referent objects were implicitly clear: oil-importing industrial nations. Likewise, 'referent objects' of the access to health care – clients of health services – are self-obvious. This implicit clarity allowed measurement and management of all of the 'As', for example, *accessibility* was the time it takes for the client to reach a health care facility, *affordability* was the relationship between the client's income and the cost of health service, and *acceptability* meant patient comfort with, for example the physical attributes of doctors' offices and neighborhoods.

For today's energy security, the question 'For whom?' may be more complicated than in case of both access to health care and energy security in the 1970s. The scope of contemporary energy security studies goes beyond OECD oil importers to include nations of all levels of development that extract, import, export and use a variety of energy sources and carriers. Moreover, such studies also address perspectives on energy security of non-state actors ranging from global production networks (Bridge, 2008) to individual regions, utilities and consumers. This opens pandora's box of possible interpretations, particularly of affordability and acceptability, because it is not clear *for whom* energy should be affordable or acceptable. For example, APERC (2007) uses affordability to mean profitability of energy investments, whereas Kruyt et al. (2009) and Hughes (2012) interpret it as low energy prices for consumers. Sharifuddin (2013) argues that affordability also relates to government accounts in terms of subsidy levels and import/export balance. Which of these interpretations of affordability is relevant to energy security in a particular situation depends on how the question *'security for whom?'* is answered (Table 1).

Identifying a valid referent object is equally important for clarifying *acceptability*. The APERC report as well as its main interpretations – Kruyt et al. (2009), Chester (2009) (who replaces it with 'sustainability'), Hughes (2012) and Winzer (2012) – all equate acceptability with environmental impacts of energy systems. However, what is environmentally acceptable varies widely among different actors: local population, environmental NGOs, industries, and nation states. Therefore without defining a referent object the term '[environmental] acceptability' loses any specific meaning.

Since referent objects of energy security were not addressed in the four As, the subsequent literature used diverse, fragmented and often contradictory approaches to this problem. Some studies (e.g. Kruyt et al., 2009; Hughes, 2012; Winzer, 2012) did not explicitly define referent objects. In contrast, Chester (2009) used the fact that the meaning of energy security depends on the referent object as the central argument for her thesis that the energy security concept cannot be universally defined. Yet others attempted to develop a view of energy security which would incorporate viewpoints of different referent objects by summing them up through surveys and interviews (e.g. Sovacool and Mukherjee, 2011). In our view this is not a robust method because it blurs rather than clarifies the distinct priorities of different actors (Cherp, 2012).

4.2. Security for which values?

The second fundamental security question is *Security for which values?*. The four As are characteristics of energy systems, not human values. Of course, they are linked to political, economic, social and other priorities. However, the literature inspired by the four As does not analyze these links. This is more than merely a formal omission because failing to identify protected values and their connections with energy means failing to answer a central concrete policy question: "which energy security systems to protect?". This is a key issue for moving energy security science beyond last century's insights. The classic energy security studies proceeded from the strong, self-evident and implicit connection between national values such as political independence and territorial integrity and a particular energy system: oil supplies (see e.g. Sagan (1988) on pre-war Japan, Lubell (1961) on Western Europe in the 1960s, and Cheon and Urpelainen (2014) on OECD countries in the last quarter of the 20th century). In contrast,

[6] In fairness, to Chester, these references focused on one of her messages and ignored the others, such as drawing attention to several 'aspects' of energy security (including risks, temporal aspects, variation from one energy 'market' to another, etc.) and her call for a robust debate on the meaning of energy security based on transparent assumptions.

[7] He also used concepts from energy systems analysis as we mention in Section 5.1.

Table 1
Different interpretations of affordability – the importance of asking: 'Security for whom?'.

Affordability for whom?	Energy prices should be…
Households and private consumers	Low compared to household income[a,b,c]
Industry and businesses	Low compared to competitors' prices[c]
Nations	Low enough to ensure the energy import bill is small compared to export earnings[c]
Energy companies and investors	High enough to ensure sufficient profitability for energy companies and investors[d]

[a] Kruyt et al. (2009) says that affordability translates to low energy prices but does not specify the consumer group (households or industry).
[b] Sharifuddin (2013) defines affordability relative to government accounts, private consumers and industries.
[c] Hughes (2012) defines affordability relative to consumer income.
[d] APERC (2007) refers to investment cost affordability.

contemporary energy security extends beyond oil to other energy sectors (Yergin, 2006) and in addition to traditional geopolitical values (Kuzemko, 2013) is also connected to economic welfare (Bohi and Toman, 1996; Helm, 2002) as well as to internal political and social stability (Cherp et al., 2012).

Thus, a central question for contemporary energy security studies is to identify and explore connections between energy systems and important social values. Protecting values of different nations means protecting distinct energy systems of those nations, not 'energy in general'. This implies tailored metrics of and policies for enhancing energy security. The four As are not suited for designing such metrics or informing such policies because they are unclear about the values to protect, the energy systems to which they apply, and the links between the two.

4.3. From what threats?

The four As are also not specific with respect to threats to energy security. Policies on public services (including energy) are concerned with either attaining desired standards (e.g. extending energy or health care access to new areas or groups) or maintaining these standards by the most effective means (e.g. unbundling electricity generation and transmission to increase competitiveness). In contrast, energy security policies are concerned with already attained standards. This difference echoes Baldwin's distinction between 'acquiring new values' (which not related to security) and 'protecting existing values' (which is at the heart of security). Thus, energy security concerns are largely shaped by experiences of disruptions and perceptions of risks. For example, classic energy security studies emerged not as a result of growth and change in energy systems, but as a result of disruptions to already existing systems. While analysis of disruptions has always been central to energy security studies (cf. the term "uninterrupted" in the IEA's 2014 definition and 'reliable' in Yergin's 1988 definition), Amory and Hunter Lovin's *Brittle Power* Lovins and Lovins, 1982 and other seminal papers (e.g. Stirling, 2010; Yergin, 2006) expanded the focus from the *causes* of disruptions to the ability to respond them, i.e. to energy system *resilience*.

The concepts of risk and resilience are not embedded in the four As and receive no systematic treatment in the related literature. Echoing the classic energy security studies, APERC (2007) mentions geological (availability), geopolitical (accessibility) and economic (affordability) threats, but does not mention resilience or explore other vulnerabilities such as aging infrastructure, terrorist attacks, natural events, or intermittency of solar and wind energy (e.g. Farrell et al., 2004; Johansson, 2013; Grave et al., 2012; Liliestam, 2014). Naturally, a concept of energy security cannot list all possible risks or vulnerabilities, but it should provide a framework for identifying, measuring and managing vulnerabilities.

5. Alternative approaches

This section summarizes some recent conceptual developments concerning energy security. Most of these insights proceed from defining energy security as the *low vulnerability of vital energy systems* (see e.g. Jewell et al. (2014)). This definition has three advantages. First, it connects to Baldwin's (1997) definition of security (see Section 2), substituting 'low probability of damage' by 'low vulnerability' and connecting 'acquired values' to 'vital energy systems'.[8] Second, it is not restricted to specific sectors, elements of supply chains, or issues and therefore is flexible enough to be applicable to historic, contemporary and future energy systems in diverse contexts. Third, it points to areas where closer contextual specifications of energy security can be developed, namely (a) delineating vital energy systems; (b) exploring their vulnerabilities; and (c) understanding the political process which leads to the prioritization of certain energy systems and vulnerabilities. The following three sections provide more detail on each of the areas.

5.1. Vital energy systems

The concept of 'vital energy systems' addresses a central security question 'what to protect?'. Vital energy systems are those energy systems (energy resources, technologies and uses linked together by energy flows) that support critical social functions ('acquired values' in security terms). Vital energy systems can be delineated according to geographic and sectoral boundaries (Cherp and Jewell, 2013) as shown in Fig. 1. Examples of vital energy systems include oil supplies to armies (Sagan, 1988), energy infrastructure (Farrell et al., 2004), renewable energy sources (Grave et al., 2012; Johansson, 2013), energy 'services' (Jansen and Seebregts, 2009), energy export revenues (Nemet and Brandt, 2012; Persson et al., 2007), and biofuel or hydrogen trade in decarbonized energy systems (Jewell et al., 2014; Månsson et al., 2014).

Differentiating between energy systems allows the development of metrics and assessment processes for both individual systems and their interaction. Examples of such assessments are the Suply–Demand Index (Scheepers et al., 2007), the Global Energy Assessment (Riahi et al., 2012; Cherp et al., 2012; Hughes, 2012), the IEA's Model of Short-term Energy Security (MOSES) (Jewell, 2011), and the National Energy Security Assessment of Australia (RET, 2011). In addition to better measurement,

[8] This definition takes Yergin's classic definition cited in footnote 2 into the 21st century. It includes the concepts of adequacy, reliability and reasonable prices into a more general concept of 'low vulnerability' (which also includes 'resilience' and other characteristics of energy systems). It expands the reference to 'supply' to the more general concept of 'energy systems' (also including infrastructure, demand, and end-uses). Finally, it folds Yergins reference to national values and objectives into the concept of *vital* energy systems.

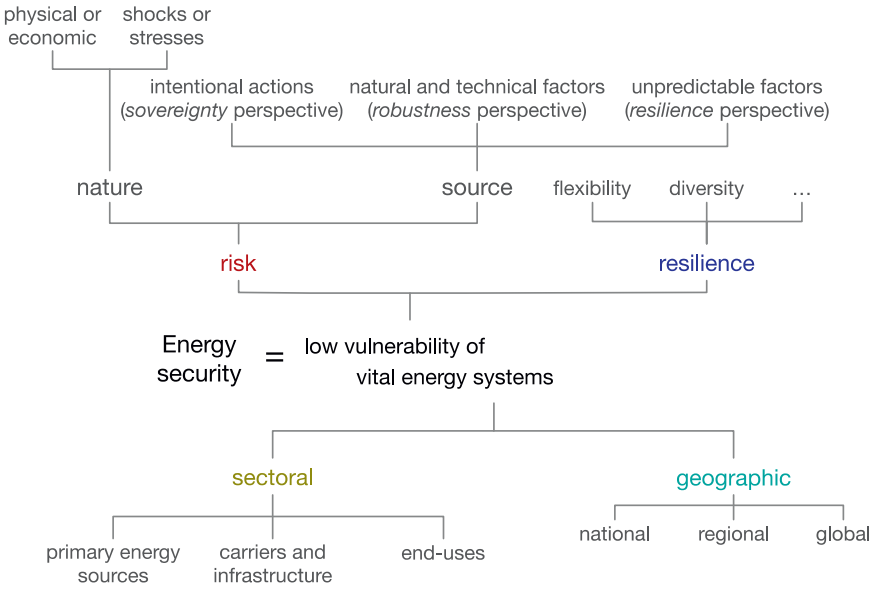

Fig. 1. Energy security is defined as 'low vulnerability of vital energy systems'. Vital energy systems are energy resources, infrastructure and uses linked together by energy flows that support critical social functions. They can be delineated by sectoral or geographic boundaries (e.g. 'the Eurasian gas market' or 'the Western US electricity grid'). Vulnerabilities are combinations of exposure to risks and resilience capacities. The three perspectives on vulnerabilities are rooted in different policy problems and different scientific disciplines. *Source*: Compiled from Cherp and Jewell, 2011, 2013.

identification of vital energy system also allows better targeting of energy security policies (Jewell, 2014).

5.2. Vulnerabilities

Vulnerabilities of vital energy systems are combinations of their exposure to risks and their resilience—Fig. 1 (Cherp and Jewell, 2013; Jewell, 2011; IEA, 2011). Energy security studies differentiate between risks of different natures and origins. Most make a distinction between short-term disruptions called 'shocks' and long-term 'stresses' (Stirling, 2011; Winzer, 2012).[9] The second common distinction is between physical and economic risks. Concerning the latter, a useful energy security analysis cuts through the rhetoric of "affordable", "reasonable", "competitive", "cost-reflective", or "fair" prices. A good starting point is the argument that in the context of energy security: "prices are […] affordable if they stop short of causing severe disruption of normal social and economic activity" (Deese, 1979, 140). Prices can be disruptive for different economic actors as discussed in Table 1 and Section 4.1. Thus using the term 'affordability' with respect to energy security should always answer the question 'affordability for whom?'.

Contemporary energy security studies distinguish not only between the *nature* of risks, but also between their *origins* (or sources as Winzer (2012) puts it). Baldwin (1997) points to a distinction between risks as threats from other social actors and forces of nature. These constitute two fundamentally distinct perspectives (Cherp and Jewell, 2011). One, the 'sovereignty perspective', sees the origin of risks in deliberate actions of foreign actors. It has its roots in political science and focuses on interests, power, intentions, and the space for maneuver. Another, the 'robustness perspective', sees the origin of risks in natural and technological phenomena such as resource scarcity, the aging of infrastructure and natural events. It has its roots in natural science and engineering and focuses on probabilities, magnitude and impacts of disruptive events.

[9] This also relates to Baldwin's (1997) question of security "on what time scale?".

The third perspective on energy security, 'the resilience perspective', sees the origin of risks in largely unpredictable social, economic and technological factors. It has its roots in ecology, economics and complex systems analysis. It shifts the emphasis from risk exposure to the other aspect of vulnerability, resilience. The resilience factors addressed by science and policy of energy security range from more straightforward ones (such as spare production capacities, stockpiling, emergency plans, and diverse suppliers (Yergin, 2006)) to technologic diversification (Stirling, 1994). Two recent articles which explore the resilience perspective are Stirling (2010) who focuses on the different aspects of diversity and Gracceva and Zeniewski (2014) who characterize energy security in terms of what they call 'systemic properties' and Molyneaux et al. (2014) who provide insights on measuring resilience in energy systems from a range of disciplines.

5.3. Referent objects and securitization

Both vital energy systems and their vulnerabilities are not only objective phenomena, but also political constructs defined and prioritized by various social actors. This is where 'referent objects' and the question 'security for whom?' become important. The energy security literature still has not paid enough attention to this question, but there are several promising developments.

A recent policy report from Corner House explores how the politics of scarcity and consumption influence *for whom* energy are secured in policies (Hildyard et al., 2012). Two other academic contributions use securitization theory to explain energy security policies. For example, Leung et al. (2014) show that what is viewed as 'vital' depends not only on characteristics of a particular energy systems, but also on its historical significance and the power of associated institutional interests. Similarly, Nyman (2014) demonstrated how the importance of a single energy company for national energy security in the US was politically constructed to prevent its acquisition by a Chinese company. The combination of securitization theory and the concept of vital energy systems offers promising avenues of future research.

6. Conclusion

Over the last two decades, the science of energy security has evolved from classic political economy studies of oil supplies for industrialized democracies to a field addressing a much wider range of energy sectors and challenges. This evolution has produced a dizzying variety of fragmented and contradictory interpretations of energy security in scholarly and policy literature. In our view these growing pains should not discourage a search for a rigorous conceptualization of energy security to provide a shared platform and language for scientific analysis and for rational policy evaluation and learning.

An influential scheme of classifying energy security concerns proposed by APERC in 2007 included availability, accessibility, affordability and acceptability ('the four As of energy security'). The four As have given rise to different interpretations and modifications, but have not been critically examined as a concept of energy security. In this viewpoint we analyze the four As and the related literature and summarize alternative approaches to conceptualizing energy security.

We start with observing that energy security is an instance of security in general and therefore general concepts from security studies are applicable to energy security. We proceed from Baldwin's (1997) definition of security as a 'low probability of damage to acquired values'. Through a historic analysis we demonstrate that the four As are partially rooted in the classic energy security studies of the 1970s (which coin the notions of availability and affordability) and partly inspired by the literature on access to health care, where the other two notions – accessibility and acceptability – were introduced as early as 1981. Neither these traditions, nor the four As answer or even pose any of the key security questions: "Security for whom?", "Security for which values?" and "Security from what threats?"

We also summarize developments from the emerging science of energy security.[10] Defining energy security as 'low vulnerability of vital energy systems' opens a road towards more detailed specifications of (a) vital energy systems; and (b) their vulnerabilities, composed of exposure to risks and resilience (Fig. 1). Of course, the concepts of vital energy systems, vulnerabilities, risks and resilience have different meanings in different contexts and for different actors. In particular, they reflect not only objective properties of energy stocks, flows, infrastructure, markets and prices, but also political constructs rooted in institutional interests, memories and distinct perspectives on the future. This is precisely why the meaning of energy security will always vary from one place to another. Does it make sense then, one may wonder, to replace one set of 'polysemic' terms (the four As) with another?

We believe it does. The point of conceptualizing a difficult political concept is not to eliminate different interpretations but rather to enable their meaningful analysis, comparison and dialogue. The proposed conceptualization helps to explain and inform policies by prompting the right questions for example: which energy systems are vital? which short- and long-term risks are they exposed to? what is their resilience? what changes in energy prices would disrupt normal activities? for whom? Addressing such questions brings together insights from several scientific disciplines to advance the science of energy security, as well as support informed policy making, better policy analysis and learning.

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[10] The authors would like to thank Gavin Bridge for this term.

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