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Understanding Attitudes toward Energy Security: Results of a Cross-National Survey

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ABSTRACT

Energy security is embedded in a complex system encompassing factors that constitute the social environment in which individuals are immersed. Everything from education, to access to resources to policy and cultural values of particular places affects perceptions and experiences of energy security. This article examines the types of energy security challenges that nations face and characterizes the policy responses that are often used to address these challenges. Drawing from a survey of energy consumers in ten countries, we conduct a cross-national comparison of energy security attitudes and analyze each country's corresponding energy resources, consumption characteristics and energy policies. Through multivariate regression analysis and case studies we find that socio-demographic and regional characteristics affect attitudes towards energy security. Specifically, a strong relationship exists between level of reliance on oil imports and level of concern for a variety of energy security characteristics including availability, affordability and equity. Our results also reaffirm the importance of gender and age in shaping perceptions of security. Level of development, reliance on oil and strong energy efficiency policies also affect individuals' sense of energy security. In sum, we find that energy security is a highly context-dependent condition that is best understood from a nuanced and multi-dimensional perspective.

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1. Introduction

The traditional conception of energy security addresses the relative availability, affordability, and safety of energy fuels and services. The World Bank Group (2005), for example, tells us that energy security is based on the three pillars of energy efficiency, diversification of supply, and minimization of price volatility. Consumer advocates and users tend to view energy security as reasonably priced energy services without disruption. Major oil and gas producers focus on the stability of their access to new reserves, while electric utility companies emphasize the integrity of the electricity grid. Politicians dwell on protecting energy resources and infrastructure from terrorism and war. From a distinct vantage point, scientists, engineers, and entrepreneurs characterize energy security as a function of strong energy R&D, innovation, and technology-transfer systems. These diffuse conceptions of energy security map onto distinct national energy-security concerns, which undoubtedly are reflected in the attitudes of citizens.

Given the complex nature of energy security, emerging energy security challenges, and differing socioeconomic attitudes, it is important to understand the factors that shape individual perspectives on energy security. The literature suggests that demographic factors play a considerable role in determining perception of and exposure to energy security. However, social identity as influenced by place of residence is also important in shaping perceptions of security. Energy security is embedded in factors that constitute the social environment in which individuals are immersed, including everything from education to access to resources to policy and cultural values of particular places.

This article examines the types of energy security challenges that nations face and characterizes the policy responses that are often used to address these challenges. To do this we analyze a ten-country survey of attitudes towards energy security, evaluating not only demographic characteristics, but also national characteristics that constitute the level of energy vulnerability or security to which respondents are exposed. We have designed our survey to focus on energy as a whole—cutting across multiple sectors, technologies, and commodities—rather than individual fuels to reflect the reality of modern energy production and usage (dependent on a portfolio of different sources). This broadens the focus to collective energy security rather than narrower concepts of like oil or grid security. In addition to evaluating socio-demographic characteristics we seek to strengthen existing literature by incorporating geographic considerations into our survey. We triangulate our survey with data informing the level of energy security of each of the countries evaluated. These data include a wide spectrum of national policies and energy profiles that constitute the energy environment in which individuals reside.

Our results reaffirm the importance of demographic characteristics, but also add new insight into the types of energy profiles that promote stronger perceptions of and interest in energy and climate security. In particular, we find a strong negative correlation between the level of reliance on oil imports and citizen valuations of energy security. Likewise we find a negative correlation between the level of economic development (as measured by GDP per capita) and the emphasis placed on security characteristics including availability, welfare, affordability, transparency, and environmental stability.

The article proceeds with six sections. In Section 2 we examine the types of energy security challenges that nations face and characterize the common policy responses. We then describe the research design used in our cross-national comparison of energy security attitudes (Section 3). We present our descriptive results in Section 4, beginning with an overview of each country's energy resources and consumption characteristics as well as the energy policies they have in place. Then, turning to a comparison of their views of energy security, we focus on variations in respondents; assessments of 20 attitudinal measures. In Section 5, we explore the socio-demographic and regional characteristics of attitudes towards energy security through multivariate analysis. The article concludes with an overview of our findings and recommendations for future research.

2. Conceptual Framework

This section introduces readers to the concept and practice of energy security, broadly defined as equitably providing affordable, reliable, efficient, environmentally benign, proactively governed and socially acceptable energy services to consumers. The first part of this section illustrates different national strategies towards achieving energy security followed by a brief discussion of energy security challenges such as growing demand, infrastructural limitations, and climate change. The final part summarizes socioeconomic attitudes and perceptions towards energy supply, energy use, and the environmental constraints involved with the energy sector.

2.1 The Range of Energy Security: Sufficiency to Dependency

In the United States, energy security has generally meant the availability of sufficient energy resources and services at affordable prices (Lesbirel, 2004). The oil security policy of the United States was formalized by the Carter Doctrine, which stated that any effort by a hostile power to block the flow of oil from the Persian Gulf would be viewed as an assault on the vital interests of the United States and would be repelled by "any means necessary, including military force" (Klare, 2007). Under various presidents, oil security has meant ending all oil imports, eliminating imports only from the Middle East, merely reducing dependence on foreign imports, and entirely weaning the country off oil. US energy-security policy has historically also included maintaining a strategic petroleum reserve, reducing physical threats to energy infrastructure, and preventing the proliferation of nuclear weapons in "non-nuclear weapons states" and non-signatories to the Nuclear Non-Proliferation Treaty such as Iran and North Korea (Sovacool and Brown, 2010). More recently, concern about an increasingly fragile U.S. electricity grid has become more evident (EPRI, 2011) and is heightened by the expanded electrification of US military operations (U.S. Army, 2010; U.S. Department of Defense, 2011).

Other countries with limited energy resources have deployed different strategies to achieve security. Japan has pursued an energy security strategy of diversification, trade, and investment, as well as selective engagement with neighboring Asian countries to jointly develop energy resources and offset Japan's stark scarcity of domestic reserves (Atsumi, 2007; Toichi, 2003). Conversely, in the United Kingdom energy security tends to be associated with promoting open and competitive energy markets that will provide fair access to energy supplies, foster investment, and deliver diverse and reliable energy at competitive prices (Chang and Lee, 2008).

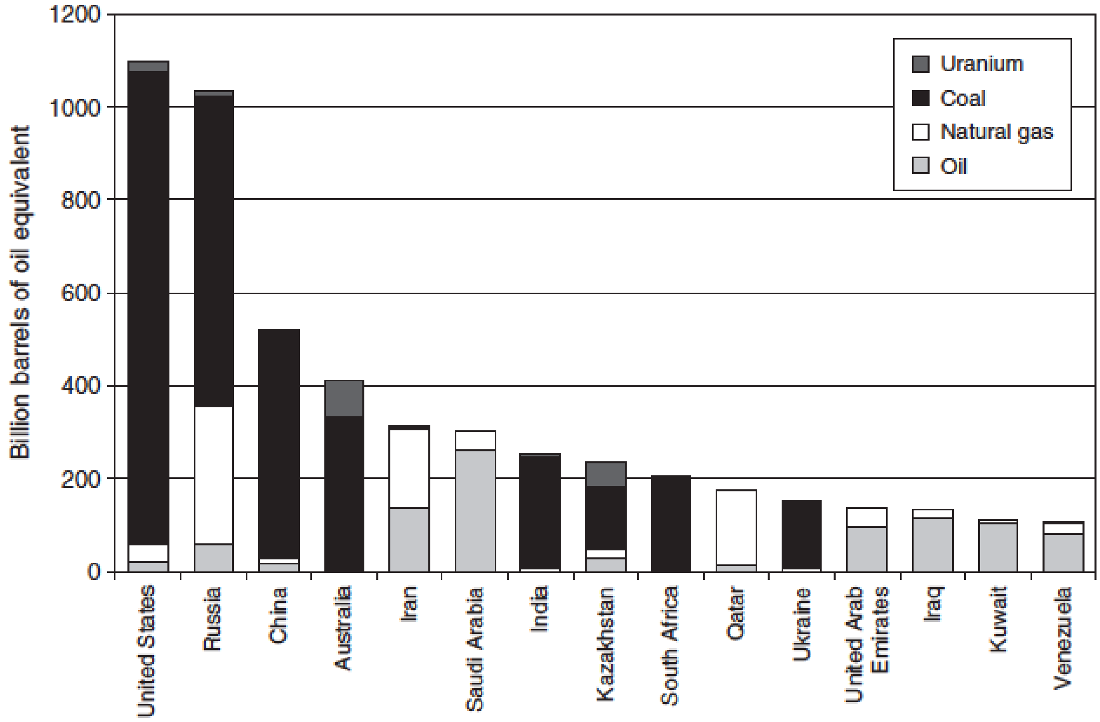
Similarly, the focus on energy security in countries that are struggling to meet their energy requirements is quite distinct. China, for example, has viewed energy security as an ability to rapidly adjust to their new dependence on global markets and engage in energy diplomacy, shifting from its former commitments to self-reliance and sufficiency (*zi li geng sheng*) to a new desire to build a well-off society (*xiaokang shehui*) (Bambawale and Sovacool, 2011a). China's current approach to energy security entails buying stakes in foreign oil fields, militarily protecting vulnerable shipping lanes, and an all-out "energy scramble" for resources (Cheng, 2008; Dadwal, 2007; Kim and Jones, 2005; Xu, 2006).

Among the countries with excess supplies of oil and natural gas, the focus on energy security takes on other forms. As one example, Russia appears to pursue an energy security strategy of asserting state influence over strategic resources to gain primary control over the infrastructure through which it ships its hydrocarbons to international markets. Restricting foreign investment in domestic oil and gas fields is an important element of this strategy. Buoyed by this strategy, Russia was recently able to triple the price of natural gas exported to Belarus and Ukraine because those countries were completely dependent on Russian supply (Sevastyanov, 2008). Nevertheless, 'security of demand' is critical for Russia, and it aims to reassert state control over strategic resources and gain primacy over the main pipelines and market channels through which it ships its petroleum and natural gas to international markets (Yergin, 2006). Saudi Arabia similarly pursues energy security by maintaining security of demand for its oil and gas exports (Bambawale and Sovacool, 2011c). In contrast, Australia's strategy involves cultivating a strong demand for uranium, natural gas, and coal trading (Leaver, 2007, 2008; Wu et al., 2008). Venezuela and Colombia focus on minimizing attacks on oil, gas, and electric infrastructure (Barrera-Hernandez, 2004).

International comparisons of energy security highlight the interdependence of countries enmeshed in larger relationships between and within producers and consumers of energy fuels and services. Globally, trade in energy commodities amounted to more than $3 trillion in 2011, including oil, natural gas, coal, and uranium (Brown and Sovacool, 2011). As a result, few countries are truly energy independent. As Figure 1 shows, the world's known oil reserves (1.2 trillion barrels) are concentrated in volatile regions, as are the largest petroleum companies. The three biggest petroleum companies—the Saudi Arabian Oil Company, the National Iranian Oil Company, and Qatar Petroleum—own more crude oil than the next 40 largest oil companies combined. The 12 largest oil companies control roughly 80 percent of petroleum reserves and are all state owned.

Therefore, although oil and gas are internationally traded in what superficially resembles a free market, most supplies are controlled by a handful of government-dominated firms and major oil companies. The distribution of other conventional energy resources, including coal, natural gas, and uranium, is equally consolidated. Eighty percent of the world's oil can be found in nine countries that have only 5 percent of the world population, 80 percent of the world's natural gas is in 13 countries, and 80 percent of the world's coal is in six countries. Many of the same countries are among the six that control more than 80 percent of the world's uranium resources (Brown and Sovacool, 2011). The oligopolistic nature of oil markets makes it difficult for countries that are heavily reliant on oil imports to truly have energy independence. For example Hayden Lesbirel (2004) demonstrates that as Japan diversified its energy portfolio after the 1970 oil price shocks, it inadvertently regionally concentrated its reliance on Middle Eastern oil. In countries such as Japan that have few natural resource and limited ability to diversify their energy supply, the reliance on oil and the companies and countries that supply it may become normalized, thereby minimizing the emphasis on and importance of energy independence among their citizens.

Figure 1. Global Distribution of Energy Reserves



(Source: Brown and Sovacool, 2011)

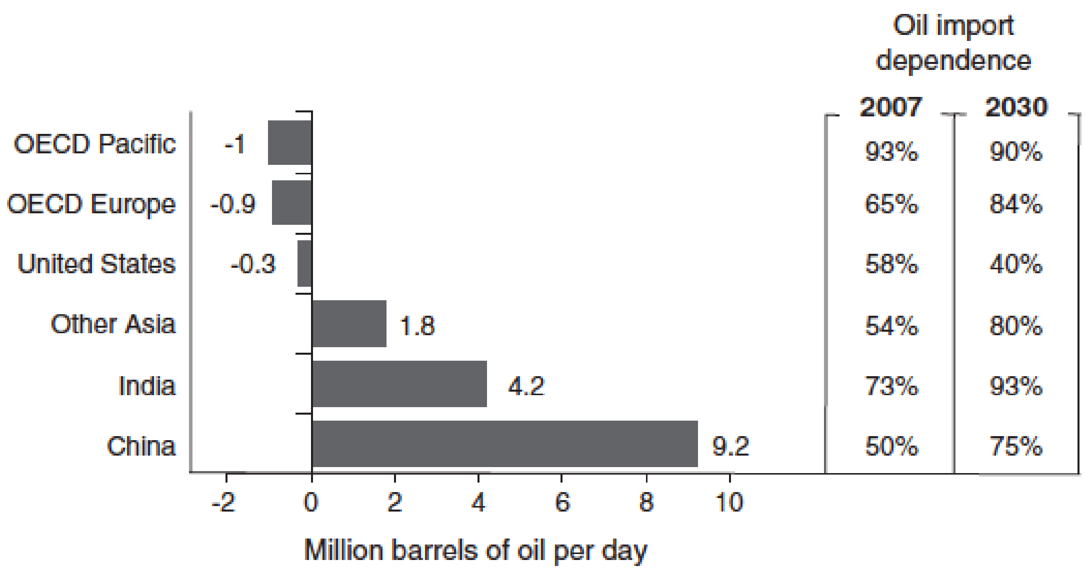
As a result, threats to energy security take distinct forms. Japan and Chile have essentially no domestic fossil fuels and thus are completely dependent on foreign supplies. Saudi Arabia is the largest exporter of crude oil but must import refined gasoline. Russia exports natural gas but must import uranium. The United States is a net exporter of coal but imports oil. This interdependence explains why any discussion of energy security must consider the interactions between countries as much as it considers the resources of individual countries. Energy security does not stand abstractly by itself; rather, it is most meaningful in a geographic context.

2.1.1 Energy, Infrastructure and Climate Change

The deterioration of energy security has also become increasingly multi-dimensional as its links to other challenges become clearer. The growing worldwide demands for electricity and for mobility compounds issues of energy security. The world is in transition from a position of abundant fossil energy supplies to a future of limited fossil energy resources. The demand for energy is expected to increase by 45 percent between now and 2030, and by more than 300 percent by the end of the century. Coal without carbon capture and sequestration is projected to account for the largest share of this overall rise, with oil and natural gas consumption also expanding rapidly.

The growing imbalance of oil production and consumption exacerbates the risk of fuel shortages and interruptions in supply, which will take a fairly rapid turn for the worse for many countries if alternative fuels such as ethanol and biodiesel are not widely deployed. The likely geographic pattern of expected oil production and consumption over the next two decades suggests that oil dependence in Europe, China, India, and other Asian countries could grow rapidly, each importing 75 percent or more of its oil by 2030. All of the growth in oil demand is forecast by the International Energy Agency to come from non-OECD countries, with China contributing 43 percent and the Middle East and India each about 20 percent. As Figure 2 depicts, the increase in oil dependence in India is expected to be particularly dramatic, exceeding 90 percent by 2030.

Figure 2. The Growing Imbalance Between Energy Supply and Demand



(Source: Brown and Sovacool, 2011)

The destabilization of the world's climate (or, to be more precise, of certain climatic zones), driven by relentless emissions of greenhouse gases, has the potential to exacerbate food and water shortages, advance the spread of infectious disease, induce mass migration, damage trillions of dollars of property, and precipitate extreme weather events—all of which could lead to increased conflict worldwide.

This broad range of threats to energy security necessitates a holistic treatment of causes and effects. Without a fully articulated appreciation of these complexities, different strands of energy and climate policy run the risk of competing with each other or, worse, trading off so that the net result is continued emissions, higher prices, greater energy poverty, and degraded security.

2.2 Socioeconomics & Attitudes Towards Energy and the Environment

Climate and energy policy are further complicated by the fact that the impacts of energy security and of climate change vulnerability vary among different countries, communities and individuals. The literature suggests that socio-demographic characteristics have a strong impact on vulnerability (Pidgeon et al., 2008). Perceptions about energy security and climate change are also subject to considerable socio-demographic variation (Casey and Scott, 2006). Females, individuals with higher levels of education, and liberals are more likely to engage in environmentally responsible behavior (Casey and Scott, 2006).

With respect to gender, McCright and Dunlap (2011) have found that conservative white males are significantly more likely than are other Americans to endorse denialist views on climate change. A recent opinion poll in the U.S. found that energy supply security is found to be the top priority for men in all but the youngest age groups. Alternatively for women the environment and climate is of highest importance regardless of age (Jordan, et al., 2012). These findings are consistent with the results of the “Six Americas” study, which finds that females are more likely to be ‘concerned,’ ‘very sure global warming is happening’ and that it is ‘caused mostly by human activities’ (Leiserowitz, 2012).

However, the impact of gender is not universal and must be contextualized by other factors, such as age and education. One study found no significant differences between male and female students in their environmental attitudes and their attitudes on green products (Chen and Chai, 2010). The significance of demographic characteristics such as gender is reduced when other variables such as the consumption of environmental literature, environmental concern, and environmental worldview are taken into account (Mobley et al., 2010). Staughan and Roberts (1999) find that perceived consumer effectiveness (PCE) provides the greatest insight into ecologically conscious consumer behavior. Additionally, research has revealed significant links between social identity and perception of information, risk perception and adaptation (Frank et al., 2011). Strong in-group identity and perceptions of potentially influential out-groups such as the scientific community appear to particularly influence perception and use of information when making environmental decisions. These findings suggest that social identity plays a role in climate-risk perception, motivation and adaptation (Frank et al., 2011).

Gender similarly has been reported to be a strong indicator of perceptions of climate vulnerability. Women express a significantly greater belief in negative outcomes as a result of climate change than men (Bord and O'Connor, 1997). The gender gap is indicative of perceived vulnerability to risk. In comparing other significant demographic variables, such as education, income or knowledge, Brody et al. (2008) found gender to be the only significant demographic variable that explains perceived risk. However, vulnerability indicators are only appropriate for identifying vulnerable people, and only at local scales, when systems can be narrowly defined and inductive arguments can be built.

For the other types of problems, either vulnerability is not an adequate concept or vulnerability indicators are not an adequate methodology (Hinkel, 2011). Scholars have, for example, questioned the assumptions behind women’s vulnerability and virtuousness and highlighted how these concepts deflect attention from inequalities in decision-making (Arora-Jonsson, 2011). Generalizations about women’s vulnerability and virtuousness can lead to an increase in women’s responsibility without corresponding rewards. By reiterating statements about poor women in the South and the pro-environmental women of the North, these assumptions can further reinforce North–South biases (Arora-Jonsson, 2011).

Therefore there is need to contextualize debates on climate change and energy security to enable action and to respond effectively to its adverse effects in specific places. Cinner and colleagues (2012) have explored vulnerability across 29 coastal communities in five western Indian Ocean countries to understand the impacts of coral bleaching on fishery returns. They find that the three dimensions of vulnerability (exposure, sensitivity, and adaptive capacity) vary considerably within and between the five countries (Cinner et al., 2012). To adequately understand climate impacts and perceptions it is important to evaluate vulnerability within the context of specific places.

Place specific considerations not only take account of demographic characteristics, but also give some sense of the social atmosphere in which identity is developed. Scholars have found that social processes such as community cohesion, good leadership, and individual support to collective action are critical factors that influence the perception people have about their community's ability to build resilience and cope with change (Schwarz et al., 2011). There is also a need for analysis that can explore impacts and dynamics of social values from the local (internal) to more global (external) scale. For example, exploration at different scales can create a broader understanding of the discourses that create climate policy (Rogers-Hayden et al., 2011). Policy is often made at the national scale with many countries unwilling to sign away energy sovereignty to a regional or supranational authority. As such, it is also important to analyze energy policy, and perspectives on energy security at the national level (Patt, 2010).

Taken together these studies suggest that demographic factors play a considerable role in determining perception of and exposure towards climate change and energy security. However, social identity is also important in shaping perceptions of security. Identity is influenced by the places in which individuals live. As such, energy security and climate perception may exist at the nexus of innate demographic characteristics and the socio-ecological environments to which individuals are exposed, including everything from education to access to resources to policy and cultural values of particular places.

3. Research Methods

Drawing from these separate strands of thought—the complex nature of energy security, emerging energy security challenges, and differing socioeconomic attitudes—properly understanding perceptions of climate and energy security becomes a matter of understanding the factors that constitute the social environment in which individuals are immersed. To do this we evaluate not only demographic characteristics but also national characteristics that constitute the level of energy vulnerability or security to which each individual and indeed demographic group is exposed. We therefore incorporate geographic considerations into our survey, and triangulate our survey with data informing the level of energy security of each of the countries evaluated. These data include a wide spectrum of national policies and energy profiles that constitute the energy environment in which individuals reside. We endeavored to develop a survey to add new insight into the energy security concept by exploring attitudes at the nexus of demographic and socio-environmental factors.

It might be argued that surveying individuals perceptions is of limited utility for understanding energy security if experts themselves do not agree on the concept. At issue here are two social frames of knowledge. The effort of epistemic communities (networks of experts) to distill consistent and logical conceptualizations of energy security is valuable. Indeed, we contribute to that very activity in this article. However, it is plausible, even probable, that social, intersubjectively established understandings of energy security will differ from the understandings developed by epistemic communities—which often aim at universalistic, decontextualized views. Intersubjective understandings will by their very nature be more socially grounded, arising through geographically distinct interactions between the individuals and groups that comprise society and shaped by already existing social structures (Hayes, 2012; Hopf, 2012; Berger and Luckman, 1967). As a consequence, insights drawn from intersubjective frames can help illuminate the complex, multi-dimensional nature of energy security systems.

Intersubjective structures have significant implications for understanding complex issues like energy security. The nature and challenge of energy security is not objectively but instead politically determined. Individuals—through their interactions with each other and with existing social and political structures—shape policy. In turn, the policy conditions to which individuals are exposed shape their perspectives of energy security. The literature on securitization theory in international relations highlights the importance of analyzing security as the result of a political process in which social structures as well as individual preferences play an important role (Buzan, 1998; Stritzel, 2007; Balzacq, 2005). In order to build an adequate understanding of energy security as a political phenomenon, we must account for variations in how the issue is intersubjectively constructed between and across geographies. By surveying individuals and looking for patterns in the responses, we begin the process of charting intersubjective understandings of energy security. Convergences between the responses of individuals highlight the presence and operation of intersubjectively established social norms (i.e. normalization of high energy prices, concern for energy availability rather than transparency), which are shaped by and in turn shape energy and environmental policy. As such, survey responses allow us to analyze the socio-demographic and regional characteristics that inform understandings and experiences of energy security both within and beyond the nation-state.

To do so, we distributed a survey questionnaire in our ten sample countries to collect data about people's attitudes and concerns on energy security, a process summarized by Sovacool et al. (2012). However, unlike that work, this article then looks at each country's profile on key energy and political characteristics along with their energy policy profile. To specify the country difference in attitudes toward energy security, we run multivariate regressions on country residence by controlling for socioeconomic status. Finally, the regression results were cross-checked with the country profiles and policy profiles to better understand the impact of domestic policies on energy security. This section lays out the details of our data collection method and regression analysis.

3.1 Survey data

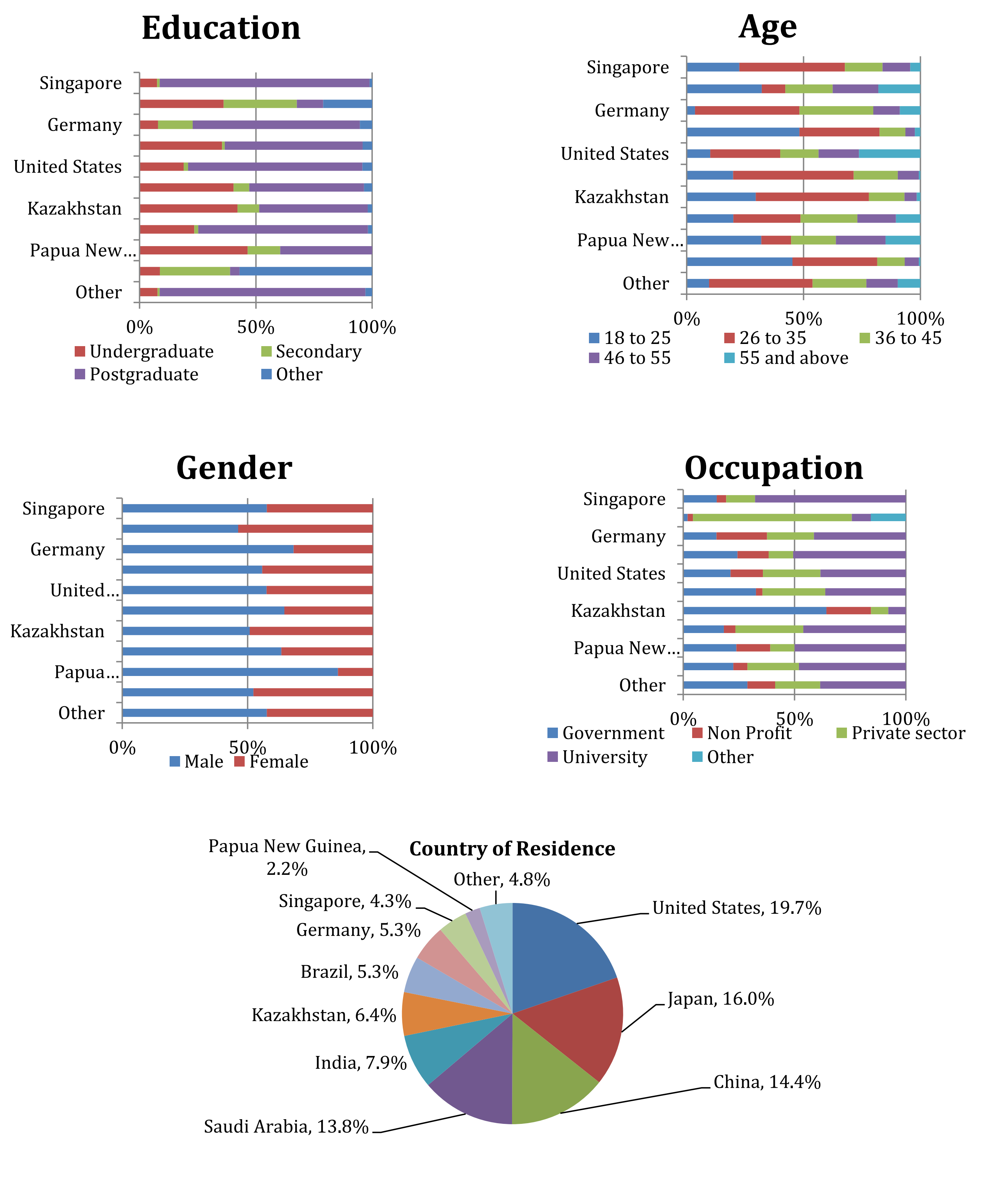
Our questionnaire conceived of energy security as consisting of sixteen different components drawn from an extensive review of the literature as well as a series of research interviews, focus groups, and an expert workshop, processes described in Sovacool et al. (2012). The questionnaire was distributed in seven languages (English, Mandarin, Portuguese, Russian, Arabic, German, and Japanese) to a mix of respondents in eleven countries: Brazil, China, Germany, India, Kazakhstan, Japan, Papua New Guinea, Russia, Saudi Arabia, Singapore, and the United States. The diversified country composition represents both sides of global energy trading with varied degrees of domestic market regulation and international political power. Moreover, it includes countries with a mix of different political systems (capitalist, communist, and hybrid), stages of economic development (post-industrial, industrializing, lower middle income), energy economies (exporters, importers, and transit countries), and geographic regions (North America, Asia, and Europe).

We distributed the questionnaire both in print and online, although no participants in Papua New Guinea utilized the electronic version. The survey sample was not random, but instead purposive to ensure a broad coverage of participants from different sectors including government officials, businesspersons, employees of non-governmental organizations, and university employees, who were not necessarily experts in the field of energy. In other words, we targeted respondents with different backgrounds and from dissimilar sectors to capture a diversity of perspectives within the sample. Such techniques have been shown to increase the validity of research in the fields of critical stakeholder analysis, political science, statistics, and public health. Participation was voluntary with no compensation.

The survey questions were deliberately structured to measure the energy security attitudes in multiple dimensions (Sovacool et al., 2012). From January 2010 to July 2010, a total of 2,167 surveys were completed providing the measurement of sixteen dimensions of energy security. The survey results represent the opinions of an informed audience with a mix of demographic characteristics (Figure 1). Our survey is biased toward postgraduates and university employees, and countries with more respondents. Indeed, the number of respondents from Russia was too small for inclusion in our cross-national statistical analysis. Thus, our study is limited to ten countries, with the addition of an “other” category of respondents principally from Russia. The sample also possibly suffers from self-selection bias (Sovacool et al., 2012).

Figure 3: Demographic characteristics of our energy security survey sample

Education and gender figures expressed in percentage, 100% = 2036 respondents



3.2 Analytic Approach

We created eight scaled variables that summarize attitudinal responses to 16 dimensions of energy security. Correlation and factor analysis were used to determine significant factors for each scaled variable. For example, to construct the Availability Scale, five variables developed from the survey questions were integrated into the single scaled variable. Factor analysis was used to determine significant factors in the Availability Scale, which included secure supply of conventional energy (i.e., Secure Oil), promotion of trade (Trade), minimizing depletion of domestic energy (Depletion), stable price signals (Price Signal), and affordable energy (Affordability). These variables were loaded as a single factor with an eigenvalue of 1.56. The Eigenvalue is a measure of the strength of the variance of factors in a factor analysis. Using the Kaiser criterion, only factors with eigenvalues greater than 1 are retained as each factor extracts at least as much variance as at least one original variable (Kaiser, 1960). The Chronbach's alpha is similarly a reliability measure of the strength of inter-correlation among the factors. A factored variable is generally considered a stronger measure than original variables if the alpha is equal to or greater than 0.70.

The five variables were scaled into the index with a reliability test Cronbach's alpha of 0.71 and an average interim covariance of 0.23. Note that all of the attitudinal variables used a five-point Likert response scale from 1 ("Extremely Unimportant") to 5 ("Extremely Important"). For the full composition of the eight scaled variables created see Appendix 1. In sum, the variables focus on:

- **Availability**--indicating the importance of secure supply of conventional energy, promotion of trade, minimizing depletion of domestic energy, stable price signals, and affordable energy
- **Welfare**--indicating the importance of equity, preserving land, water, and air quality, climate change, greenhouse gas emissions, and transparency
- **Efficiency**--indicating the importance of low energy intensity, small scale energy, R&D, trade, transparency, equity, and education
- **Affordability**--indicating the importance of affordable energy prices, small-scale energy, equity, and R&D
- **Environment**--indicating the importance of preserving land, water, and air quality, stabilizing the climate and reducing greenhouse gas emissions
- **Transparency**--indicating the importance of equity, transparency, and education
- **Climate**--indicating the importance of stabilizing the climate and reducing greenhouse gas emissions (i.e., both climate change mitigation and adaptation)
- **Equity**--indicating the importance of preserving land and water quality, transparency, and equity.

In addition, combining the 16 dimensions into a single measure of energy security created a composite "Energy Security Scale." Table 1 presents the mean score of each country on each of these eight scaled-variables. The results confirm the multidimensional nature of energy security. Securing the supply of fuels such as coal, natural gas, uranium, and oil were all rated highly by respondents across our survey, but so were seemingly less connected themes such as energy trade, the quality of the environment, the efficiency of energy production and use, and governance issues relating to transparency, accountability, and regulation.

Table 1. Average country responses on 8 scales (value range: 1-5)

Variables	Availability Scale	Welfare Scale	Efficiency Scale	Affordability Scale	Environment Scale	Transparency Scale	Climate Scale	Equity Scale	Energy Security Scale
High oil import dependence									
Singapore	4.10	4.34	4.10	4.15	4.41	4.19	4.33	4.28	4.19
Japan	4.31	4.30	4.17	4.24	4.40	4.07	4.29	4.21	4.29
Germany	4.07	4.40	4.40	4.35	4.48	4.27	4.48	4.36	4.33
Moderate oil import dependence									
China	4.38	4.58	4.20	4.23	4.70	4.20	4.59	4.44	4.43
United States	4.17	4.64	4.43	4.35	4.70	4.52	4.60	4.62	4.45
India	4.64	4.70	4.56	4.53	4.77	4.60	4.67	4.70	4.65
Self-sufficient (little to no dependence)									
Kazakhstan	4.55	4.54	4.31	4.37	4.61	4.37	4.40	4.53	4.47
Saudi Arabia	4.57	4.67	4.57	4.62	4.71	4.64	4.58	4.69	4.62
Papua New Guinea	4.61	4.75	4.62	4.67	4.73	4.78	4.68	4.80	4.66
Brazil	4.73	4.83	4.71	4.76	4.87	4.75	4.86	4.81	4.77
Mean	4.41	4.58	4.41	4.43	4.64	4.44	4.55	4.54	4.53

Note: the underlying attitudinal variables used a five-point Likert response scale from 1 = Extremely Unimportant to 5 = Extremely Important.

Brazil, a country with little dependence on imported oil as the result of successfully developing sugar cane ethanol, had the highest rating on the aggregate measure of attitudes toward energy security. Respondents from Brazil exhibited a strong concern for all of the dimensions of energy security, especially those related to the environment, welfare, and equity. In contrast Singapore, which is completely reliant on oil imports had the lowest energy security rating. While Singapore has a number of government led initiatives to develop clean energy technology, it has been reluctant to engage with climate change and other domestic energy initiatives. An initial assessment of the survey data suggests a relationship between energy independence and valuation of energy security, with individuals from countries with greater oil-independence expressing greater concern for the importance of energy security.

To test these observations, we created a series of models designed to predict the importance of socio-demographic and regional predictors against the scaled variables (used as the dependent variable in each model). The independent variables included Gender, Age, Education, Region of Residence and Occupation. These variables are described in more detail in Figure 3. The models were estimated using OLS linear regression. Robust standard errors were used to control for heteroskedasticity. For categorical variables we used a baseline case to calibrate the relative significance of different categories on the variable. For example, region of residence is compared against the United States as the baseline case.

4. Descriptive Statistics: Energy Resources, Consumption, and Policies

We begin this section with a profile of each country's energy resources and consumption characteristics as well as the energy policies they have in place; we then turn to a cross-national comparison of attitudes toward energy security, focusing on variations in their assessments of the importance of 16 dimensions of energy security.

As Table 2 documents, the degree of petroleum import dependence across the ten countries in our sample varies from severe to self-sufficient. Between these two extremes are three countries that have moderate oil dependence: China, India, and the United States. The intensity of energy consumption is notably low for the three countries with the most severe oil dependence (Singapore, Japan and Germany), perhaps reflecting a culture of concern for energy efficiency as a means of constraining import dependence. At the same time, the gross national income per capita of these three countries is also high, which enables some resilience (e.g., through energy efficiency) in the face of import dependency. None of the other energy and economic characteristic shown in Table 2 differs by oil import dependence.

Table 2. Country profiles of key characteristics in 2008

Country	Per capita carbon footprint (tCO2/capita)	Energy Intensity (Total Primary Energy Supply /GDP) (toe/$1000)[a]	TPES per capita (toe/capita)	Electricity Consumption per capita (kWh/capita)	% petroleum import	Gross national income per capita [b] ($)	Electricity retail prices for household ($/kWh)	Polity Score	Freedom Rating	Income Gini Coefficient (%, 2000-2010)
High oil import dependence										
Singapore	9.7	0.13	3.83	8,186	100.0%	48,893	0.19	-2	4.5	42.5
Japan	9	0.14	3.88	8,072	99.8%	34,692	0.206	10	1.5	24.9
Germany	9.8	0.14	4.08	7,148	98.0%	35,308	0.263 [c]	10	1	28.3
Moderate oil import dependence										
China	4.9	0.81	1.6	2,453	50.4%	7,258	0.076	-7	6.5	41.5
United States	18.4	0.19	7.5	13,647	68.7%	47,094	0.113	10	1	40.8
India	1.3	0.75	0.54	566	79.3%	3,337	0.047 [d]	9	2.5	36.8
Self-sufficient (little to no dependence)										
Kazakhstan	12.9	1.9	4.52	4,689	24.8%	10,234	0.052	-6	5.5	30.9
Saudi Arabia	15.8	0.64	6.56	7,576	0.0%	24,726	-	-10	6.5	-
Papua New Guinea	0.7	0.16	0.31	47	0.0%	2,227	-	4	3.5	50.9
Brazil	1.9	0.15	1.29	2,232	21.6%	10,607	0.171	8	2	55
Median	9.7	0.19	3.88	6,443	37.6%	15,258	0.142	4	3.5	41.15

Notes: a. TPES: total primary energy supply, is made up of production + imports – exports – international marine bunkers – international aviation bunkers ± stock changes; GDP is normalized to 2000 dollars and adjusted by PPP;

b. Gross national income data is 2010 data normalized to 2008 dollars and adjusted by PPP;

c. Electricity price for Germany households is 2007 data;

d. Electricity price for Indian households is 2005 data.

Sources: (Boden et al., 2009; China's National Development and Reform Commission (NDRC), 2011; Energy Information Administration, 2011; Faruqui, 2012; Freedom House, 2011; Integrated Network for Societal Conflict Research, 2011; International Energy Agency, 2011a; United Nations Development Programme, 2010)

As might be anticipated, the four countries that are largely self-sufficient in terms of petroleum consumption have established few energy policies to promote alternative and efficient energy resources, with the exception of Brazil (Table 3). Among the six countries with moderate or severe oil import dependence, all but Singapore has a robust set of these policies.

Table 3. Energy Policy Profiles

Country	**Educational Programs about Energy Issues**	**Energy Use in Buildings**			**Renewable Energy**			**Transport**			**Climate Change Action Plan**
		Building Energy Standards	**Solar Water Heating**	**Combined Heat and Power Incentives**	**Share of Electricity Target/Portfolio Standard**	**Feed-in Tariff**	**Investment or Production Tax Credits**	**Biofuel Blending Mandates**	**Congestion Pricing**	**Clean Vehicle Mandates**	
High oil import dependence											
Singapore		X							X		X
Japan	X	X	X	X	X	X				X	X
Germany	X	X	X	X	X	X	X	X		X	X
Moderate oil import dependence											
China	X	X	X		X	X		X		X	X
United States	X	X	X	X			X	X		X	
India		X		X	X	X	X	X			X
Self-sufficient (little to no dependence)											
Kazakhstan						X					
Saudi Arabia							X				
Papua New Guinea			X					X			
Brazil					X	X		X		X	X

Sources: (Cory et al., 2009; DSIRE, 2011; International Energy Agency, 2011b; Reiche, 2010; REN21, 2011; Singapore Ministry of Trade and Industry, 2007; World Bank, 2004; World Future Council, 2007)

The raw ratings of the 16 energy security dimensions are presented in Table 4, which shows the highest and lowest individual categories rated by respondents on the 5-point Likert scale. These results suggest qualitative and context specific priorities in each of the countries. For the United States, energy security is mostly about enhanced funding of research and development, preserving the integrity of the water supply, and minimizing air pollution. In Japan, the objectives rated to be of most importance were minimizing air pollution followed by enhancing energy research. Brazilians highlighted enhancing energy research and development and mitigating damage to forests and land, with decentralization of the energy system rated as of lowest importance. Although all of the countries have different priorities, it is interesting to note that six of the ten rate water availability of highest importance. The importance of the water-energy nexus demonstrates that energy security depends on a number of environmental characteristics beyond just energy supply.

Table 4: Highest and Lowest Rated Dimensions of Energy Security

Country	Highest rated	Second highest rated	Third highest rated	Fourth highest rated	Lowest rated	Second lowest rated	Third lowest rated	Fourth lowest rated
High oil import dependence								
Singapore	Water availability	Air pollution	Energy R&D	Security of supply	Energy decentralization	Domestic fuel depletion	Transparency in energy decisions	Energy intensity
Japan	Air pollution	Energy R&D	Land degradation	Security of supply	Energy decentralization	Transparency in energy decisions	Education	Equitable distribution
Germany	Energy R&D	Climate change mitigation	Energy intensity	Land degradation	Security of Supply	Domestic fuel depletion	Transparency in energy decisions	Price stability
Moderate oil import dependence								
China	Security of supply	Land degradation	Air pollution	Water availability	Energy decentralization	Trade	Education	Transparency in energy decisions
US	Water availability	Energy R&D	Air pollution	Land degradation	Energy decentralization	Domestic fuel depletion	Affordability	Security of supply
India	Water availability	Security of supply	Energy R&D	Land degradation	Energy decentralization	Price stability	Equitable distribution	Energy intensity
Self-sufficient (little to no dependence)								
Kazakhstan	Water availability	Land degradation	Air pollution	Security of supply	Energy decentralization	Energy intensity	Climate change adaptation	Transparency in energy decisions
Saudi Arabia	Water availability	Air pollution	Security of supply	Energy R&D	Depletion	Energy intensity	Transparency	Decentralization
Papua New Guinea	Water availability	Land degradation	Affordability	Equitable distribution	Domestic fuel depletion	Energy intensity	Energy decentralization	Trade
Brazil	Energy R&D	Land degradation	Water	Climate change mitigation	Energy decentralization	Energy intensity	Transparency in energy decisions	Domestic fuel depletion

Note: Cells in the same color code indicate they rank the same.

While these simple scoring techniques give a sense of the diversity of priorities within each country, they do not fully elucidate the deeper socio-demographic and regional dimensions of how energy security concerns might cluster together. To better understand these energy profiles we compared the security preferences of individuals in each country against the others. Additionally, we evaluated the impact of socio-demographic characteristics that reach beyond country boundaries such as age, gender, and ethnicity on energy security preferences.

5. Multivariate Analysis

5.1 Regional Characteristics of Attitudes towards Energy Security

We evaluated the characteristics of energy security preferences in comparison with the energy profiles of each of the countries within which the respondents reside. Here we wanted to develop a measure of the energy characteristics that are more likely to promote strong interest in energy and climate security. To get at this we added a regional aspect to the survey, and tested socio-demographic predictors in combination with geographic predictors. All of the countries were compared against the United States as the baseline. We compared against the United States because it is in the median country with respect to reliance on petroleum imports, and represents the largest sample population.

The multiple regression analysis of each of the eight scales against the socio-economic characteristics and countries of origin suggests a link between petroleum self-sufficiency and the concern for oil availability. The relationship also highlights the importance of development. The heavily oil reliant states (Singapore, Japan and Germany) have the highest GDP per capita. The least oil-reliant states have the lowest GDP per capita. Regression results in Table 5 in combination with analysis of country energy profiles in Table 1 demonstrate that the strongest predictor of importance of energy security is the level of oil independence. The relationship between oil reliance and energy security is likely mutually constitutive. On the one hand the countries with greater reliance on petroleum imports de-emphasize the importance of energy security, because they are unable to shift their reliance. Development is a significant factor as well, as the wealthiest nations are also the most oil-reliant. These states can afford to be less concerned with price variability as a consequence of energy dependence. On the other hand, import-independent states such as Brazil may have instituted various policies to secure greater independence because their citizens are more vulnerable to energy price instability and supply disruptions, and as a consequence place greater value on energy security. Petroleum exporters such as Saudi Arabia and Kazakhstan may value energy security more highly because energy comprises a far greater percentage of their national economic activity than it does for other states. Whereas most states with diversified economic portfolios can compensate for changes in energy prices, the economies of energy exporters like Saudi Arabia are integrally tied to energy prices with little means of hedging.

Perhaps unsurprisingly, respondents from the most petroleum import-independent states demonstrate the highest level of concern for factors including availability, efficiency, transparency and equity of access to energy (significant results highlighted in blue). Individuals from the heavily petroleum import-reliant states express lower levels of concern for all of the factors except for availability. The level of concern expressed for availability is not significantly different from that expressed by respondents in the U.S. However, individuals in the petroleum-reliant states are significantly less concerned with other aspects of energy security, in comparison to individuals in the U.S. Finally, these results are demonstrated with a regression of the Energy Security Scale (a scaled variable created from all 16 characteristics of energy security). Overall, respondents from the developed economies of Japan and Singapore are less likely to view energy security as highly important. In contrast, respondents from developing economies are more likely to rank energy security as highly important.

In the middle, India and China are split with respect to perspectives on energy security. Respondents from India rate the dimension of energy security in ways that are quite consistent with the other developing countries in our sample. The one exception is the Equity scale, which India judges to be less important than the ratings of U.S. respondents. This is quite surprising given the significant electricity poverty in India, where 35% of the population does not have access to the grid. The government created an ambitious Rural Electrification Policy in 2006, which seeks to provide reliable electricity at reasonable rates to all households by 2012. This led Bambawale and Sovacool (2011b) to postulate that equity would be a strong dimension of energy security concerns in India, but this did not prove to be the case, as we have also shown.

Unlike India, China is more consistent with developed countries in their attitudes towards energy security. Respondents from China are less likely to value Efficiency, Affordability and Transparency when compared with the United States. The only aspect of energy security Chinese respondents is more likely to value highly is Availability. Given China's rapid growth and increasing demand for energy it makes sense that availability of energy is a significant concern. Respondents from China value environment scale the most importantly among all eight energy security scales (Table 1), which is probably due to the growing environmental concerns from rising levels of domestic pollution. Unlike the U.S. respondents who highly value the promotion of trade in energy products, technologies, and exports (Sovacool, 2010), respondents from China view promoting trade significantly as a less important dimension of energy security (Table 5). This difference of attitudes stems from China's decades of emphasizing self-dependence and its "going out" strategy of making overseas purchases and investments of oil and gas assets by its state oil companies (Bambawale and Sovacool, 2011a). Similarly, China had a significantly negative coefficient on small-scale, decentralized energy systems, which can also be explained by the difference in attitudes of the two countries. To the contrary of the U.S.'s concern for decentralized generation as part of its energy democracy, China has the tradition of central planning and investing in large-sized centralized power plants. China's current decision-making is centralized in the power sector as well as in the oil sector (Daojiong, 2006). As with other countries, China's local traditions and policy contexts help explain the attitudes of its residents toward energy security.

Table 5. Multivariate Regression Analysis of 8 Scales

Variables	Availability Scale	Welfare Scale	Efficiency Scale	Affordability Scale	Environment Scale	Transparency Scale	Climate Scale	Equity Scale	Energy Security Scale
R^2	0.15***	0.11****	0.12***	0.11***	0.08***	0.13***	0.06***	0.13***	0.13***
Gender (Female)	+0.09***	+0.11***	+0.08***	+0.11***	+0.12***	+0.10***	+0.25***	+0.10***	0.10***
Age Baseline (18-25)									
26-35									
36-45									
46-55	+0.09**								
55+	+0.11**	+0.11**	+0.14***	+0.15***		+0.16***		+0.14***	+0.18***
Education Baseline (Other)									
Secondary								-0.08*	
Undergraduate					-0.08*			-0.09**	
Post Graduate	-0.14***		-0.08**	-0.11**	-0.12**	-0.15***		-0.17***	-0.11***
Occupation Baseline									

(Private Sector)									
Government						+0.08*			
Non Profit	-0.10*								
University									
Other									
Residence Baseline (US)									
Singapore		-0.27***	-0.29***	-0.15*	-0.27***	-0.28***	-0.25**	-0.30***	-0.22***
Japan		-0.39***	-0.27***	-0.17***	-0.35***	-0.47***	-0.32***	-0.46***	-0.20***
Germany		-0.21***			-0.20***	-0.21***		-0.23***	
India	+0.50***	+0.08**	+0.16***	+0.21***	+0.09**	+0.11**		-0.10**	+0.23***
China	+0.21***		-0.20***	-0.10**		-0.30***		-0.16***	
Kazakhstan	+0.52***			+0.17**					+0.19***
Saudi Arabia	+0.35***		+0.13**	+0.24***					+0.14***
Papua New Guinea	+0.41***		+0.18***	+0.30***		+0.26***		+0.17***	+0.19***
Brazil	+0.58***	+0.22***	+0.31***	+0.44***	+0.20***	+0.28***	+0.29***	+0.22***	+0.34***
Other							-0.19*		

With respect to climate change the countries are all comparable to the U.S. except for Singapore, Japan and Brazil. Respondents from Singapore and Japan view climate issues as less important than individuals in the United States. Individuals in Brazil view climate issues as more important. These perspectives align with the climate policies of each of these countries. To elucidate the ways in which policies at the national level may interact with the security perceptions of individuals within the countries, we briefly explore the policies and energy portfolios of three cases in more depth: the U.S., our baseline with a moderate level of energy import reliance, Brazil, which is largely import-independent and Japan which is heavily import-reliant.

U.S.

With less than 5% of the world's population, the U.S. is responsible for approximately one quarter of its primary energy consumption and greenhouse gas emissions. The United States is an excellent baseline country with a mixture of import-reliance and domestic energy generation potential. Because of its reliance on fossil fuels for both transportation and electricity generation combined with a high level of development, its energy strategic planning has both energy supply security and environmental dimensions. Often the two have been contradictory, with the potential to develop domestic energy in the form of offshore oil, Appalachian coal, and natural gas competing with concerns for environmental protection and integrity. The United States aspires to a low-carbon economy, but its current energy system is carbon intensive; it is second only to China in total energy-related CO_2 emissions—at 5,610 million metric tons (Mt) of CO_2 in 2010.

Since the Arab oil embargo of 1973-74, U.S. energy analysts have generally agreed that U.S. oil dependence exposes the economy to disruption and puts its national security at risk (Greene, 2010). Nevertheless, the government has been slow, even reluctant, to promote energy efficiency policies. Following the creation of Corporate Average Fuel Economy (CAFE) Standards in the late 1970s, automotive fuel economy in the U.S. has been essentially unchanged for more than two decades, peaking in 1985 at 27.5 miles per gallon (MPG). Over the past several years, the Obama administration has mandated that CAFE standards will achieve 54.5 MPG by 2025. Fuel diversity is also being increased as the result of renewable fuel standards and policies and R&D programs to accelerate the electrification of U.S transportation. The U.S. has one of the largest energy R&D budgets of any country, reflecting a national sentiment that science and technology can invent solutions to energy challenges that is reflected in the significant rating given to that dimension of energy security (Table 4).

Regarding the electric grid side, the potential for energy efficiency to continue to stretch the nation's energy resources remains vast, but the commitment to this is influenced by highly variable state and local initiatives. There is a growing consensus that a smart grid is an essential enabler of low-carbon electricity generation and efficient energy use (Brown and Zhou, 2012). Yet states are in different stages of smart-meter, energy-efficiency, and renewable electricity deployment. In his 2011 State of the Union address, President Obama proposed a goal of generating 80% of the nation's electricity from clean energy sources by 2035; however, only 11% of its electricity currently comes from renewable sources and the clean energy standard has not been passed. Renewable sources of electricity show great promise, but their market penetration is limited by a raft of economic, regulatory, and infrastructure constraints. Furthermore, so long as oil prices are relatively stable, consumers have not demanded greater efficiency standards or even pushed for energy diversification as much as in other states such as Brazil.

As a consequence of its mixed energy portfolio, high level of development, and environmental awareness, in considering security U.S. respondents emphasize the importance of water availability, research and development, and air pollution while deemphasizing energy availability and security of supply (Table 4). Overall they place higher emphasis on energy security than respondents from other industrialized countries but not to as highly as respondents from developing, import-independent states (Table 5). The resurgence of oil and natural gas production in the U.S. may transform the national energy security debate. The current bonanza of unconventional oil and gas was in its infancy when the 2010 survey was conducted, and so it is not clear if respondents considered it when evaluating their views of energy security issues. If the resurgence continues, the climate change consequences of U.S. fossil fuel dependence may become more salient to citizens. The reduction in U.S. oil dependence anticipated in 2010 IEA statistics and illustrated in Figure 2 is consistent with this transformation.

Brazil

As stated earlier Brazil has little dependence on imported oil, and yet the highest rating on aggregate measures of energy security. The higher preference of Brazilians for energy security compared to citizens of the United States, is likely influenced by offshore oil reserves recently discovered in 2006, with the country seeking to increase oil production from 2 million barrels per day in 2012 to 5 million barrels per day by 2020, implying that Brazilian consumers have taken an active interest in global oil markets. Historically high rates of deforestation in the Amazon, and concern about the impact that climate change will have on existing energy infrastructure such as hydroelectric dams, may also explain higher preferences for the environmental dimensions of energy security. The fact that Brazilians deemphasize transparency in decision making (Table 4) could be connected to Brazil's past as a military dictatorship, meaning that many citizens may see energy security in terms of military security and believe that authority for energy policies should be consolidated.

Brazil's government has for example expressed a commitment to a coordinated series of energy policy programs, which supports and is likely constituted by Brazilians' inclination for energy security. Brazil's Proalcool Program and flex-fuel vehicle promotion has shown the world how to cut its dependence on oil imports by producing ethanol at scale. By engaging sugarcane farmers, ethanol distillers, automobile manufacturers, and environmental groups in the formulation of national energy policy, Brazil has experienced the rapid adoption of ethanol and flex-fuel vehicles.

Today, sugarcane ethanol meets approximately half of Brazil's transportation fuel requirements, Brazilian mills are largely self sufficient in steam and electrical energy production, and in many cases mills export surplus energy to the electric grid and sold as a by-product. In addition, the industry directly or indirectly supports 3.5 million jobs (Brown and Sovacool, 2011). Although, Brazil has a much more diversified economy than states such as Saudi Arabia, energy is still a major contributing sector. Taken together, these policy and resource contexts explain why countries such as Brazil place greater emphasis on the various facets of energy security. It is important not to overgeneralize, but the relationship with import-reliance/independence appears to be a major contributing factor to perceptions and experience of energy security within the country.

Japan

Japanese respondents emphasize air pollution, energy research and development, and security of supply while deemphasizing energy decentralization and transparency in energy decision-making (Figure 3). In contrast to Brazil, Japan has essentially no domestic fossil fuels and is thus completely dependent on foreign supplies. Japan's approach to energy security has been shaped by Japan's petroleum reliance and various policies that have tried to diversity its supply (Tsutomu, 2003). After the 1970 soil shocks, the government promoted a two-pronged approach to energy security; they diversified energy resources away from petroleum as much as possible and reduced energy intensity by implementing rigorous energy efficiency standards across all sectors of the economy (Lesbirel, 2004). As a consequence of these strategies, the cost of energy in Japan has been relatively high for the past 30 years. Japanese consumers have acclimated to high energy prices, suggesting a society-wide decision to minimize their energy exposure. The government in turn has an obligation to promote energy efficiency (Wilhite et al., 1996). The high price of energy in Japan also minimizes energy insecurity by giving the government economic room to maneuver. For example, should international prices spike, the government can lower energy taxes temporarily to moderate the impact.

As Japanese respondents highlight, reliance on technology is also critical to the Japanese approach to energy security (Table 4). Technology is central to energy efficiency and to energy generation in the form of nuclear technology. Between 1970 and 2010 Japan saw its reliance on nuclear power grow from 3% to 15% (Lesberil, 2004). It is important to note that our data were collected prior to the Fukushima crisis, and thus do not reflect the reshaping of the energy security landscape in Japan. Even so, the disaster at Fukushima is in some ways illustrative of Japan's policies and relationship with energy security. The Fukushima crisis highlights the possible overreliance on nuclear power as a semi-indigenous source of energy, as well as a breakdown in the arrangement between the government (to ensure energy stability) and the public (to pay high prices).

Fukushima exposed the failings of the Japanese regulatory structure and highlights the shortcomings of deemphasizing transparency in decision-making and energy denaturalization (Table 4). The Japanese regulatory agency at the time of the crisis (Nuclear and Industrial Safety Agency) operated within the Ministry of Economy, Industry, and Trade and was subservient to the Ministry's nuclear energy promotion agenda. Thus, the failure to heed warnings that the Fukushima reactors lay within a historic tsunami zone and International Atomic Energy Agency best practices recommendations (e.g. higher seawalls) appear at least in part to be the product of government negligence and conflict of interest (Qiang and Chen, 2012). As respondents indicate, the Japanese sense of energy security was inseparable from trust in government as the guarantor of energy.

Nevertheless, Japan's policies and individual's perceptions of these policies and energy security risks in many ways have evolved from Japan's relationship with and response to oil import-reliance for the past 40 years. Prior to the Fukushima crisis, Japanese respondents' expressed less concern for energy security than respondents in other developed countries (Table 5), perhaps not because energy is unimportant to them, but because they felt they had done as much as they could to secure energy independence, and had become accustomed to higher energy prices.

The energy policies and portfolios of countries give some indications of the socio-economic contexts that interact with and indeed frame intersubjective understandings and experiences of energy security. However, to better elucidate the intersubjective dimensions of energy security systems that transcend the boundaries of nations states we additionally evaluated respondents' preferences by socio-demographic characteristics such as age, gender, and ethnicity.

5.2 Socio-demographic Characteristics of Attitudes towards Energy Security

The literature on resilience and adaptation suggests that women, less educated, and older individuals care more about energy and climate security because they tend to be more vulnerable. Our multivariate regression analysis of the eight scaled variables supports this hypothesis (Table 5). Across the board, women express a greater concern for aspects of energy and climate security than men. Each of the scaled variables is judged to be more important by female than by male responses. The differences are particularly significant for the transparency and affordability scales.

Similarly older individuals (that is 55 years of age or older) express a greater concern for six of the 8 energy security scaled variables related to energy security--those related to availability, welfare, efficiency, affordability, transparency and equity. In contrast, more educated individuals (that is, those with postgraduate education) express less concern for most of the scaled variables: availability, efficiency, affordability, the environment, transparency and equity. Concerns for equity and transparency have especially strong negative correlations with greater education. Education is likely to be correlated with higher levels of income. Individuals with more education are more likely to have easy access to energy and to cleaner environments. This may explain why they are more likely to rank transparency, equity, the environment and availability as highly important, when compared with wealthier individuals.

Although individuals in each of the countries highlighted different priorities with respect to energy security (Table 4), it is striking that perspectives on security align quite strongly with the level of petroleum dependence of each of the countries (Table 5). Perhaps unsurprisingly the most petroleum-reliant countries are also among the wealthiest. The result is somewhat counterintuitive in that developed countries might be expected to place a greater emphasis on various attributes of energy security. However, the greater importance that individuals in developing countries place on almost all characteristics of energy security perhaps highlights the greater vulnerability of individuals within these countries. They cannot afford to take energy and climate security for granted. This similarly reinforces the significant results of the demographic variables, particularly gender. Women are also more likely to experience greater vulnerability and exposure to energy insecurity. Finally, taken together the results highlight the importance of diversifying energy portfolios, and evaluating energy security beyond just the supply of fossil fuels and towards a broader range of social and environmental measures.

6. Conclusions

Energy security is a diverse phenomenon embedded in socio-economic and cultural systems. Perceptions of energy security are shaped by socio-demographic as well as regional characteristics. These perceptions inform intersubjective understandings of the issue, which in turn shape the political response to the issue. Given the complex, political nature of energy security, emerging energy security challenges, and differing socioeconomic attitudes, it is important to understand the social and environmental factors that shape perceptions towards energy security. This article examines the types of energy security challenges that nations face and characterizes the policy responses that are often used to address these challenges.

Through the conduct of an original ten-country survey we explore attitudes towards energy security at the nexus of demographic and socio-environmental factors. We find that demographic factors influence perceptions and priorities for energy security. However, the energy portfolios and policies of the countries within which individuals reside also have a strong influence in shaping security perceptions and energy and environmental priorities. Our cross-national comparison of attitudes toward energy security underscores the diversity of security concerns recognized by different countries and the linkage of these views to their energy economy, resources, and demographic details of energy users.

By surveying individuals across a range of geographies, we have begun to establish the intersubjective structures that shape political responses to energy security. Our conclusions here are by no means conclusive, and far more work remains to be done to determine how energy security is constructed and how those constructions inform energy security policy. Because energy security is an issue that impacts so many elements of society as well as the relationship between society and the state, we hope our efforts will encourage much further work.

With respect to our survey data we draw three specific conclusions. First, survey responses confirm the multidimensional nature of energy security. Securing the supply of certain fuels such as coal, natural gas, uranium, and oil were all rated highly by respondents across our survey, but so were seemingly less connected themes such as energy trade, the quality of the environment, the efficiency of energy production and use, and governance issues relating to transparency, accountability, and regulation. At one level, these results imply that no "one-size fits all" mentality of energy security can ever exist, nor should countries pursue uniform energy security goals and policies. All will differ according to particular culture and context.

Second, though each country has its own energy markets and differences in terms of technology, supply, consumption, and behavior, respondents from countries with similar energy portfolios shared some commonalities. In particular, the results suggest that the level of oil import dependence is especially strong discriminator of attitudes and policies toward energy security. Respondents from the three countries with high oil import dependence express lower levels of concern for all of the factors except for availability; they have a low concern for equity, transparency, welfare, environment, and efficiency. Among the six countries with moderate or severe oil import dependence, all but Singapore have a robust set of related energy policies. In contrast, the four countries that are largely self-sufficient in terms of petroleum consumption have a strong concern for availability, efficiency, transparency, and equity of access to energy, but they have established few energy policies to promote alternative and efficient energy resources. In sum, these two groups diverge significantly in their energy security attitudes and policies.

Finally, and as anticipated, several socio-demographic characteristics track closely with attitudes toward energy security. Across the board, women express a greater concern for aspects of energy and climate security than men. Each of the scaled variables is judged to be more important by female than by male responses (Table 5). The differences are particularly significant for the transparency and affordability scales. Similarly older individuals express a greater concern for a majority of the dimensions of energy security. These correlations are consistent with a growing body of literature that suggests that older individuals are more vulnerable to energy and climate risks. Additionally, education plays an important role with the most educated respondents expressing the least concern on each of the scales accept for welfare and climate change. While education it not a perfect correlate, it likely reflects differences in income. Those with lower levels of education and income express greater concern for virtually all facets of energy security. These individuals are more vulnerable to energy scarcity, environmental detriment and price increases. These findings suggest that socio-demographic characteristics can help identify dimensions of energy security that extend beyond the nation state. In particular, gender, age and income and can be useful in identifying groups with similar vulnerabilities and common types of energy security concerns that extend beyond national boundaries.

Clearly, climate and energy attitudes and policies are complicated by the fact that the impacts of energy security and of climate change are not universally shared. Numerous conditions influence the vulnerability of different countries, communities and individuals. Since socio-demographic characteristics have a strong impact on vulnerability, perceptions about energy security and climate change are likely to be subject to considerable socio-demographic and geographic variation, and they will reflect the energy supply, equity, environment, and other conditions of particular places and populations. As we have shown from focusing on the implications of this research for individual countries, energy security is a highly context-dependent condition that is best understood from a nuanced and multi-dimensional perspective.

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Appendix 1. Composite measures incorporated into each scaled variable

Variables	Availability Scale	Welfare Scale	Efficiency Scale	Affordability Scale	Environment Scale	Transparency Scale	Climate Scale	Equity Scale	Energy Security Scale
Eigen Value	**1.54**	**3.37**	**2.46**	**1.51**	**2.70**	**1.40**	**1.14**	**2.24**	**5.42**
Chronbach's Alpha	**0.70**	**0.85**	**0.78**	**0.69**	**0.85**	**0.76**	**0.81**	**0.81**	**0.87**
Secure Oil	X								X
Trade	X		X						X
Depletion	X								X
Price Signal	X			X					X
Affordable price	X			X					X
Small Scale			X	X					X
Low Energy			X						X
Research & Development			X	X					X
Equity		X	X	X		X		X	X
Transparency			X			X		X	X
Education			X			X		X	X
Land		X			X			X	X
Water		X			X			X	X
Pollution		X			X				X
Climate Change		X			X		X		X
Emissions		X			X		X		X

(Factor and correlate analysis were used to determine the composites to be incorporated into each scale)