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Exploring propositions about perceptions of energy security: An international survey

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ABSTRACT

This study investigates how energy users from government, industry, civil society, and academia perceive of energy security challenges. It also analyzes how demographic characteristics influence such perceptions, and how geography, economic structure, modes of domestic energy production, and culture shape energy security priorities. Its primary source of data is a four-part survey distributed in seven languages (English, Mandarin, Portuguese, Russian, Arabic, German, and Japanese) to 2167 respondents in Brazil, China, Germany, India, Kazakhstan, Japan, Papua New Guinea, Saudi Arabia, Singapore, and the United States. These countries were selected because they represent a mix of urban and rural populations, developed and developing economies, import- and export-oriented energy trading flows, communist and capitalist societies, liberalized and state-owned energy markets, and small and large geographic sizes. The survey results are used to test four propositions about energy security related to the education, age, occupation, and gender of respondents, as well five propositions about national energy priorities and the interconnected attributes of security of supply, energy efficiency, energy research and development, energy trade, diversification and decentralization, affordability, environmental quality, climate change, and energy governance.

1. Introduction

Energy security – equitably providing available, affordable, reliable, efficient, environmentally benign, proactively governed and socially acceptable energy services to end-users – is inextricably tied up both with traditional conceptions of national security and with emerging concepts of human rights and individual security. Ever since the British fleet converted from coal to oil on the eve of World War I to make it faster than its

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German counterpart, major powers have looked upon access to energy resources as a key national interest, and threats to that access have the potential to spark a military response (Yergin, 2006; Smil, 2004). The attack upon Pearl Harbor was partially triggered when the United States, which supplied the vast majority of Japan's oil, responded to Japan's invasion of Indochina by freezing assets and cutting off oil exports. This has been described as the "first energy war." The oil price hikes of the 1970s shocked energy consumers around the world into a discomfiting recognition of the degree to which their prosperity depended upon what Henry Kissinger called "decisions made by nations thousands of miles away" (quoted in Clo, 2000: pp. 133).

Concerns about such vulnerabilities, and fears that competition over energy resources could turn violent, faded during past decades of cheap energy but are now resurgent. Conventional crude oil supplies are concentrated in countries widely considered at best self-serving and at worst unstable (Alhajji, 2007). The world's known oil reserves are concentrated in a handful of countries—notably in the Middle East, Russia, Nigeria and Venezuela. And oil, although internationally traded in what superficially resembles a free market, does not operate under normal market conditions, given that most oil supplies are controlled by a handful of government-dominated firms.

Moreover, accessibility to energy supplies is now only a portion of the energy security problem (Sovacool and Brown, 2010; Alhajji, 2010). Al Qaeda has threatened to attack the world's critical economic infrastructure, of which energy is clearly a key component. Inadequate investment and poor management of energy systems have led to electricity shortages and blackouts that have disrupted life in the United States, Europe, Russia and many developing countries. Furthermore, plans for increased reliance on nuclear energy introduce new pressures on the already crumbling non-proliferation regime (Florini and Sovacool, 2011).

Energy security analysis must also take into account the increasingly dire environmental consequences of current energy production and consumption patterns. Most notably, climate change is already having far more conspicuous impacts than even the most recent predictions of the Intergovernmental Panel on Climate Change had forecast. The rapid retreat of the Arctic icecap has garnered headlines, but it is far from the only ominous sign (Mousavi et al., 2010). The security implications are inescapable. The glacier that provides much of Kashmir's water, for example is melting so quickly that it may disappear altogether in the next decade (Talib, 2007). In such regions of high tensions and simmering violence, climate change and other manifestations of environmental degradation caused in part by current energy production and consumption patterns may push conflicts to new levels.

Lastly, energy poverty – traditionally defined as lack of reliable access to electricity networks and dependence on solid fuels for cooking and lighting – continues to plague emerging economies around the world. Though the traditional focus of energy security analysis centers on securing supplies of conventional energy fuels (such as oil, coal, or natural gas) for use in high-consumption societies, the extent to which energy security concerns may fundamentally differ for developing countries is rarely discussed, especially since these countries do not (yet) consume a significant amount of the world's energy (Birol, 2007). As of 2010, 1.4 billion people lacked access to electricity – 85% of them in rural areas – and progress towards universal electrification is phlegmatic. By 2030, those lacking access to electricity will still amount to about 1.2 billion people. People relying on traditional biomass will rise from 2.7 billion today to 2.8 billion by 2030. Household air pollution from the use of biomass in inefficient indoor stoves will cause 1.5 million premature deaths per year, more than 4000 per day by 2030. This is greater than premature death rates associated with malaria, Tuberculosis, or HIV/AIDS (International Energy Agency, UNDP, and UNIDO 2010).

Taken collectively, resource depletion, concentration of supply, rising prices, environmental destruction, climate change, and energy poverty present grave concerns. Yet how are these issues perceived by energy users? How may demographic characteristics such as gender, occupation, age, or education influence perceptions of energy security challenges? Furthermore, how might geography, economic structure, domestic energy production, and culture affect conceptions of energy security?

This study directly answers these questions by exploring how a mix of government, industry, civil society, and academic energy users from 10 countries perceive energy security threats and dimensions. Its primary source of data is a four-part survey distributed in seven languages (English, Mandarin, Portuguese, Russian, Arabic, German, and Japanese) to 2167 respondents in Brazil, China, Germany, India, Kazakhstan, Japan, Papua New Guinea, Saudi Arabia, Singapore, and the United States. These countries were selected because they represent a mix of urban and rural populations, developed and developing economies, import- and export-dependent energy trading flows, communist and capitalist societies, liberalized and state-owned energy markets, and countries of different geographic sizes. The survey results are used to test four propositions about energy security related to the education, age, occupation, and gender of respondents, as well five propositions about national energy priorities and the interconnected topics of security of supply, energy efficiency, energy research and development, energy trade, diversification, decentralization, affordability, environmental quality, climate change, and energy governance.

2. Research methods and propositions

Because scant data on energy security perceptions within our 10 countries existed in the peer-reviewed literature, we began by designing and testing a survey that asked respondents to rank the following 16 dimensions of energy security:

- securing a supply of fossil fuels and uranium;
- bolstering trade in energy fuels and commodities;
- minimizing depletion of domestically available fuels;
- providing predictable and clear price signals;
- enabling affordably priced energy services;
- providing equitable access to energy services;
- decentralizing to small-scale energy supply;
- lowering energy intensity (energy use per unit of Gross Domestic Product);

- researching and developing new energy technologies;
- ensuring transparency and participation in project siting and decision-making;
- offering energy education and information;
- preserving land and forests;
- enhancing the availability and quality of water;
- minimizing air pollution;
- responding to climate change/adaptation;
- reducing greenhouse gas emissions/mitigation.

These dimensions of energy security were distilled from a meta-survey of 90 peer reviewed articles (discussed in greater detail in Sovacool and Brown, 2010) and formulated into survey questions which were tested with two focus groups consisting of fifteen experts in aggregate. Rather than conceiving of energy security only in terms of security over access to fuel, our survey advances a broader notion of energy security encompassing technology, fuels, trade, behavior, institutions, the environment, and education. Similar arguments in favor of the broad nature of energy security are presented in Kruyt et al. (2009), Jacobson (2009), Vivoda (2010), Jansen and Seebregts (2010), and Sovacool (2011a). These studies have noted that energy security threats and perceptions often differ by scale, from individual and household needs to national and energy system challenges to global and geopolitical energy security threats; sector, from electricity supply and transport to residential and commercial energy use; technology, including small-scale technologies such as cookstoves, biogas digesters, and solar panels to large-scale infrastructure such as pipelines, power plants, and transmission grids; and country composition, including industrialized economies such as Japan and the United States to middle income countries such as China and Singapore to least developed countries such as Papua New Guinea.

Our structured questionnaire consisted mainly of multiple choice questions that we have used previously to assess national energy security issues (Bambawale and Sovacool, 2011a; Bambawale and Sovacool, 2011b; Bambawale and Sovacool, 2011c; Valentine et al., 2011a; Sovacool, 2011b). As Table 1 reveals, the survey was made available online to respondents across all 10 countries through a survey hosting website, and also distributed physically to improve response rates (though in the case of Papua New Guinea none of the participants utilized the online version). A total of 2167 surveys were completed between January 2010 and July 2010, and a copy of the survey in English is provided in Appendix A. Fig. 1 provides an overview of the demographic characteristics of respondents, though we must note that (a) the sample size of the survey is not proportional to national population size, (b) the results have not been weighted to match national demographic profiles, and (c) 104 respondents did not provide their country of residence when completing the survey online.

Distribution of the survey was purposive, that is it was not random, but instead directed at ensuring a mix of respondents from different sectors. These included government officials, businesspersons, employees of non-governmental organizations, and university employees, who were not necessarily experts in the field of energy. Those who chose to respond did so only based on their willingness to participate; they were not compensated. To be eligible, a person needed only (a) consider one of our 10 countries their home and (b) consume and use energy there.

The survey consisted of three parts with 19 total questions. The first part collected demographic information about respondents, including their country of residence, nationality, age, level of education, gender, occupation, name of employer and job title. The second part asked participants to rate 16 dimensions of energy security according to a five-point Likert (1932) scale:

1. extremely unimportant;
2. somewhat unimportant;
3. neither important nor unimportant;
4. somewhat important;
5. extremely important.

We call this method of questioning ''rating.'' The third part asked respondents to choose the five most important dimensions of energy security from the list of 16 and rank them in order of importance from first to fifth. We called this method of questioning ''ranking.'' The final question was open-ended, asking respondents to add any energy security dimension that they thought was missing in the survey, and instructing them to rate it on the Likert scale previously mentioned.

It should be noted that our aim was not to generalize the survey results to any population. Instead, the results represent

Table 1 – Summary of energy security survey distribution.

Country	Language(s)	Distribution	Respondents	% Total
United States	English	Electronic (online) and print	427	19.7
Japan	English and Japanese	Electronic (online) and print	346	16.0
China	English and Mandarin	Electronic (online) and print	312	14.4
Saudi Arabia	English and Arabic	Electronic (online) and print	298	13.8
India	English	Electronic (online) and print	172	7.9
Kazakhstan	English and Russian	Electronic (online) and print	138	6.4
Brazil	English and Portuguese	Electronic (online) and print	115	5.3
Germany	English and German	Electronic (online) and print	114	5.3
Singapore	English and Mandarin	Electronic (online) and print	93	4.3
Papua New Guinea	English	Print	48	2.2
Others	–	Electronic (online) and print	104	4.7
Total			2167	100

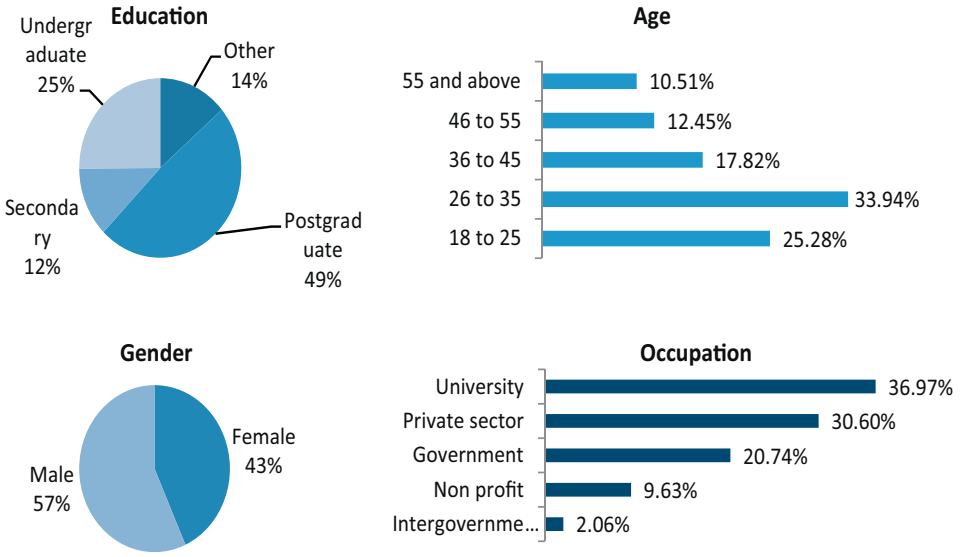

Fig. 1 – Demographic characteristics of our energy security survey sample. Education and gender figures expressed in percentages, 100% = 2036 respondents. Note: "University" refers to those working at colleges, universities, schools, and academic institutions. "Private sector" refers to those working in electricity supply, transport, industry, business, and for-profit organizations. "Government" refers to those working for local, state, and national governments as well as national institutes and regulatory agencies. "Non-profit" refers to those working in civil society, non-governmental organizations, and intergovernmental organizations such as the International Energy Agency or International Atomic Energy Agency.

the opinions of an informed audience with a mix of demographic characteristics. As Table 1 and Fig. 1 reveal, some biases exist within the sample. Surveys were incredibly difficult to distribute in Papua New Guinea meaning they account for less than 3% of respondents, whereas respondents from the United States, Japan, China, and Saudi Arabia each represented more than 13% of responses. Nearly half the respondents were postgraduates in our sample, more than a third worked at universities, and more than one-third were aged 26–35, which is proportionately higher than an unbiased sample would represent. Our survey also possibly suffers from self-selection bias (Cook and Campbell, 1979): that is, only those that already deem energy security to be important (or those unhappy with energy security in their country) would ostensibly take the time to complete it. We also did not weigh responses to represent actual proportions in the global population. For example, the United States accounts for about 20% of our respondents even though it has less than 5% of the global population, meaning our results reflect a bias towards US (and Japanese, Chinese, and Saudi Arabian) respondents.

We use the survey results in this study to test nine propositions stemming from former energy security research and presented in Table 2. Propositions 1–4 focus on the various demographic characteristics of respondents, investigating how energy security conceptions differ by age, education,

Table 2 – Energy security propositions and survey questions.

Proposition	Explanation	Survey question(s)
P1: The influence of education	One would expect those with postgraduate and undergraduate education to be more appreciative of participation, decentralization, and education related to energy issues and problems	When you think about energy security for your country of residence in the next five years, how important is it to have small-scale, decentralized energy systems; to ensure transparency and participation in energy permitting, siting, and decision-making; and to inform consumers and promote social and community education about energy issues?
P2: The ignorance of youth	We would expect individuals over the age of 65 to prioritize having stable and predictable energy prices and long-term issues such as minimizing the depletion of energy resources	When you think about energy security for your country of residence in the next five years, how important is it to minimize depletion of domestically available energy fuels?; to have stable, predictable, and clear price signals?

Table 2 (*Continued*)

Proposition	Explanation	Survey question(s)
P3: Defending one's vocation	One would expect that perspectives on energy security held by those employed in the private sector would be significantly more conservative, with those participants rating and ranking climate change and environmental dimensions poorly. Industry representatives and government officials would also be expected to rate energy research expenditures highly	When you think about energy security for your country of residence in the next five years, how important is it to minimize the impact of climate change (i.e., adaptation); and to reduce greenhouse gas emissions (i.e. mitigation)?; to minimize the destruction of forests and the degradation of land and soil; to provide available and clean water; and to minimize air pollution?; to conduct research and development on new and innovative energy technologies?
P4: Feminism and mother earth	We would expect women to prioritize climate change, environmental issues, and renewable energy more than men	When you think about energy security for your country of residence in the next five years, how important is it to minimize the impact of climate change (i.e., adaptation); to reduce greenhouse gas emissions (i.e. mitigation)?; to minimize the destruction of forests and the degradation of land and soil; to provide available and clean water; and to minimize air pollution?
P5: The influence of affluence	We would expect developing countries such as Brazil, China, India, Kazakhstan and Papua New Guinea to be predominantly concerned about the security of fossil fuel supply, given their rapid economic growth, whereas developed economies such as Germany, Japan, Singapore, and the United States would prioritize energy efficiency and energy research and development	When you think about energy security for your country of residence in the next five years, how important is it to have a secure supply of oil, gas, coal, and/or uranium?; to have low energy intensity (unit of energy required per unit of economic output)?; to conduct research and development on new and innovative energy technologies?
P6: The have and have nots	One would expect major energy importers such as Germany, Japan, and the United States to be concerned with lessening dependence on foreign supplies and increasing diversification and decentralization, whereas exporters such as Kazakhstan and Saudi Arabia would emphasize trade and the value of energy exports. The rapidly industrializing economies of Brazil, China, and India would be expected to "scramble" for as many energy resources as they could acquire.	When you think about energy security for your country of residence in the next five years, how important is it to promote trade in energy products, technologies, and exports?
P7: The presence of poverty	One would expect big geographic countries with small populations and/or low population densities such as Papua New Guinea and Kazakhstan to prioritize expanding energy access and affordability, whereas those with large populations and/or higher densities such as India, Japan, and Singapore would place greater emphasis on minimizing environmental insults and preserving water, air, and land	When you think about energy security for your country of residence in the next five years, how important is it to have affordably priced energy services?; to minimize the destruction of forests and the degradation of land and soil; to provide available and clean water; and to minimize air pollution?
P8: Climate change and vulnerability	One would expect richer countries such as Germany, Japan, Singapore, and the United States to place a higher priority on climate change mitigation, whereas developing countries such as Brazil, India, China, Kazakhstan, and Papua New Guinea would prioritize adaptation	When you think about energy security for your country of residence in the next five years, how important is it to minimize the impact of climate change (i.e., adaptation); and to reduce greenhouse gas emissions (i.e. mitigation)?
P9: The hand of political control	One would expect highly competitive, representative democracies such those found in Germany, India, and the United States to place greater emphasis on decentralization, participation, and education, whereas more tightly controlled economies such as in China, Saudi Arabia, and Singapore would emphasize centralization and less-inclusive decision-making	When you think about energy security for your country of residence in the next five years, how important is it to have small-scale, decentralized energy systems; to ensure transparency and participation in energy permitting, siting, and decision-making; and to inform consumers and promote social and community education about energy issues?

occupation, and gender. Propositions 5–9 seek to highlight national perspectives, mainly how energy security differs between developing and developed economies, importing and exporting nations, countries of varying geographic sizes and population densities, countries with varying vulnerability to climate change, and countries with more or less centralized control over energy planning.

3. Results and discussion

As Table 3 reveals, the "ratings" derived from the five-point Likert scale show a convergence of answers ranging from a mean of 4.02 for decentralization of energy systems at the bottom to a high of 4.72 for preserving the integrity of water

supplies. This indicates that in aggregate, respondents rated all dimensions as falling within the range of important to extremely important. Table 4 illustrates the results from the subsequent ranking exercise, and it shows that respondents ranked security over fossil fuel and uranium supplies highest with 31% ranking this dimension first or second, whereas they ranked enhancement of energy trade the lowest with only about 10% placing it first or second. Once again, however, the fact that the dimension of lowest priority was nevertheless ranked as a first or second by 10% of respondents speaks to the overall importance attributed to all of the 16 energy security dimensions. Table 5 presents the four highest and lowest rated energy security dimensions for each country.

Before we discuss the results of our nine propositions, some general findings merit elaboration. Preserving the integrity of water supply and minimizing air pollution were the two most highly rated energy security objectives. They were highly rated by all categories of respondents within each nation, except by residents of Germany and Japan. Enhancing research and development of new energy technologies was also one of the top rated objectives across several countries. In East and middle Asian countries – India, China, Japan and Saudi Arabia – security over fossil fuel supplies was consistently ranked of foremost concern. In Singapore it came a close second after availability of water. For the United States and Germany, mitigation of greenhouse gas emissions was the top ranked dimension of energy security. Decentralizing energy systems was consistently rated as the dimension of least importance across all countries, age groups, educational class, genders and occupations.

For the United States, respondents rated enhanced funding of research and development and preserving the integrity of water supply as constituting the most important dimensions of energy security. Conversely, the lowest rated dimensions were decentralization of energy systems followed by minimization of domestic fuel stock depletion. More

Table 3 – Rating the importance of the 16 energy security dimensions. Summary of ratings (n = 2167).

	Mean	Min	Max	SD
To provide available and clean water	4.72	3.0	5.0	1.23
To minimize air pollution	4.71	3.0	5.0	1.31
To conduct research and development on new and innovative energy technologies	4.71	2.0	5.0	1.02
To minimize the destruction of forests and the degradation of land and soil	4.66	3.0	5.0	1.13
To reduce greenhouse gas emissions (i.e. mitigation)	4.58	3.0	5.0	0.92
To have a secure supply of coal, gas, oil and/or uranium	4.50	3.0	5.0	1.12
To minimize the impact of climate change (i.e., adaptation)	4.47	3.0	5.0	1.43
To assure equitable access to energy services to all of its citizens	4.44	2.0	5.0	1.01
To inform consumers and promote social and community education about energy issues	4.42	1.0	5.0	1.44
To have low energy intensity (unit of energy required per unit of economic output)	4.41	1.0	5.0	1.28
To have stable, predictable, and clear price signals	4.38	2.0	5.0	1.13
To have affordably priced energy services	4.37	3.0	5.0	1.21
To minimize depletion of domestically available energy fuels	4.33	2.0	5.0	1.02
To ensure transparency and participation in energy permitting, siting, and decision-making	4.32	1.0	5.0	1.67
To promote trade in energy products, technologies, and exports	4.27	3.0	5.0	1.14
To have small-scale, decentralized energy systems	4.02	2.0	5.0	1.55

Range: 1 = extremely unimportant; 5 = extremely important.

Table 4 – Ranking the importance of the 16 energy security dimensions. Summary of rankings (n = 2167).

Respondents ranking each dimension as a 1 or a 2 in importance	No. of respondents	%
To have a secure supply of coal, gas, oil and/or uranium	681	31%
To conduct research and development on new and innovative energy technologies	480	22%
To reduce greenhouse gas emissions (i.e. mitigation)	448	21%
To provide available and clean water	392	18%
To minimize depletion of domestically available energy fuels	328	15%
To minimize air pollution	320	15%
To minimize the impact of climate change (i.e., adaptation)	307	14%
To have low energy intensity (unit of energy required per unit of economic output)	306	14%
To have affordably priced energy services	305	14%
To minimize the destruction of forests and the degradation of land and soil	286	13%
To inform consumers and promote social and community education about energy issues	269	12%
To ensure transparency and participation in energy permitting, siting, and decision-making	236	11%
To have stable, predictable, and clear price signals	226	10%
To have small-scale, decentralized energy systems	219	10%
To assure equitable access to energy services to all of its citizens	218	10%
To promote trade in energy products, technologies, and exports	217	10%

Table 5 – Highest and lowest rated energy security dimensions by country.

Country	Highest rated	Second highest rated	Third highest rated	Fourth highest rated	Lowest rated	Second lowest rated	Third lowest rated	Fourth lowest rated
Singapore (n = 93)	Water	Air pollution	Energy research	Security of supply	Decentralization	Depletion	Transparency	Energy efficiency
India (n = 172)	Water	Security of supply	Energy research	Forests	Decentralization	Prices	Equity	Energy efficiency
Japan (n = 346)	Air pollution	Energy research	Forestry	Security of supply	Decentralization	Transparency	Education and equity (tie)	–
China (n = 312)	Security of supply	Forestry	Air pollution	Water	Decentralization	Trade	Education	Transparency
Kazakhstan (n = 138)	Water	Forestry and Air pollution (tie)	–	Security of supply	Decentralization	Energy efficiency	Adaptation	Transparency
Saudi Arabia (n = 298)	Water	Air pollution	Security of supply	Energy research	Depletion	Energy efficiency	Transparency	Decentralization
United States (n = 427)	Water and energy research	–	Air pollution	Forestry	Decentralization	Depletion	Affordability	Security of supply
Brazil (n = 115)	Energy research	Forestry	Water and mitigation (tie)		Decentralization	Energy efficiency	Transparency	Depletion
Germany (n = 114)	Energy research	Mitigation	Energy efficiency	Forestry	Security of supply	Depletion	Transparency and price (tie)	–
Papua New Guinea (n = 48)	Water	Forestry	Affordability and equity (tie)	–	Depletion	Energy efficiency	Decentralization	Trade

than one-third of respondents ranked climate change mitigation as a top priority, and when asked the final open-ended question at the end of the survey about which dimensions may have been missed, the most popular response was ''renewable energy development'' followed by ''reducing consumption.'' Those working in university and non-profit sectors in the United States were less inclined to rate security of fossil fuel supply as important, and more inclined to emphasize climate change adaptation. Other recurring answers to the open-ended question included the promotion of wind and solar energy, nuclear power, and electric grid reliability.

For China, securing supplies of fossil fuels was rated and ranked highest of all dimensions, followed (perhaps contradictorily) by minimizing destruction of land, water and air. Similar to other countries, decentralization of energy systems was rated of least importance. Reducing waste, improving energy efficiency, and reducing adverse emissions were mentioned as additional priorities in the open-ended question at the end of the survey.

For Japan, the objectives rated to be of most importance were minimizing air pollution followed by enhancing energy research, while the objectives of least importance were decentralization of supply and enhanced transparency. Interestingly, about half (44%) of the respondents ranked security over fossil fuel supplies as a key priority, while one-quarter (24%) indicated the climate change mitigation should be given top priority. We consider this to be a reflection of a clear social expectation for the Japanese government to seek a balance in providing secure, affordable energy supplies while also making a significant contribution to climate change abatement (Valentine et al., 2011a). Open-ended responses indicated nuclear energy development, enhanced international cooperation, and diplomacy among nations as additional energy security dimensions of salience.

For India, preserving the integrity of the water supply and enhancing security over fossil fuel supplies were rated of highest importance, whereas decentralization of the energy system was rated of lowest importance. In terms of ranking, enhancing security over fossil fuel supplies was also deemed to be of top priority followed by energy research and development. Open-ended responses identified renewable energy development, population control, improving public transport, and enhancing rural access to energy services as additional energy security dimensions of importance.

For Singapore, preserving the integrity of the water supply was rated of most importance followed by minimizing air pollution. Conversely, decentralizing energy systems and minimizing depletion of domestic fuels were rated of lowest importance (which makes sense as Singapore has no decentralized supply nor any significant domestic energy sources apart from waste incineration). Preserving the integrity of water supplies was also ranked as a top priority by one-third of respondents followed by enhancing security of fossil fuel supplies. Open-ended responses identified renewable energy development as an additional energy security dimension of importance.

For Germany, enhancing energy research and development and climate change mitigation were rated of highest

importance while enhancing security of fossil fuel supplies was rated of lowest importance. More than one-third (37%) ranked climate change mitigation as a top priority objective followed by improving energy efficiency. Open-ended responses identified further development of solar and wind energy as additional energy security dimensions of importance.

For Brazil, enhancing energy research and development and mitigating damage to forests and land were rated of high importance, whereas decentralization of the energy system was rated of lowest importance. One-third ranked research and development as a top priority objective, followed by enhancing security of fossil fuel supplies. Open-ended responses prioritized diversification of energy sources and development of renewable energy, particularly ethanol produced from sugarcane, and hydroelectricity. This is likely because products of sugarcane, hydropower, and biomass accounted for 47.3% of all energy in Brazil in 2009.

For Saudi Arabia, preserving the integrity of the water supply and minimizing air pollution were the dimensions rated of highest importance followed by enhancing security of fossil fuel supplies. Conversely, improving energy efficiency and minimizing depletion of domestic fuel stocks were rated poorly. Almost half (44%) the respondents ranked enhancing security of fossil fuel supplies as a top priority followed by improving transparency in energy permitting and siting (36%). Open-ended responses identified renewable energy, nuclear energy, political stability, and stabilizing oil prices as additional energy security dimensions of importance.

For Kazakhstan, the dimension of energy security of highest importance was preserving the integrity of the water supply followed by minimizing air pollution and avoiding degradation of lands and forests. The dimensions rated of least importance were decentralization of the energy system and improving energy efficiency. Minimizing air pollution and preserving the integrity of the water supply were also the two objectives ranked highest priority. Open-ended responses identified improved bio-processing of waste, reversing privatization of energy infrastructure, and opening up the country to foreign direct investment as additional energy security dimensions of importance.

For Papua New Guinea, preserving the integrity of the water supply, minimizing air pollution, and ensuring equitable access to energy were the three dimensions of highest importance. Minimizing depletion of domestic energy stocks, improving energy efficiency, and decentralization were rated of lowest importance. About one-quarter (23%) ranked enhancing security of fossil fuel supplies as a top priority followed by climate change mitigation (21%). Open-ended responses identified better governance, community mobilization, recycling, and renewable energy as additional energy security dimensions of importance.

3.1. *The influence of education*

We speculated that those with postgraduate and undergraduate education would place a higher value on participation in the energy planning process, decentralizing energy systems, and improving energy education due to their own educational influences. Universities tend to be institutions that encourage participation and this influence may enhance aspirations to participate in public planning activities. Furthermore, university graduates tend to be more liberal in orientation, and therefore more supportive of the type of power sharing inherent in decentralized energy systems. Finally, in the course of university training, students are typically exposed to different ideological and disciplinary perspectives and would inherently understand the value of knowledge and information in order to improve the efficacy of public involvement in energy planning. Table 6 shows the energy security ratings for the entire sample broken down by final education achievement. The table highlights dimensions of comparatively high importance in green, comparatively moderate importance in yellow, and comparatively low importance in red. The data fails to support our proposition related to the influence of education. Overall, the data suggests that no specific age group rated improved transparency, enhanced energy education, or decentralization of energy systems to be of comparatively higher importance.

3.2. *The ignorance of youth*

We surmised that older individuals would place greater importance on ensuring stable prices because they have fixed incomes. This is supported by Warriner (1981) who found that since a larger proportion of the elderly survive on low and fixed incomes, their already frugal living conditions make it difficult to cut back on consumption and make energy services a conspicuous part of their lifestyle. We also expected older individuals to perceive long-term initiatives (such as minimizing the depletion of domestic energy resources) as having greater importance when compared to the perceptions of younger people. This is premised on research by Lutzenhiser (1993) and Greenberg (2009) who identified age-related disparities in knowledge regarding energy use and technology, with older persons found to be more appreciative of minimizing depletion of energy stocks and in favor of improving energy efficiency.

The data summarized in Fig. 2 neither supports nor denies our proposition. Fig. 2 presents the response disparity between those aged 18–35 and those aged 36–55 in assessing the levels of importance attributed to the 16 energy security dimensions. The blue boxes indicate comparatively higher importance attributed to the dimension by those aged 18–35, while the pink boxes indicate higher importance attributed to the dimension by those aged 36–55. In most cases, the table shows that older respondents placed more emphasis on enhancing security of fossil fuel supplies and improving energy efficiency, whereas younger respondents tended to place more importance on achieving objectives such as energy education, transparency, and energy trade. Fig. 3, which looks closely at how specific dimensions were rated by different age groups, shows that as respondents get older they tend to place greater importance in supporting energy technology research, improving price stability, and decentralizing energy systems but tend to de-emphasize the importance of maintaining affordability and reducing the depletion of domestic fuel stocks.

Table 6 – Mean energy security ratings by education (n = 2167).

Dimension of Energy Security	Secondary	Undergraduate	Postgraduate	Other
To have a secure supply of coal, gas, oil and/or uranium	4.51	4.59	4.42	4.66
To promote trade in energy products, technologies, and exports	4.26	4.31	4.24	4.40
To minimize depletion of domestically available energy fuels	4.38	4.46	4.22	4.51
To have stable, predictable, and clear price signals	4.39	4.43	4.35	4.46
To have affordably priced energy services	4.44	4.45	4.29	4.53
To have small-scale, decentralized energy systems	4.14	3.99	3.96	4.28
To have low energy intensity (unit of energy required per unit of economic output)	4.34	4.38	4.46	4.44
To conduct research and development on new and innovative energy technologies	4.62	4.69	4.75	4.71
To assure equitable access to energy services to all of its citizens	4.41	4.43	4.43	4.60
To ensure transparency and participation in energy permitting, siting, and decision-making	4.21	4.36	4.35	4.36
To inform consumers and promote social and community education about energy issues	4.35	4.38	4.44	4.53
To minimize the destruction of forests and the degradation of land and soil	4.58	4.70	4.67	4.68
To provide available and clean water	4.63	4.70	4.74	4.81
To minimize air pollution	4.70	4.69	4.70	4.79
To minimize the impact of climate change (i.e., adaptation)	4.38	4.49	4.50	4.50
To reduce greenhouse gas emissions (i.e. mitigation)	4.50	4.59	4.63	4.55

3.3. *Defending one's vocation*

We postulated that industry perspectives on energy security would deemphasize the importance of climate change mitigation and reducing environmental damages. This is loosely based on a premise put forth by sociologists DiMaggio and Powell (1983) who noted that through a process of ''institutional isomorphism'' people come to share the same values and mores of the organizations that they work for. To extend this logic, in industry where the profit motive is strong, one would expect economic aspirations to trump environmental aspirations. Dunlap and Olsen (1984) have also found that, compared to advocates of renewable energy, employees of oil and gas companies are more tolerant of the environmental insults associated with energy production and use, suggesting that the particular industry one is in can shape views about energy security. We also speculate that both government and industry sector stakeholders will place comparatively greater emphasis on the importance of energy research and development as per research done by Gottlieb and Matre (1976).

	USA	india	singapore	germany	china	japan	saudi	brazil	kazakh	PNG
SS	-0.29	0.12	-0.20	-0.65	-0.13	-0.05	0.03	-0.21	-0.18	-0.04
trade	0.08	-0.05	0.04	0.07	0.23	0.03	-0.05	0.15	-0.32	0.06
depletion	0.04	0.01	0.36	-0.47	0.05	-0.04	-0.25	-0.09	-0.32	0.01
price	-0.08	0.12	-0.21	-0.04	0.03	-0.07	-0.06	-0.08	-0.21	-0.01
affordability	0.05	-0.13	0.00	0.10	0.09	-0.05	0.05	0.19	-0.27	0.06
decentralized	-0.14	0.07	0.24	-0.11	0.25	-0.10	-0.01	-0.31	-0.49	-0.03
EE	-0.08	0.14	-0.28	0.00	-0.02	0.11	0.00	-0.29	-0.56	-0.06
R&D	0.01	0.02	0.00	-0.11	0.13	0.00	-0.15	0.00	-0.34	-0.01
Equitable acces	-0.13	0.05	-0.19	-0.10	0.24	0.01	-0.11	0.03	-0.44	0.03
Transparency	0.05	0.02	-0.08	0.04	0.37	0.02	0.00	0.06	-0.28	0.10
education	0.10	0.39	0.04	0.52	0.21	0.03	-0.03	0.01	0.01	0.11
land /forests	0.02	0.14	-0.11	-0.23	-0.12	0.00	-0.09	0.08	-0.02	-0.03
water	-0.03	0.05	-0.21	-0.43	-0.07	0.12	0.02	0.13	-0.03	0.04
air	-0.02	0.08	-0.03	0.00	-0.07	-0.06	-0.12	0.04	-0.10	-0.01
CC adaptation	0.01	0.21	0.00	-0.34	0.22	-0.17	-0.25	0.09	-0.35	-0.02
CC mitigation	0.09	0.13	-0.01	-0.18	0.06	-0.12	-0.21	0.08	0.00	0.00
average	-0.02	0.09	-0.04	-0.12	0.09	-0.02	-0.08	-0.01	-0.24	0.01

Fig. 2 – Differences between average scores of those aged 18–35 Compared to 36–55 (n = 1940).

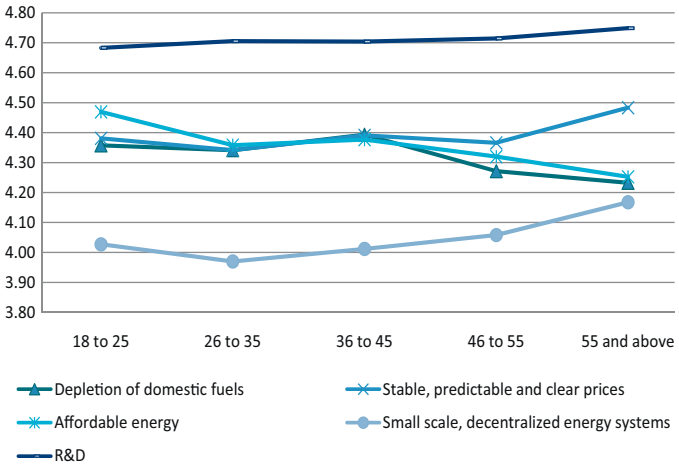

Fig. 3 – Energy security ratings for five dimensions by age (n = 2167).

Table 7 – Mean energy security ratings broken down by occupation (n = 2167).

Dimension of Energy Security	Private sector	University	Non profit	Govern-ment	Inter-govern-mental	Other
To have a secure supply of coal, gas, oil and/or uranium	4.45	4.48	4.17	4.74	4.62	4.47
To promote trade in energy products, technologies, and exports	4.24	4.25	4.14	4.41	4.31	4.05
To minimize depletion of domestically available energy fuels	4.36	4.31	4.07	4.46	3.97	4.32
To have stable, predictable, and clear price signals	4.35	4.34	4.29	4.52	4.41	4.37
To have affordably priced energy services	4.35	4.37	4.17	4.48	4.31	4.47
To have small-scale, decentralized energy systems	4.00	4.02	4.10	4.02	4.03	3.79
To have low energy intensity (unit of energy required per unit of economic output)	4.39	4.43	4.35	4.44	4.36	4.26
To conduct research and development on new and innovative energy technologies	4.66	4.75	4.66	4.77	4.51	4.68
To assure equitable access to energy services to all of its citizens	4.32	4.48	4.35	4.59	4.33	4.47
To ensure transparency and participation in energy permitting, siting, and decision-making	4.22	4.36	4.33	4.45	4.31	4.05
To inform consumers and promote social and community education about energy issues	4.28	4.51	4.43	4.50	4.51	4.05
To minimize the destruction of forests and the degradation of land and soil	4.61	4.69	4.63	4.74	4.49	4.47
To provide available and clean water	4.61	4.77	4.70	4.83	4.77	4.42
To minimize air pollution	4.66	4.72	4.70	4.77	4.62	4.32
To minimize the impact of climate change (i.e., adaptation)	4.36	4.52	4.33	4.62	4.44	4.26
To reduce greenhouse gas emissions (i.e. mitigation)	4.47	4.63	4.59	4.68	4.46	4.21

The data presented in Table 7 fails to fully validate our propositions. We found that, as expected, climate change mitigation is more important to government employees than those employed in the private sector in countries such as the United States, India, Germany, Saudi Arabia, Brazil, Kazakhstan, and Papua New Guinea. However, contrary to expectations, in Singapore, China and Japan, private sector employees rate mitigation of climate change *more* highly. As Table 7 additionally shows, private sector participants rated preservation of environmental endowments and minimization of air pollution to be of comparatively high importance within the list of 16 dimensions, and in some cases rated some environmental dimensions higher than intergovernmental employees (land and forestry, air pollution, and climate change mitigation) and non-profit employees (climate change adaptation) did.

Table 8 – Mean energy security ratings broken down by gender (n = 2167).

Dimension of Energy Security	Female	Male
To have a secure supply of coal, gas, oil and/or uranium	4.49	4.51
To promote trade in energy products, technologies, and exports	4.29	4.25
To minimize depletion of domestically available energy fuels	4.46	4.23
To have stable, predictable, and clear price signals	4.42	4.34
To have affordably priced energy services	4.46	4.30
To have small-scale, decentralized energy systems	4.10	3.96
To have low energy intensity (unit of energy required per unit of economic output)	4.43	4.39
To conduct research and development on new and innovative energy technologies	4.73	4.69
To assure equitable access to energy services to all of its citizens	4.49	4.39
To ensure transparency and participation in energy permitting, siting, and decision-making	4.34	4.30
To inform consumers and promote social and community education about energy issues	4.50	4.35
To minimize the destruction of forests and the degradation of land and soil	4.71	4.62
To provide available and clean water	4.74	4.70
To minimize air pollution	4.78	4.64
To minimize the impact of climate change (i.e., adaptation)	4.55	4.41
To reduce greenhouse gas emissions (i.e. mitigation)	4.66	4.52

We did however, find general support for the contention that research funding would be of comparatively higher importance for private sector respondents (a mean score of 4.66 tied for first with air pollution) and government sector respondents (tied for second with air pollution after water).

3.4. *Feminism and mother earth*

We postulated that compared to men, women would place greater importance on mitigation of climate change and minimizing environmental degradation. This is based on research by Kellstedt et al. (2008) who noted that studies "consistently show that women and racial minorities are more fearful of the risks of climate change" and that "traditional divisions of labor account for higher levels of environmental concern among women." O'Connor and Fisher (1999) and Viscusi and Zeckhasuer (2006) have also identified a "gender-based" disparity regarding climate change attitudes and perceptions, as has Denton (2002) who argued that women will be disproportionately affected by climate change vulnerabilities, and therefore, place greater importance in mitigating such damage. Looked at from an alternative perspective, in terms of support for renewable energy, Greenberg (2009) found in his survey of U.S. attitudes that proponents of renewable energy and environmentally friendly sources of energy tended to be white, highly educated women, while supporters of fossil fuels professed strong religious beliefs, trusted authority, and tended to be minority males. Devine-Wright (2007) has also noted that more women support new renewable energy development (90%) than men do (66%) and that men prefer nuclear power. More abstractly, Lutzenhiser (1993) (270) has argued that "mothers may have the greater role in transmitting environmental values".

The data presented in Table 8 supports this proposition. Women rated minimizing destruction of land and forests higher than men did in all countries except India. Women were also more conscious of the environment than men were, rating the minimization of air pollution, climate change mitigation, climate change adaptation, and preserving the integrity of water supplies higher than men did. In indirect support of our proposition, women rated minimizing depletion of domestic fuel stocks and improving energy efficiency as being more important than men did across the majority of countries (except in India and China where responses between the genders were equal or nearly equal). In all countries but Japan, women gave higher ratings to energy education than men did. We contend that all of these metrics indirectly support our proposition because improvements in these three dimensions reduce environmental degradation. Table 8 shows that the only dimension of energy security men rated higher than women did was in regard to enhancing security of fossil fuel supplies.

3.5. *The influence of affluence*

We surmised that rapidly developing economies (countries such as Brazil and China) would attach increased importance to security of fossil fuel supplies. Developing nations are characterized by rapidly accelerating demand for energy and so procuring additional energy resources tend to headline energy policy requirements. China, for example, is consuming 8.5 million barrels of oil per day, making it the world's second largest oil consumer. In 2008, China consumed 16.4% of the world's energy, an amount larger than combined consumption in the rest of Asia (which consumed 11.6%) (International Energy Agency, 2010: pp. 30).

We also speculate that technologically advanced economies (such as Germany and Japan) would prioritize enhanced energy efficiency and energy research. This proposition stems from the observation that OECD countries lead the world in

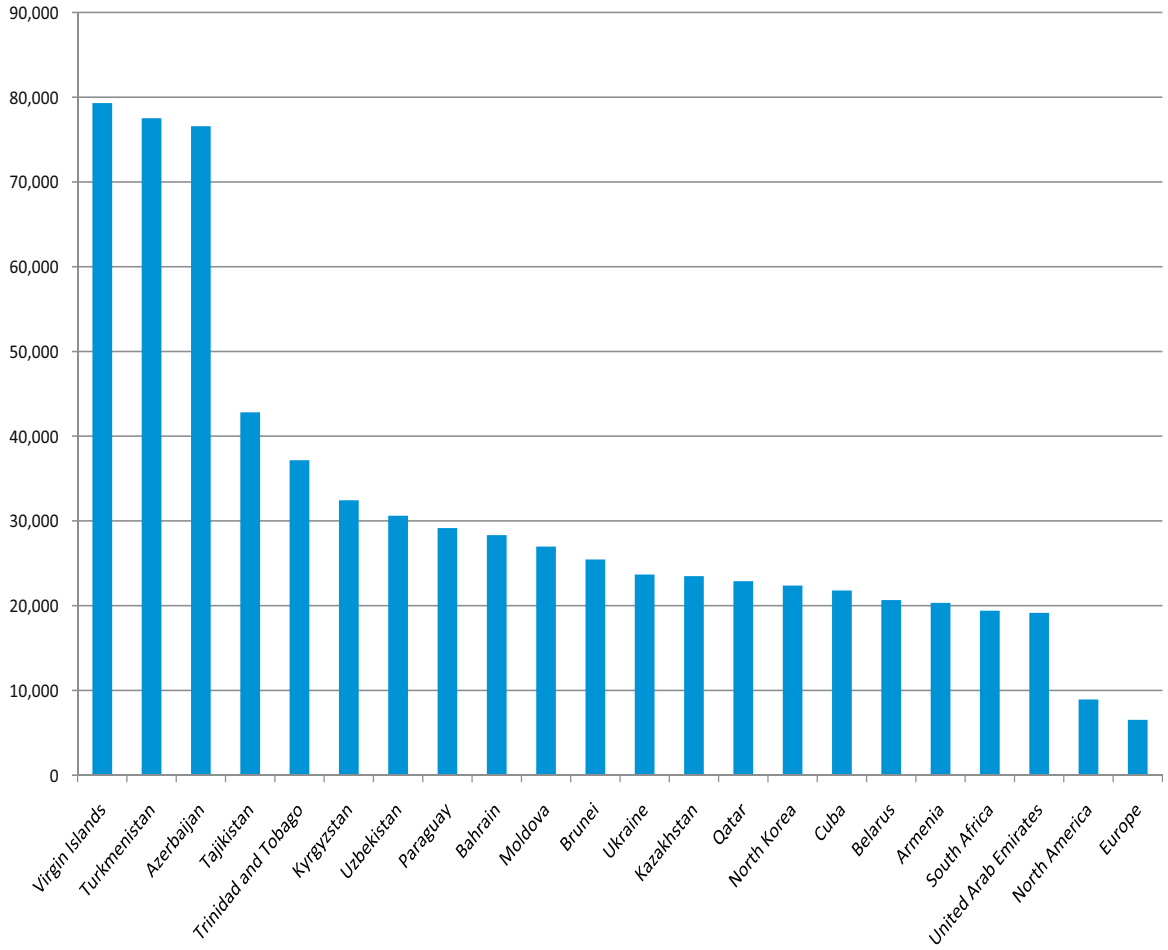

Fig. 4 – Selected energy intensities (BTUs per 2000 USD, PPP), 2006.

total energy research expenditures – spending more than $14 billion each year –and have some of the lowest energy intensities compared to developing countries, numbers summarized in Fig. 4, which show that energy intensity ratios in North America and Europe are a fraction of those found in many developing countries.

The data supports only part of this proposition: that developing economies (in our sample Brazil, China, India, Kazakhstan, and Papua New Guinea) rate security of supply higher than fully industrialized economies (Germany, Japan, Singapore, and the United States). In contrast, Fig. 5 shows that both developed and developing nations rated improving

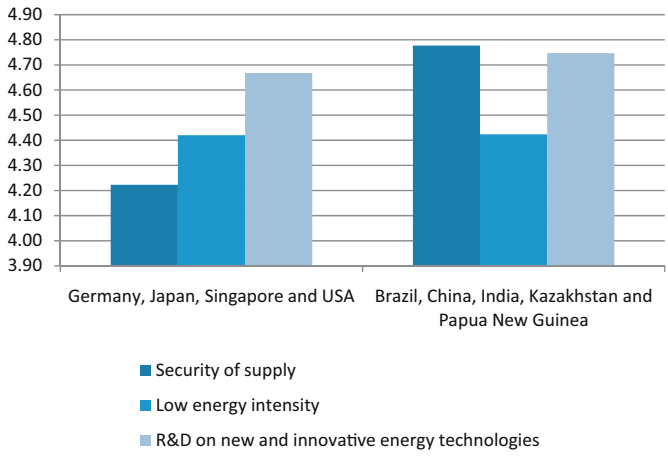

Fig. 5 – Selected energy security ratings for developed (n = 980) and developing economies (n = 785).

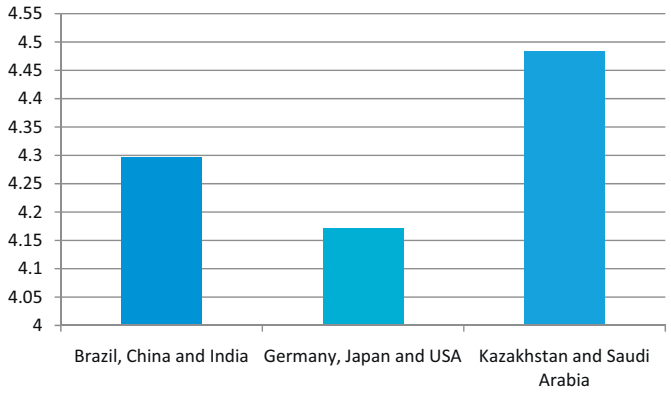

Fig. 6 – Selected energy security ratings for developing countries (n = 599), importers (n = 887), and exporters (n = 436).

energy efficiency to be of equal importance (mean score of 4.4) and developing countries rated enhanced energy research to be of greater importance (mean score of 4.72) than developed nations (4.65) did.

3.6. *The haves and have nots*

We postulated that stakeholders from import-dependent countries such as Germany, Japan, and the United States would assign higher importance to smaller, decentralized energy systems and lessening dependence on energy imports, whereas major exporters such as Kazakhstan (uranium) and Saudi Arabia (oil) would consider enhancement of energy trade to be of high priority. These intuitive propositions stem in part from research by Sovacool and Lim (2010) who argued that importing, exporting, and cross-transit countries will view energy security differently. Importing countries look to substitute fuels, keep prices low, diversify imports, and diversify energy sources, whereas exporting countries look for security in demand, higher prices, and a stable energy market. Meanwhile, cross-transit countries place emphasis on competition and trade because for them, dependence and lack of diversification increases the propensity for cross-boundary trade which they benefit financially from. We also speculated that rapidly industrializing economies such as Brazil, China, and India would view enhanced energy trade as an important step to helping them procure energy fuels.

As Fig. 6 shows, we found that the data supports both propositions. The two dominant exporters from data set (Kazakhstan and Saudi Arabia) rated enhanced energy trade to be much more important than importing countries did. Respondents from the developing economies of Brazil, China, and India rated enhanced energy trade to be much more important than developed countries did.

3.7. *The presence of poverty*

We proposed that countries with low population densities or those with sizable rural populations would rate energy equity and affordability to be more important dimensions of energy security. Intuitively, countries with lower population densities face larger costs per capita in distributing energy; and therefore face greater economic hurdles in ensuring energy equity. Poorer, less densely populated nations like Kazakhstan and Papua New Guinea tend to have extremely low levels of access, leading us to believe that sparsely populated nations in particular would consider affordability an important energy security criterion. In contrast, environmental degradation is frequently more prevalent in densely populated nations.

Similarly, the environmental Kuznets curve hypothesis relates changes in income to changes in pollution levels, environmental quality, and environmental degradation. It suggests that environmental degradation and pollution increases with income as societies begin to develop and their levels of consumption grow at the expense of the environment. Environmental degradation then decreases after a peak, or turning point, as societies are better able to afford more sustainable practices (Carson, 2010; Copeland and Taylor, 2004; Deacon and Norman, 2006; Harbaugh et al., 2002; López and Mitra, 2000; Smith and Ezzati, 2005; Suri and Chapman, 1998).

We therefore speculated that the importance of enhanced environmental governance in regard to energy planning would be of greater concern in densely populated nations. This is certainly true for India where the Bhopal disaster sired elevated levels of environmental governance. It is also true of Japan, which was arguably the first nation in Asia to pass comprehensive legislation controlling industrial pollution to promote cleaner air and water in the 1960s following highly publicized cases of arsenic poisoning, mercury poisoning (Minamata disease), semi-acute spinal and optical nervous disorders and hexavalent chromium diseases (Valentine, 2011c; Tsuru, 2000; Fukasaku, 1995).

We found only partial support for this proposition. Respondents from Papua New Guinea and Kazakhstan did rate affordability of energy services to be of higher importance than respondents from India, Japan, and Singapore did. But as Fig. 7 shows, Papua New Guinean and Kazakhstani respondents also rated preservation of environmental endowments and minimization of air pollution higher in importance than India, Japan, and Singapore did. This contradicted our postulation that densely populated nations would rate

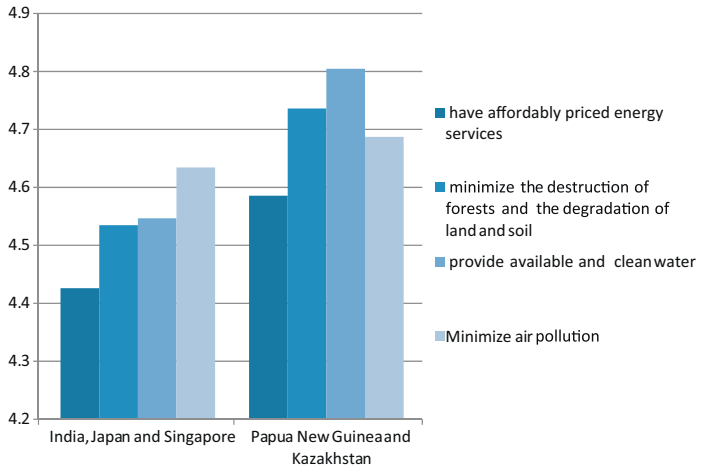

Fig. 7 – Selected energy security ratings for affordability and environmental dimensions for rural (n = 186) and urban (n = 301) countries.

improved environmental governance associated with energy planning to be of greater importance when compared to perspectives in less densely populated nations.

3.8. *Climate change and vulnerability*

We proposed that individuals in wealthier countries would consider climate change mitigation and abatement to be of more importance than individuals in poorer countries because affluence tends to improve one's capacity to invest in the future, whereas lack of affluence tends to focus attention on improving economic well-being over the shorter term (though to some degree all respondents would likely approve of increased adaptive capacity and resilience in their own community). We contend that the verity of this proposition underpins part of the north–south ideological divide in climate change negotiations and the associated agreement under the Kyoto protocol for industrialized nations to commit to GHG emission reduction targets first. On one hand, leaders from developing nations argue that they will continue to resist binding GHG emission reduction targets because such targets would adversely influence economic growth which is of a higher priority (IGES, 2005). On the other hand, leaders of industrialized countries have exhibited a willingness to accept further binding targets but will do so only if there is some sort of commitment on the part of developing countries to reduce GHG emissions.

Although public opinion on climate change is complex and multidimensional (Tàbara and Miller, 2011), some anecdotal evidence suggests that industrialized countries such as those in the European Union, Japan, and Australia place greater emphasis on climate change mitigation, whereas developing countries either do not regard climate change as an important issue or focus on climate change adaptation (Wilbanks et al., 2007). Others have noted that developing countries in general want to continue emitting greenhouse gases to accomplish their economic and social development goals whereas developed countries have pledged to stop their own emissions. Prouty (2009) writes that many leaders in the developing world see climate change as predominately the fault of industrialized countries. The United States and European Union, for example, account for two-thirds of the primary build of up carbon in the atmosphere by themselves, whereas the entire continent of Africa is responsible for just 3% of global emissions since 1900. Planners and leaders in developing economies have argued hard for the "right" to continue emitting greenhouse gases, an approach sometimes called "compaction and convergence" as it implies eventually both sets of countries will emit similar levels of greenhouse gases in the future. This "right" to emit is evident in the list of non-Annex 1 countries subject to the Kyoto Protocol. A final set of studies have noted that even within countries affluence affects perspectives on climate change, the more affluent tend to place a greater priority on climate change mitigation (Rabe and Borick, 2010; Pew Center for the People and The Press,

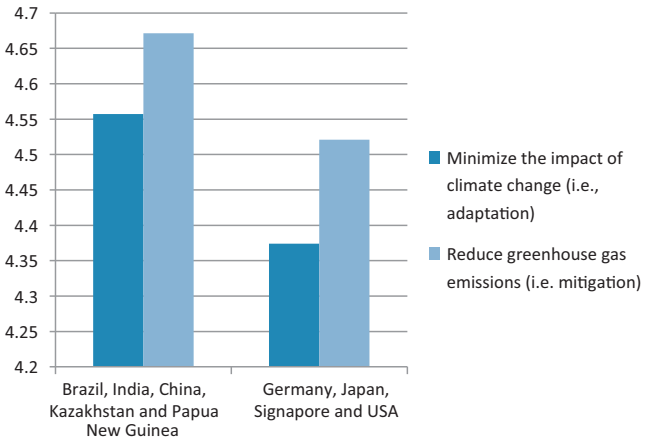

Fig. 8 – Selected energy security ratings for climate change adaptation and mitigation for developing (n = 785) and developed (n = 980) countries.

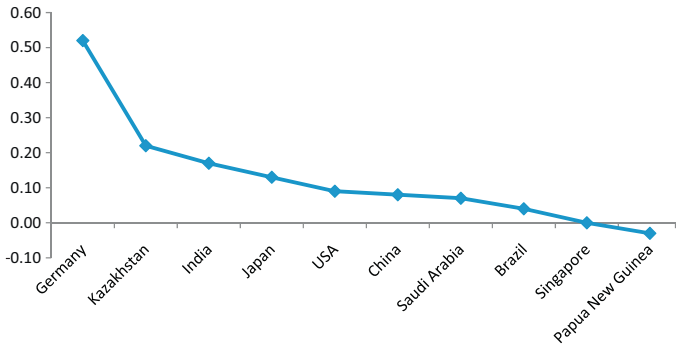

Fig. 9 – Difference between average scores on climate change mitigation and adaptation.

2009) or on making investments in wind, solar, and cleaner forms of energy supply (Greenberg, 2009).

Surprisingly, the data does not support our proposition. Brazil, China, India, Kazakhstan, and Papua New Guinea rated mitigation and adaptation to be of greater importance than Germany, Japan, Singapore, and the United States did. As Fig. 8 suggests, both developed and developing countries rated climate change mitigation to be of higher importance than taking abatement measures. One possible explanation for the preference of mitigation over abatement is intuitive; if possible most people consider it to be more preferable to solve a problem directly than to rectify its effects indirectly. Our results also imply that policymakers may not be adequately representing the views of their constituents. Despite the reluctance of leaders in both industrialized and developing nations to commit to GHG emission reduction levels sufficient to mitigate climate change, there appears to be widespread support for committing to such measures.

Furthermore, Fig. 9 casts doubt on the correlation between preferences for adaptation and mitigation with economic development, showing that differences between the scores were greatest for Germany and Kazakhstan (one developed, one developing economy) but the least for Singapore and Papua New Guinea (again, one developed and one developing economy).

3.9. *The hand of political control*

We surmised that respondents from countries with competitive representative democracies would place more emphasis on decentralizing energy systems, improving participation in energy planning, and promoting energy education, whereas respondents from more tightly controlled economies would see stronger benefits arising from centralization of energy planning and control and view improved transparency as a less important dimension of energy security. Indeed, in democracies such as the United States, there appears to be amplified expectations by citizens to be consulted in regard to energy planning, as evidenced by opposition to the Cape Wind project off the Massachusetts coast, liquid natural gas terminals proposed for Maine and New Jersey, and the Yucca Mountain nuclear repository in Nevada. The result has been a movement to include citizens in energy permitting discussions so that they are more likely to approve, and even benefit from, energy projects (Valentine, 2011b). Conversely, Sovacool and Valentine (2010) and Valentine and Sovacool (2010) have found that in economies guided by government control (e.g., France, China, India, Japan and South Korea), energy planning is centralized and participation in energy planning limited. As Francis Fukuyama points out, the manner in which a nation is ruled is hard to disaggregate from social values and culturally

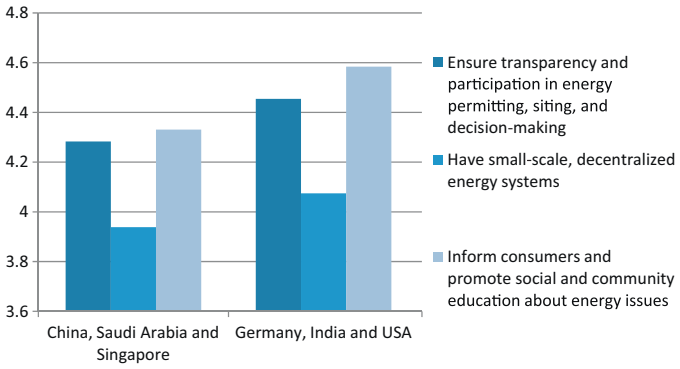

Fig. 10 – Selected energy security ratings for governance indicators for democratic (n = 713) and authoritarian (n = 703) countries.

Table 9 – Evaluation of energy security propositions.

Proposition	Supported	Unsupported	Neither
P1: The influence of education		✓	
P2: The ignorance of youth			✓
P3: Defending one's Vocation		✓	
P4: Feminism and mother earth	✓		
P5: The influence of affluence			✓
P6: The have and have nots	✓		
P7: The presence of poverty			✓
P8: Climate change and vulnerability		✓	
P9: The hand of political control	✓		

embedded ideologies (Fukuyama, 1999). In our data set, we considered China (a one-party communist state), Singapore (a virtual one-party democracy), Japan (a virtual one-party democracy until recently) and Saudi Arabia (a kingdom) to be nations which exemplify a higher degree of centralized economic control, whereas current political conditions in India, the United States, and Germany are considered to be representative democracies.

For these two groups of countries, we found some support for our proposition. Fig. 10 shows that Germany, India, and the United States each rated improved transparency, decentralization of energy systems, and enhanced community energy education more favorably than China, Saudi Arabia, and Singapore. Indeed, Saudi Arabian and Chinese respondents rated these dimensions of energy security among the lowest levels of importance across all 16 dimension, whereas German, Indian and American respondents identified two of the dimensions to be of comparatively high priority (improved transparency and enhanced energy education). On the other hand, it needs to be acknowledged that the lowest rated and ranked dimension of energy security across the entire sample was decentralization of energy supply so although it can be said that individuals from centrally controlled economies may not place much relative importance in decentralized energy networks; the same can also be said of respondents from competitive, representative democracies.

4. Conclusion

Our survey of 2167 energy users from an array of demographic and vocational backgrounds in 10 countries has produced some intriguing results. As Table 9 shows, the data tends to support the proposition that female respondents are more likely to rate environmental dimensions of energy security, such as water, land, air pollution, and climate change, more highly than men. Data also supported the supposition that respondents from major energy exporting nations such as Kazakhstan and Saudi Arabia place a greater emphasis on enhancing energy trade and improving access to fossil fuels and uranium than respondents from major energy importing nations such as Germany, Japan, and the United States do. Our results were also consistent with the postulation that respondents from competitive representative democratic nations will hold dimensions of energy security such as improved stakeholder participation, enhanced transparency, and improved energy education to be of greater importance than do respondents from more tightly controlled economies.

On the other hand, our data did not support (a) the proposition that as respondents receive more education they will take a longer term view of energy issues; (b) the proposition that those in private industry will de-emphasize environmental issues such as mitigating pollution and climate change; and (c) the proposition that respondents from developing countries place a greater emphasis on climate change mitigation and adaptation than respondents from developed countries do.

We found mixed evidence regarding support for the propositions that (a) there is a correlation between age and the perceived importance of long-term energy security aspects; (b) more densely populated nations tend to place higher priority on the importance of minimizing environmental degradation (which our data contests) while more sparsely populated nations emphasize the importance of energy equity and decentralization of energy systems (which the data supports); and (c) the proposition that affluent countries tend to attribute greater importance to enhanced energy research.

Moreover, our results were unable to confirm a number of additional propositions rooted in some of the academic literature on energy security and policy that we did not initially intend to evaluate. Our results point to a disparity between what experts writing in energy journals and books deem to be crucial energy security concerns, and what members of the general public themselves deem to be crucial. Our results also produced subtle discrepancies between our rating and ranking methods. Having respondents *rate* energy security dimensions according to a five-point scale produces different results than having them *rank* energy security dimensions in order of importance. As Kahneman et al. (1991) discovered in regard to contingent value assessment, how a question is asked seemed in our study to influence responses.

Our results raise questions regarding the validity of some popular suppositions made in the literature, such as the belief that industrialized and densely populated countries place greater emphasis on minimizing environmental damage associated with energy production, or that developing countries prioritize climate change adaptation over mitigation. In these ways the ''common sense'' presented by the

literature may be wrong. It may be that many of these claims have never been formally validated; they are presumed to be true, entrenched through citation in subsequent studies but never empirically confirmed.

Our study also serves as a reminder of the complexity of energy security both in theory and in practice. In one sense, all dimensions of energy security were rated and ranked relatively highly: the highest rated component differed from the lowest rated component by a mere 0.7 on a five-point scale; the highest ranked component received 31% of responses whereas the lowest ranked received 10%. While we found subtle differences in the perceived levels of importance of the sixteen dimensions of energy security examined in our survey, the dimension of lowest perceived importance for energy security (decentralization of energy systems) still received a mean score of 4.02 (important) while the highest rated dimension (preserving the integrity of water supplies) received a mean score of 4.72 (extremely important). Though the rankings in our study show much greater variation, the fact that no dimension of energy security scored below a 4 on a five-point scale suggests that *all* 16 dimensions of energy security identified in our survey are considered to be of importance.

Our study therefore strongly suggests that energy security analysis must extend beyond traditional themes such as security of fossil fuel supplies and the efficacy of energy markets to incorporate emergent areas of concern such as energy efficiency, engendering stable and clear price signals, providing affordably priced energy services, and enhancing the sustainability of energy technologies. Researching and developing new and innovative energy systems, ensuring equitable access to energy services, and improving transparency and participation in energy decision-making are all considered to be of importance by those affected by energy planning decisions. Improving knowledge through energy education is also seen as a meaningful aspect of a nations energy security because enhanced knowledge improves decision making and energy governance.

Finally, it is important to emphasize that minimizing damage to environmental endowments, maintaining the integrity of water supplies, lessening levels of air pollution and greenhouse gas emissions, and creating effective responses to climate change are all considered to be important dimensions of energy security—these environmental issues should no longer be considered external to the energy security debate. In essence, our study shows that to look at concern such as energy security narrowly, avoiding even a single of our sixteen dimensions, artificially limits the discussion and promotes energy planning and policy that fails to meet stakeholder expectations. The diversity of perspectives and priorities captured in our survey may require policymakers and scholars to reexamine their own assumptions about what energy security is, and how it can be best improved.

Appendix A. The energy security survey

SECTION 1

1. Please tell us about yourself:
   a. Level of education: ☐ Postgraduate ☐ Undergraduate ☐ Secondary ☐ Other
   b. Age: ☐ 18 to 25 ☐ 26 to 35 ☐ 36 to 45 ☐ 46 to 55 ☐ 55 and above
   c. Gender: ☐ Male ☐ Female
   d. Country of residence:
      ☐ United States
      ☐ Brazil
      ☐ Russia
      ☐ China
      ☐ India
      ☐ Kazakhstan
      ☐ Papua New Guinea
      ☐ Saudi Arabia
      ☐ Singapore
      ☐ Japan
      ☐ Germany
   e. Nationality: _____
   f. Type of Occupation:
      ☐ Private sector / industry / business / for-profit organization
      ☐ Non profit, non-governmental organization / civil society
      ☐ Government / national institute / regulatory agency
      ☐ University / school / academic institution
      ☐ Intergovernmental organization
   g. Name of Primary Employer (optional):
      _____
   h. Job Title (optional): _____

SECTION 2

2. When you think about energy security for your country of residence in the next five years, how important is it ….

	Extremely important	Somewhat important	Neither important nor unimportant	Somewhat unimportant	Extremely unimportant
…to have a **secure supply of oil, gas, coal, and/or uranium**	☐	☐	☐	☐	☐
…to promote **trade** in energy products, technologies, and exports	☐	☐	☐	☐	☐
…to **minimize depletion** of domestically available energy fuels	☐	☐	☐	☐	☐
…to have **stable, predictable, and clear price signals**	☐	☐	☐	☐	☐
…to have **affordably priced energy services**	☐	☐	☐	☐	☐
…to have **small-scale, decentralized** energy systems	☐	☐	☐	☐	☐
…to have **low energy intensity** (unit of energy required per unit of economic output)	☐	☐	☐	☐	☐
…to conduct **research and development** on new and innovative energy technologies	☐	☐	☐	☐	☐
…to assure **equitable access** to energy services to all of its citizens	☐	☐	☐	☐	☐
…to ensure **transparency and participation** in energy permitting, siting, and decision-making	☐	☐	☐	☐	☐
…to inform consumers and promote social and community **education** about energy issues	☐	☐	☐	☐	☐
…to minimize the destruction of forests and the degradation of **land** and soil	☐	☐	☐	☐	☐
…to provide available and clean **water**	☐	☐	☐	☐	☐
…to minimize **air pollution**	☐	☐	☐	☐	☐
…to minimize the impact of **climate change** (i.e., adaptation)	☐	☐	☐	☐	☐
…to reduce **greenhouse gas emissions** (i.e. mitigation)	☐	☐	☐	☐	☐

SECTION 3

3. Given the sixteen dimensions of energy security discussed here, select the five that you think are most important for your country of residence, and rank them from 1 (the most important) to 5 (5th most important), without allowing for ties. Please rank only 5 dimensions:

☐ Secure supply of oil, gas, coal, and uranium

☐ Bolstering trade

☐ Minimizing rates of depletion

☐ Predictable and clear price signals

☐ Affordably priced energy services

☐ Decentralization and small-scale supply

☐ Low energy intensity

☐ Research and development

☐ Equitable access

☐ Transparency and participation in siting and decision-making

☐ Education and information

☐ Preservation of land

☐ Availability and quality of water

☐ Minimal air pollution

☐ Responding to climate change/adaptation

☐ Reducing greenhouse gas emissions/mitigation

SECTION 4

Did we miss any dimension that you consider important for the energy security of your country of residence in the next five years? Please enter below (or if we didn't, then leave blank)

_____

If you did provide an answer, when you think about energy security for your country of residence in the next five years, how important is this above dimension?

☐ Extremely Important

☐ Somewhat Important

☐ Neither Important nor Unimportant

☐ Somewhat Unimportant

☐ Extremely Unimportant

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