Evaluating Energy Security in the Asia-Pacific Region: A Novel Methodological Approach

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Abstract

This paper establishes an 'energy security assessment instrument' based on a new and expanded conceptualisation of energy security. The instrument is a systematic interrogative tool for evaluating energy security of individual states or regions. It consists of eleven broad energy security dimensions associated with the current global energy system. These energy security dimensions take into account numerous quantitative and qualitative attributes of a state's energy security and policy, and include both traditional energy security concerns and many new factors, such as environmental, socio-cultural and technological. Another dimension, largely absent from previous analyses, is the existence of, and the issues addressed in, energy security policy in each country. This instrument serves as an assessment system with which to evaluate energy security in the Asia-Pacific region. The instrument is valuable as it may be utilised to draw a comprehensive map of regional energy security, which can also include comparative analysis of energy security characteristics across the Asia-Pacific region.

Keywords: Energy Security, Evaluation Methodology, Asia-Pacific

1. Introduction: New Energy Security Challenges

Energy security has become an emerging area of focus in International Relations, with high energy prices, the increased demand and competition for geographically concentrated resources, the fear of resource scarcity and/or depletion in the near future and concerns with the likely social and political effects of climate change. Due to its polysemic nature, few works have made a serious attempt to clarify the concept of energy security (Chester, 2010). In the existing literature, it is most commonly defined as reliable supplies of energy at reasonable prices to support the economy and industry (Dorian et al, 2006). Most studies conceptualise energy security in terms of security of oil supplies (Fried and Trezise, 1993; Stringer, 2008). This oil supply-based focus has as its cornerstones reducing vulnerability to foreign threats or pressure, preventing a supply crisis from occurring and minimising the economic and military impact of a supply crisis once it has occurred. These goals implicitly assume an "oil supply crisis" as the focus of energy security. In essence, the central tenets of conventional oil-importer focussed energy security policy are: (1) reduction of threats to oil supply, and (2) operating in a mode of crisis management. These tenets constitute a shared view among many key energy policy-makers in both Asia and the West.

Yet, the last decade has seen an extraordinary shift in energy security challenges that challenge existing policy orthodoxies (Victor and Yueh, 2010). Yergin (2006) noted that the traditional understanding of energy security is too limited and must be expanded to include many new factors and challenges, while at the same time recognising that energy security does not stand by itself but is lodged in the larger relations among nations and how they interact with one another. The substance of these challenges therefore needs to be incorporated into a new concept of energy security. With increasingly global, diverse energy

markets and increasingly transnational problems resulting from energy transformation and use, old energy security rationales are less salient, and other issues, including climate change and other environmental, economic and international considerations are becoming increasingly important. As a consequence, a more comprehensive operating definition of 'energy security' is necessary, along with a workable framework for analysis of energy security policy. This is essential to yield greater energy security in a broader, more comprehensive sense for both energy exporters and importers. According to Von Hippel et al. (2009), there are four major challenges that need to be incorporated into a new concept of energy security:

- *Environment*: perhaps the most serious challenge to traditional (supply security-oriented) energy security thinking; if environmental problems, such as climate change and the global warming are to be solved, energy security policies will have to be reformulated
- *Technology*: a key challenge when it comes to energy security is to create the technological basis for a global economy that operates not on fossil fuels but increasingly on alternative and renewable energy sources; as the world moves rapidly toward a "technologically intensive" energy society, a new energy security concept must address the various issues associated with the development of new technologies
- *Demand-side Management*: conventional energy security seeks to assure supply while assuming that demand is given; it has tended to underestimate demand-side risks from, for example, demand surges or large supply capacity surpluses (as a result of recession); uncertainty in the demand side of the total energy picture is a key component of a new concept of energy security
- *Domestic Socio-cultural and Political Factors*: not in my backyard (NIMBY) and other environmental justice concerns are becoming global phenomena, making it increasingly difficult, time-consuming and costly to site large power plants, waste treatment and disposal facilities; opposition to plant sitting has elevated the importance of local politics in energy policy planning; NIMBY epitomises the social and cultural risks that need to be recognised in new energy policy-making agendas

I argue that there are three additional challenges that need to be incorporated into a new concept of energy security:

- *Human Security*: if a state is energy independent, traditionally it may be considered energy secure; however, the new energy security conceptualisation has to take into account providing basic energy services, such as access to electricity, to the entire population; this has been ignored by the traditional conceptualisation of energy security
- *International*: energy security policies must also address international (regional and global) implications of energy security challenges; it is important to consider whether a state is committed to international cooperation on energy-related issues (i.e. regional energy security cooperation, Kyoto or similar agreements)
- *Public Relations*: a mature energy security policy will allow for regular public participation in energy security-related issues and will involve regular public education campaigns on important issues related to energy security
- *Policy*: a final challenge to the traditional energy security thinking is the actual existence of energy security policy; if a state does not have a clearly stated energy security policy, which addresses in detail, the traditional and new energy security

challenges, this shows that this state may not have the capacity and/or commitment to ensure energy security

The above key components are central additions to the traditional supply-side perspective on energy security. Energy security policies in the Asia-Pacific region must address the domestic and international implications of these dimensions.

2. Energy Security in the Asia-Pacific Region

Energy security has emerged as a critical issue in the broader Asia-Pacific region. Many countries in the region are developing countries with rapid economic growth, which is accompanied by an increasing demand for energy. The spectacular recent economic growth in the Asia-Pacific region has spurred a vast expansion in the need for energy services, and an expansion in the demand for the fuels that help to supply these services. This has particularly been the case in China and India. In 2009, ten largest regional economies (Australia, Canada, China, India, Indonesia, Japan, Mexico, Russia, South Korea and the United States) consumed 61 per cent of the world's energy (BP, 2010). The region's energy demand, especially China's and India's, has grown rapidly over the past decade and most projections suggest their voracious thirst for energy will further expand in the coming decades. Future projections suggest that the growth of energy use in the Asia-Pacific region, particularly in China, will have major consequences for geopolitics, financial and energy markets and pollution both regionally and globally (Leverett and Bader, 2005).

Rising demand from China and India is already having a profound impact on the energy world. It is behind the recent resurgence in resource nationalism across the world (Vivoda, 2009a). It is also a factor in higher energy prices and in the changing patterns of greenhouse gas emissions, energy trade and energy geopolitics. The major regional powers' growing energy intake and regional competition for increasingly scarce energy sources have significant security, environmental, economic and political implications for the region and the world. For example, the region's dwindling reserves of oil and gas are insufficient to satisfy the growing demand. China, Japan, India and the United States, the world's four top oil consumers, account for 42 per cent of the world's oil demand yet control only 4 per cent of the world's oil reserves (BP, 2010). Concern about adequate energy supplies, especially among these four countries, has the potential to transform power competition in the Asia-Pacific region from its current bounded forms into open confrontation. At the same time, the ten countries do not use their energy efficiently or in an environmentally responsible way. In order to produce 52 per cent of the world's GDP, they consume 61 per cent of the world's energy and account for 63 per cent of the world's carbon dioxide (CO_2) emissions (EIA, 2009; IMF, 2009). As a result, energy-related pollution is a fact of life in many of these countries. Rapidly increasing growth of fossil fuel use in the region is also already having a profound impact on global greenhouse gas emissions.

The major regional powers' growing energy intake and regional competition for increasingly scarce energy sources have significant security, economic and political implications for the region and the world. At the same time, the United States, China, India and Japan, the world's largest energy importers, and other regional actors are looking for ways to reduce their vulnerability to energy supply (or demand) disruptions and cut down on their emissions. It is in the region's interest that energy competition is kept under control and that a cooperative and binding mechanism to tackle climate change is established. The imperative for energy security in such a vulnerable strategic region as the Asia-Pacific is paramount for

global stability and development. The priority of this challenge for the Asia-Pacific region is also no accident, as it is the world's fastest growing energy consumer. What is worrying is the region's absence of cooperation on energy security (Choo, 2009).

There is a growing body of literature on energy security in the Asia-Pacific region. The existing literature examines the region's current and future energy consumption; domestic energy sources and structure; efforts to expand energy production and improve energy efficiency; and implications of energy consumption and imports of major oil consumers, such as the United States, China, India and Japan (Downs, 2006; Evans, 2006; Kambara and Howe, 2007; Koike et al., 2008; Leiby, 2007; Lesbirel, 2004; Liao, 2007; Madan, 2006; Nakatani, 2004; Noronha and Sudarshan, 2009; Salameh, 2003; Wu and Fesharaki, 2007; Xu, 2002; Xu, 2006). Numerous studies have been devoted to assessing the implications of efforts by China, and particularly its state-owned oil corporations, to tap into overseas oil markets and acquire equity oil deals around the world (Andrews-Speed et al, 2005; Calder, 2006; Dannreuther, 2003; Downs, 2000; Downs, 2004; Herberg, 2004; Lee, 2005; Myers Jaffe and Lewis, 2002; Soligo and Myers Jaffe, 2004; Zha, 2005; Zha, 2006; Ziegler, 2006; Zweig and Bi, 2005). Various edited collections (Lai, 2009; Len and Chew, 2009; Manning, 2000; Marquina, 2008; Wesley, 2007) also examine maritime and energy security in the major regional countries, but fail to engage them comparatively or to offer valuable policy recommendations.

While the existing studies are informative and offer valuable empirical and theoretical insights into regional energy security, they also suffer from serious limitations. No study to date examines regional energy security policies by adopting a more comprehensive energy security definition as a starting point. They fail to operationalise the concept of energy security in policy terms. Most studies also focus on a single country or issue. Even if they examine energy security in major regional economies, they lack critical comparative analysis. Given that most studies utilise the traditional, and narrow, conceptualisation of energy security and are limited in scope, with the exception of a study by Von Hippel et al. (2009) and Sovacool (2011), they are unable to establish a workable framework for analysis of regional energy security and policy in a broader, more comprehensive sense. They also fail to propose a comprehensive set of policy recommendations which would serve as bases for improved regional energy security cooperation.

3. Energy Security Assessment Instrument

Building on work by Von Hippel et al. (2009) and Sovacool (2011), this paper establishes an *energy security assessment instrument* as a means with which to assess energy security in the Asia-Pacific region. Von Hippel et al. (2009) included six dimensions (energy supply, economic, technological, environmental, socio-cultural and military-security) and various measures/attributes in their energy policy conceptual framework. At the same time they noted that these policy issues were by no means complete. With the aim of making the evaluative framework more robust and complete, the instrument proposed here includes six additional dimensions and 32 additional attributes. The instrument will serve as a systematic interrogative tool to evaluate each country's energy security, and will also allow for cross-country and cross-dimensional comparison. Further value of the instrument is that it may be utilised by future studies to assess temporal change (perhaps after ten years) in energy security in any particular state or in a regional context. The instrument (Table 1) consists of twelve broad national energy security dimensions and 46 attributes associated with the current global energy system. These energy security dimensions take into account numerous

quantitative and qualitative attributes of each country's energy security and policy. They include both traditional energy security concerns associated with the security of supply and many new factors, such as environmental, socio-cultural and technological, while at the same time recognising that each country's energy security is located in the larger relations among nations and how they interact with one another (international dimension). Another dimension, largely absent from previous analyses, is the existence of, and the issues addressed in, energy security policy in each country.

Table 1: Energy Security Assessment Instrument

Energy security dimension	**Attribute**	**Interpretation (preferred)**
1. Energy supply *	A. Fraction of primary energy as imports *	- low
	B. Diversification (by fuel type) *	- high
	C. Diversification (by source) *	- high
	D. Diversification (by transport routes)	- high
	E. Diversification of electricity generation (by fuel type)	- high
	F. Quality of electricity transmission and transformation network	- high
	G. Stocks (i.e. strategic petroleum reserves) as a fraction of imports *	- high
	H. Refining / fuel processing capacity as a fraction of primary energy consumption	- high
	I. Reliance on market / non-market mechanisms to secure energy imports or export markets	- market
2. Demand management	A. Evidence of fossil fuel demand reduction (through conservation / substitution) as a result of policy initiatives	- yes
	B. Exposure to demand-side risks	- low
3. Efficiency	A. Energy efficiency (mtoe/US$1,000 of GDP)	- low
	B. Energy consumption growth / economic growth ratio	- low
4. Economic *	A. Total fuel costs / GDP *	- low
	B. Import fuel costs / GDP *OR* Export fuel earnings / GDP	- low *or* high
	C. Exposure to energy-related economic / fiscal risks	- low
5. Environmental *	A. Reliance on fossil fuels as a fraction of primary energy consumption	- low
	B. Greenhouse gas emissions (CO_2, CH_4) / GDP *	- low
	C. Acid gas emissions (SO_x, NO_x) / GDP *	- low
	D. Other pollutants (air, water, solid waste) *	- low
	E. Nuclear waste (tonnes of Curies, by type) *	- low
	F. Exposure to energy-related environmental risks (i.e. sea level rise, climate change, extreme weather events) *	
6. Human security	A. Fraction of population with access to basic energy services (i.e. electricity)	- high
7. Military / security *	A. Exposure of critical energy infrastructure to energy-related military / security risks (i.e. terrorism, conflict over resources, piracy, sabotage, spread of nuclear weapons) *	- low
8. Domestic socio-cultural / Political *	A. Exposure to social or cultural energy-related risks (i.e. NIMBYism, energy sector labour unrest) *	- low
	B. Exposure to political energy-related risks (i.e. strong coal or oil lobby)	- low
9. Public Relations °	A. Availability of public information about energy security-related issues °	- high
	B. Public participation in energy security-related decision making °	- high
10. Technological *	A. Diversification for key energy-related industries (i.e. power generation) by technology type *	- high
	B. Total energy-related R&D spending / GDP	- high
	C. Diversity of energy-related R&D spending *	- high
	D. Exposure to energy-related technological risks	- low
11. International	A. Commitment to regional and other international cooperation on energy-related issues (i.e. to increased regional energy security	- high

	cooperation, such as on energy stockpiles, or to Kyoto Protocol or similar international energy-related agreements)	
12. Policy	A. Existence of energy security policy	- yes
	B. Transparency of energy security policy	- high
	C. Regular policy reviews	- yes
	D. Supply issues addressed in policy	- yes
	E. Demand management issues addressed in policy	- yes
	F. Efficiency issues addressed in policy	- yes
	G. Economic issues addressed in policy	- yes
	H. Environmental issues addressed in policy	- yes
	I. Human security issues addressed in policy	- yes
	J. Military / security issues addressed in policy	- yes
	K. Socio-cultural and political issues addressed in policy	- yes
	L. Technological issues addressed in policy	- yes
	M. International cooperation issues addressed in policy	- yes

Source: energy security dimensions and attributes annotated with an * have been adapted from Von Hippel et al. (2009); energy security dimensions and attributes annotated with an ° have been adapted from Sovacool (2011)

A key goal of energy policy is to improve energy security – whether broadly or narrowly defined – and thus to reduce existing or looming "energy insecurity" (Von Hippel et al, 2009). It is assumed that a nation-state is energy secure if all or most of the attributes have a 'preferred' value attached to them. Each energy security dimension and attribute in Table 1 is deeply rooted in the literature on Energy Security, Energy Policy, International Relations and Environmental Studies. It is beyond the scope of this paper to justify the inclusion of each of the 46 attributes of energy security and elaborate on the measurement methodology for each of the attributes. Many of them are logical and self-explanatory, and deriving the answer will require simple calculations or the application of a diversity index (see Kruyt et al., 2009). Others, particularly the interpretations of international and policy attributes, will require quantification of relatively simple qualitative answers. Several examples are outlined below for illustration purposes.

By applying quantitative measures of diversity it is likely that the United States will score 'high' and Japan 'low' on diversification of energy supply by source and transport routes (Vivoda, 2009b). With regards to market / non-market behaviour to secure energy imports, it is likely that the findings will indicate that the US relies on market mechanisms and China largely relies on non-market mechanisms. It is highly likely that Japan will score 'high' for evidence of fossil fuel demand reduction (through conservation / substitution) as a result of policy initiatives. It is more than likely that Western liberal democracies, such as Australia, Canada and the US, will score 'high' on exposure to social or cultural energy-related risks, such as NIMBYism, whereas authoritarian states, such as China and Russia, may score 'low'. Finally, it is also likely that most regional countries will score 'low' for commitment to regional and international cooperation on energy-related issues.

4. The Value of the Energy Security Assessment Instrument: Beyond the Regional Energy Security Dilemma

In the first instance, the value of the instrument is that it will allow for detailed and sophisticated interrogation of the regional energy security attributes and policies, according to the eleven key dimensions. In the first instance, each of the ten countries' energy security will be mapped according to the questions and attributes in the energy security assessment instrument. After each country's energy security has been mapped, it will be possible to rank

the countries according to how 'energy secure' they are. While there may be little value in developing a sophisticated quantitative measure of energy security for each country, what will be of much value are the cross-country differences across eleven energy security dimensions and the overall cross-dimensional differences for the ten surveyed countries. For this purpose, several energy security typologies will be constructed.

Further value of the instrument is that it will be essential for construction of *energy security typologies*. The typologies will provide significant theoretical foundation for future evaluation of regional energy security policies, and as such, be a significant contribution to the existing literature on energy security. Empirical typologies are best understood as a form of social scientific shorthand (Ragin, 1987). A single typology can replace an entire system of variables and interrelations. Typologies help social scientists comprehend the diversity that exists within a general class of social phenomena. Consequently, the construction of typologies will allow for classification of energy security in various countries according to their *main structural features*. To illustrate, it is possible that energy security features of developing countries that are also net energy importers, such as China and India, may have a significant degree of similarity across a number of dimensions. Yet, it is also possible that they will be structurally different from developed energy importers, such as Japan and South Korea, and from energy exporters, such as Australia and Russia. As a result, three different energy security typologies may be developed from this simplified hypothetical example. These innovative typologies may be based on multiple dimensions and would be essential as tools for engaging in any meaningful cross-country comparison. The typologies will provide the basis for identification of regional energy insecurities. It is anticipated that energy insecurities will vary across typologies and energy security dimensions. Once key areas of energy insecurity have been identified, the aim will be to develop a cooperative regional framework under which these insecurities may be reduced and regional energy security enhanced.

An assessment of regional energy security has to be underpinned by an understanding of how states and non-state actors interact in a highly politicised market. Energy security is a vital national security concern for all states and energy nationalism dominates the behaviour of nation-states in Asia (Lam, 2009). As a result, the current trajectory of energy markets in the Asia-Pacific is consistent with Robert Jervis' security dilemma. Jervis (1978) argued that security for one state reduces the security of the other. According to this "security dilemma", many of the means by which a state tries to increase its security, decrease the security of others. These theoretical assumptions also apply in the area of energy security. For example, if one state pursues a non-market strategy (without increasing oil production) to secure sufficient supplies of oil to satisfy domestic needs, this improves its energy security, but by removing oil from the market, deteriorates energy security of other oil importing states. Indeed, there is evidence that Japan routinely pays higher prices for energy because of the hoarding practices of neighbouring states (Vivoda and Manicom, 2011). Simultaneously however, energy security is achieved by non-state actors operating in world energy markets. An energy security gain for one state does not necessarily need to be a loss for other states. The expanded conceptualisation of energy security employed here illustrates the entire set of interests at stake, and thereby identifies the areas where interests overlap. Consistent with Keohane and Nye (2001), the potential exists under these conditions for states to build institutions in order to lower transaction costs and pursue absolute rather than relative gains. Recognising this 'energy security dilemma' is a first step towards mitigation of energy security cooperation problems in the Asia-Pacific region.

Regional energy security in the Asia-Pacific requires a multilateral approach. Energy security in the Asia-Pacific remains a complex and multifaceted challenge, with three main issues mandating coordinated action: 1) reducing dependence on fossil fuels and/or securing an adequate alternative supply to meet rising demand; 2) addressing the environmental impact of the region's energy use, as seen by the environmental repercussions from the heavy coal use in China, for example; and 3) agreeing to specific policies to improve the regional energy infrastructure and transportation networks, as well as safeguarding vital sea-lanes and "chokepoints." It is in Asia-Pacific nations' interests that they pool their resources together and jointly strive for collective energy security. For that reason, multilateral initiatives are preferable to unilateral or bilateral efforts. Ultimately, the key value of the energy security assessment instrument is that it will be essential for setting up a framework for improved regional energy security cooperation, while recognising the underlying energy security dilemma in the Asia-Pacific region. The aim of the framework will be to enhance the ability of regional policy officials to more effectively evaluate their energy security situation and improve national and regional energy security. The framework will provide a comprehensive blueprint on how energy security-related vulnerabilities and competition may be reduced and regional energy cooperation enhanced. This is in line with the 2007 'Cebu Declaration on East Asian Energy Security' as part of the Second East Asian Summit (EAS) and other non-binding regional bilateral and multilateral energy-related initiatives, such as the Asia-Pacific Economic Cooperation (APEC) Energy Security Initiative, the US-China Energy Security Cooperation Dialogue.

5. Conclusion

This paper has offered a corrective to the narrow and outdated conceptualisation of energy security. Based on an expanded conceptualisation of energy security, the paper established an 'energy security assessment instrument', a novel systematic interrogative tool which may be utilised to analyse energy security of individual states or regions. A study by Von Hippel et al. (2009) has inspired the design of the instrument. However, the evaluative framework proposed in this paper is more robust and complete than that put forward by Von Hippel et al. (2009). Overall, it consists of twelve broad national energy security dimensions associated with the current global energy system. The value of the instrument is that it will be essential for construction of energy security typologies. The construction of typologies will allow for classification of energy security in various countries according to their main structural features. The typologies are likely to provide significant theoretical foundation for future evaluation of energy security policies in the Asia-Pacific region, and as such, be a significant contribution to the existing literature on energy security.

Development of an improved energy security policy begins with a review of the attributes of the current energy system. In future research, the energy security assessment instrument will be utilised to draw a comprehensive map of regional energy security situation. The research outcomes will provide the first region-wide comprehensive assessment of energy security. Utilising the energy security assessment instrument in order to map regional energy security will generate some of the most comprehensive data series available on energy security in the Asia-Pacific region. This will add greatly to the intellectual knowledge of the discipline, deepen our understanding of energy security and policy in the Asia-Pacific region and set foundation for a policy framework with which to improve regional energy security and reduce strategic competition.

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