

## Linking Energy Independence to Energy Security

By Morgan Bazilian, Benjamin Sovacool, and Mackay Miller\*

### Introduction

Dramatic changes in oil and gas production in the United States have resurrected public interest in “energy independence” (see e.g., Houser and Mohan, 2012).<sup>1</sup> This interest came up very rapidly (as Figure 1 depicts) – the rhetoric only 5-7 years ago was dramatically different (see e.g., CFR, 2006). This attraction likely stems in part from a connotation that “independence” equals resiliency and stability of energy services without risk of volatility. However, both domestic energy issues and geopolitics are considerably more interrelated than this argument allows. In addition, the vocabulary used is often imprecise. We briefly explore aspects of the concept, and argue that although politically seductive, energy independence can distract from sound decision-making in the energy sector.

In reality, the global energy system is deeply interconnected. Not only is this true for oil markets, as an example, but when focusing on independence (or domestic supply/demand balances), it matters what the situation is in other countries and how it evolves. The case against relying on energy independence as a policy prescription tends to look at the end goals of energy policy, and describes resiliency and stability of energy services not as ends themselves, but rather as means of economic growth, innovation, and social well-being. History suggests that energy independence has persistent public and political appeal, and so the practical challenge is to rigorously ground the exuberance it can generate. To that end, we contextualize energy independence through the more robust concept of “energy security” and broader end goals of energy policy.

### Of Independence

Some degree of enthusiasm is, though, warranted – increasing domestic supply and decreasing imports has numerous possible social and economic benefits. The past five years have witnessed a sea change in the proven reserves and the production of oil, natural gas, and natural gas liquids in the United States. Largely as a consequence, there has been a marked shift in the import/export balance of these commodities. In the United States, energy independence is commonly defined in terms of the degree of reliance on imports from outside North America,<sup>2</sup> and falling imports have made independence appear attainable. Often the thrust of the energy independence goal is pinned on removing our interests from the Middle East.<sup>3</sup> However, as O’Sullivan (2013) notes, “Interests other than energy, such as terrorism, nuclear proliferation, the security of Israel and the well-being of more than more than 300 million Arabs, will continue to be high on the U.S. agenda”.<sup>4</sup>

Two significant reports underscore the popular conception of the term. The International Energy Agency (IEA) in its 2012 World Energy Outlook (IEA, 2012) noted that: “The United States will overtake Saudi Arabia as the world’s leading oil producer by about 2017 and will become a net oil exporter by 2030.”<sup>5</sup> In addition, the Citi Group published an influential report in 2012 (Morse et al., 2012) with the provocative title, “Energy 2020: North America, the new Middle East?” On first pass both appear to focus only on increases in supply, but in fact both acknowledge a significant portion of the balance is due to assumed decreases in demand. That subtlety is often missing from popular discourse, and belies the need for well-designed demand-side policy.

Levi (2012a) argues that the notion of independence ignores realities of global markets in oil (the United States does not set that price), promotes complacency in both domestic energy policy as well as foreign policy, and at the

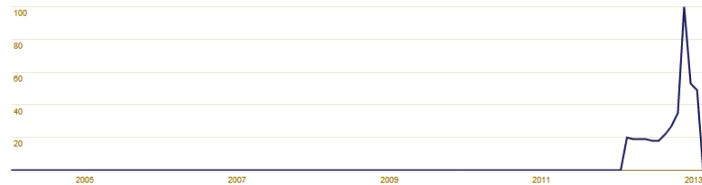


Figure 1: Google trends “interest over time” 2004 to present for the term “U.S. energy independence”. A clear spike occurs beginning in early 2012.

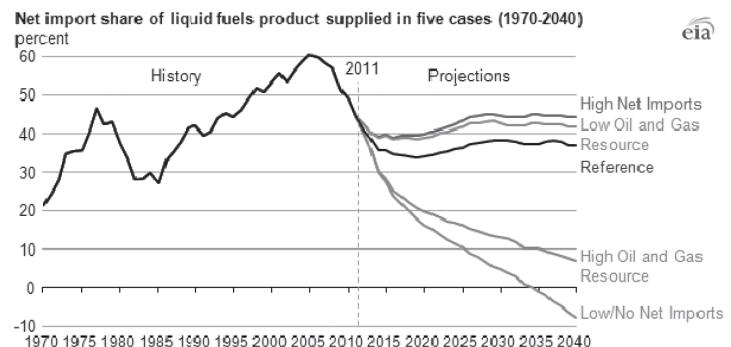


Figure 2: Net Import Shares in Various Scenarios (EIA, 2013a)

\*Morgan Bazilian is with the Joint Institute for Strategic Energy Analysis, Colorado; Benjamin Sovacool is with the Institute for Energy & the Environment, Vermont Law School, Vermont and Mackay Miller is with the National Renewable Energy Laboratory, Colorado. Morgan Bazilian may be reached at [morgan.bazilian@jisea.org](mailto:morgan.bazilian@jisea.org). See footnotes at end of text.

extreme, gives fuel to, “energy isolationism”, which would likely harm the global economy<sup>6</sup>. These three concerns vary considerably in how likely they are to influence U.S. energy policy. One need only conceive of a major energy exporting country, such as Saudi Arabia, to be reminded that such a title does not remove them from having wider energy challenges. As an example, the Kingdom’s recent significant efforts on energy efficiency and investment in solar energy are evidence of their desire to take into consideration broader requirements for their energy and economic systems.<sup>7</sup>

The potentially misleading nature of the concept of energy independence can be illustrated by the difficulty in quantifying its central metric: import dependence. The EIA recently elaborated on this difficulty, with a focus on the differences that emerge by accounting for refinery flows in the United States

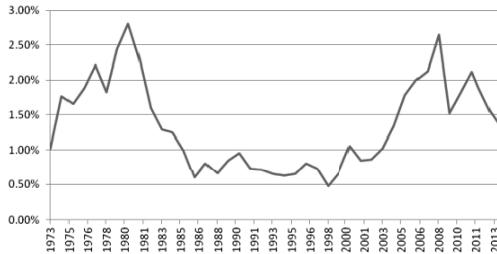


Figure 3: U.S. spending on oil imports as a fraction of U.S. GDP. (Levi, 2012b)

(EIA, 2013b). Figure 2 illustrates the uncertain future with five very different possible scenarios of net import shares in liquid fuels product.

But import dependence (net oil imports) alone does not capture the right metrics for decision making when considered from a macroeconomic perspective. Calculating oil import expenditures as a fraction of U.S. GDP gets closer to the real concerns of the economy as Levi (2012b) points out. Figure 3 illustrates that by this measure, U.S. oil imports as economic cost are still as high as they have been since 1982.

It is clear that an over reliance solely on import dependence does not account for the economic impacts of energy supply, nor many other factors, and thus is only one of many elements that need be considered for robust decision

making. We argue that a far larger set of considerations should drive energy policy, and that the concepts and methodologies from the “energy security” literature provide firmer grounding for policymaking. We briefly touch upon the related literature to that end. Still, we must recognize that energy security is an often misused concept itself, and that it has no generally agreed upon set of metrics.

### Towards Security

In its formal derivations, energy security requires a rigorous aggregation of dozens of variables that impact energy flows in the real world (see e.g., Bazilian et al., 2006). The complexity of the issues embodied within energy security are broad and vary depending on the context and perspective from which it is evaluated, and thus, no common definition exists. One assessment, for example, noted at least 45 separate definitions of energy security presented in the academic and policy literature over the past decade (Sovacool, 2011a). The bulk of the global energy security literature focuses on the geo-political aspects of energy security policy from an industrialized country perspective. As it is conceived of in those countries, an energy security policy generally comprises measures taken to reduce the risks of supply disruptions below a certain tolerable level. Insecurity in energy supply originates in the risks related to the scarcity and uneven geographical distribution of primary fuels and to the operational reliability of energy systems that ensure services are efficiently delivered to end users (see e.g., Bazilian and Roques, 2008).

Elkind (2010) argued that energy security is composed of four elements: *availability*, *reliability*, *affordability*, and *sustainability*.<sup>8</sup> Availability refers to the ability of consumers and users to secure energy that they need. It requires an extensive commercial market, buyers and sellers trading goods, parties that agree on terms, as well as sufficient physical resources, investments, technology, and legal and regulatory frameworks to back them up. Reliability refers to the extent that energy services are protected from disruption, predicated on a number of interrelated criteria including:

- Diversification of sources of supply (various fuels and technologies)
- Diversification of supply chains
- Resilience or the ability to handle shocks and recover from failures
- Reducing energy demand to ease the burden on infrastructure
- Redundancy in case failures occur
- Distributing timely information to markets.

Affordability involves low or equitable prices relative to income and stable prices. Sustainability refers to minimizing the social, environmental, and economic damage that can result from long-lived energy infrastructure. Utilizing this framework, Table 1 illustrates the complexity of energy security, showing that each of these four elements can be correlated with different components and threats.

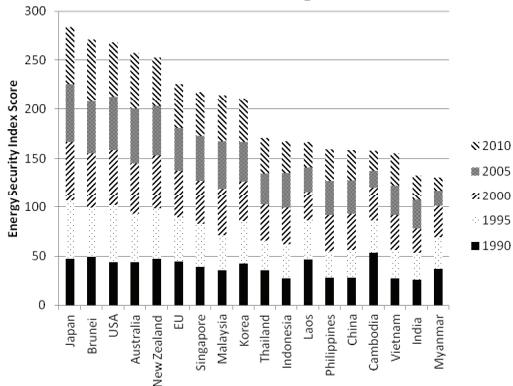
Elkind’s broad definition of energy security, mapped against components and threats, provides a nuanced framework for energy policy.

<b>Elements</b>	<b>Components</b>	<b>Threats</b>
Availability	Physical endowment of producers	Exhaustion of reserves that can be extracted cost effectively
	Ability of producers, transit countries, and consumers to agree on terms of trade	Limits on development opportunities such as resource-nationalist policies and state-to-state contracts
	Technological solutions for production, transportation, conversion, storage, and distribution	Problems in siting infrastructure including NIMBY syndrome
	Capital investment	Financial, legal, regulatory, or policy environments that inhibit investment
	Viable legal and regulatory structures	
	Compliance with environmental and other regulatory requirements	
Reliability	Robust, diversified energy value chain	Failure of energy systems due to severe weather and natural disasters
	Adequate reserve capacity	Failure due to poor maintenance or underinvestment
	Protection from terrorist attacks and political disruptions	Attack or threat of attack by military forces and terrorist organizations
	Adequate information about global energy markets	Political interventions such as embargoes and sanctions
Affordability	Minimal price volatility	Exhaustion of reserves that can be extracted cost effectively
	Equitable prices	Energy prices that require lower income households to expend large shares of their income
	Transparent pricing	Excessive subsidies that distort prices
	Realistic expectations about future prices	Failure to institute sound pricing policies
	Prices that reflect full costs	Failure to incorporate environmental and social costs to energy production and use
Sustainability	Low emissions of greenhouse gases	Adoption and promotion of carbon intensive energy infrastructure
	Minimal contribution to local, regional, and global forms of environmental pollution	Impacts of indoor and outdoor air pollution associated with energy use
	Protection of energy systems from climate change	Impacts of a changing climate such as rises in sea level, storm surges, and severe weather events

*Table 1: Elements, Components, and Threats to Energy Security (Elkind, 2010)*

**Measuring Progress**

Elkind’s conceptualization of energy security implies that the security of supplies of oil (Toman, 2009), natural gas (Luciani, 2004), coal (Kessels et al., 2008), and uranium (Keppler, 2007) are but one focal point of concern for energy policy makers throughout the world. Supply side security needs are



*Figure 4: Average Energy Security Performance for Eighteen Countries*

tightly coupled with the other pillars of energy policy and security, namely environmental considerations, governance and regulation, affordability, and industrial competitiveness.

As proof of the multidimensional complexity of energy security, our work has matched the various dimensions of energy security to particular metrics, enabling energy security to be measured according to an energy security “index” or “scorecard” (Sovacool et al., 2011b; Sovacool, 2013). The metrics involved, when applied over time to major energy consumers such as the European Union and United States, as well as the developing economies of Asia, imply that Japan (perhaps oddly), Brunei, and the United States are the most energy secure, whereas Vietnam, India, and Myanmar are less secure. These results are presented in Figure 4.

While narrower than the Energy Security Index – the Oil Vulnerability Index (OVI) developed by Gupta (2008) – is another example of a tool to compare national progress. It, too, reveals that energy security needs may be more complex than they otherwise appear. A side-by-side comparison of OVI and oil import dependence illustrates quantitatively the imprecision of the latter. Table 2, for example, shows the raw oil import dependence of various countries compared with an oil vulnerability index. Note that some of the most vulnerable countries according to the OVI are not necessarily those that have high levels of oil dependence.

We must recall that energy security too is but one of many facets of the increasingly complex and dynamic global energy system.

	Oil Import Dependency (%)	Oil Vulnerability Index	Divergence
Ireland	100%	0.49	-0.51
Belgium	99%	0.6	-0.39
Greece	98%	0.89	-0.09
Sweden	99%	0.37	-0.62
Switzerland	99%	0.49	-0.5
Portugal	98%	0.83	-0.15
Spain	98%	0.7	-0.28
Japan	97%	0.51	-0.46
Finland	96%	0.56	-0.4
France	96%	0.45	-0.51
Germany	95%	0.44	-0.51
Turkey	94%	0.82	-0.12
Italy	93%	0.55	-0.38
Austria	91%	0.46	-0.45
Netherlands	91%	0.55	-0.36
United States	58%	0.37	-0.21
Australia	37%	0.24	-0.13
<i>Average Divergence</i>			<i>-0.36</i>

*Table 2: Comparison of Oil Import Dependence and Oil Vulnerability Index of 17 OECD countries. (Source: International Energy Agency and Gupta, 2008)*

**Conclusions**

In sum, the simplifications that come with the energy independence frame can promote sub-optimal policy choices because they fail to acknowledge the complexity of energy security and wider considerations.

As an example, in the U.S. shale gas context, the abundant and rapid increase in supplies have spurred debates regarding for the attractiveness of achieving maximum energy self-sufficiency, and lead to policy prescriptions such as a suggested moratorium on further exports. The tradeoffs of these policies are illuminated in the context of the energy security index: increasing production promises a corresponding reduction in remaining years of production, and limiting exports could prop up prices for key trading partners. These first-order interdependencies illustrate some of the complexities of energy policy formulation. They reveal both the long-lasting nature of energy policy decisions (today’s choices may limit the options available to future generations) and the cascading negative economic impacts of energy isolationism. At the second order, there are other unintended consequences, such as:

- Policy and regulatory dashes in support of oil and gas competing for policy support for energy efficiency and newer, more environmentally benign generation technologies.
- Exhausting or polluting increasingly scarce water resources, especially since hydrofracturing is more water intensive than conventional gas production.

The litany of energy security tradeoffs is emblematic on how improving some of the dimensions of energy security inherently conflict with other meaningful dimensions. The future will likely bring more globally interdependent markets and systems. As a result, the pillars of robust U.S. energy policy could include an embrace of global partners, a wise optimization of the bounty of oil and gas in North America toward sustainable patterns of consumption and use, and close consideration of the possible synergies between fossil fuels and renewable energy resources.

**Footnotes**

<sup>1</sup>For media coverage early in 2012, see e.g., Krauss and Lipton, 2012.

<sup>2</sup>The oil and gas networks of Canada, the United States, and Mexico are tightly integrated.

<sup>3</sup>For media coverage on this, see e.g., Blas, 2013.

<sup>4</sup>See also Cordesman, 2013.

<sup>5</sup>See also commentary by the Executive Director: [https://acs.nrel.gov/maria-van-der-hoeven/,DanaInfo=www.huffingtonpost.com+obstacles-in-the-path-to\\_b\\_2638047.html](https://acs.nrel.gov/maria-van-der-hoeven/,DanaInfo=www.huffingtonpost.com+obstacles-in-the-path-to_b_2638047.html)

<sup>6</sup>One might add here the confusing nature of the popular discussion on this topic, which, as an example, often conflates natural gas and oil markets – despite their considerable dissimilarities in aspects such as their geographic scope and price setting.

<sup>7</sup>Or consider Norway’s productivity concerns (see e.g., Milne, 2013).

<sup>8</sup>On the environmental challenges of independence see, e.g., Destler, 2013.

## References

- Bazilian, M., O’Leary, F., O’Gallachoir, B., Howley, M. 2006. Security of Supply Metrics. Government of Ireland.
- Bazilian, M., Roques, F. 2008. Analytical methods for energy diversity and security. Elsevier Science.
- Blas, J. 2013. Shale oil, Washington and the Middle East. Financial Times
- CFR, 2006. U.S. Energy Dependence Undercutting U.S. National Security, Council Task Force Warns. Deutch and Shlesinger. New York.
- Cordesman, A. 2013. The Myth or Reality of U.S. Energy Independence. CSIS, Washington, DC. Destler, B. 2013. U.S. Energy Independence: A Step in the Wrong Direction? Huffington Post.
- Elkind, J. 2010. “Energy Security: Call for a Broader Agenda.” In Carlos Pascual and Jonathan Elkind (Eds.) Energy Security: Economics, Politics, Strategies, and Implications (Washington, DC: Brookings Institution Press), pp. 119-148.
- Gupta, E. 2008. “Oil Vulnerability Index of Oil-Importing Countries.” Energy Policy 36(3), pp. 1195-1211. International Energy Agency (IEA). 2012. World Energy Outlook. Paris, France.
- Houser, T., Mohan, S. 2012. American Energy Independence: Let the Betting Begin Rhodium group. New York.
- Kessels, J., Bakker, S., Wetzelaer, B. 2008. Energy Security and the Role of Coal (London: IEA Clean Coal Centre CCC/131)
- Keppler, J. 2007. Energy Supply Security and Nuclear Energy: Concepts, Indicators, Policies (Paris: Nuclear Energy Agency, October).
- Krauss, C., Lipton, E. 2012. U.S. Inches Toward Goal of Energy Independence. New York Times
- Levi, M. 2012a. The false promise of energy independence. NY Times.
- Levi, M. 2012b. How far have U.S. oil imports fallen. CFR Blog. New York.
- Luciani, G. Security of Supply for Natural Gas Markets: What Is It and What Is It Not? (FEEM Working Paper Number 119.04, September, 2004).
- Milne, R. 2013. Norway bank chief warns on oil reliance. Financial Times
- Morse, et al. 2012. Energy 2020. Citi Bank. New York.
- O’Sullivan, M. 2013. ‘Energy Independence’ Alone Won’t Boost U.S. Power. Bloomberg.
- Sovacool, BK (Ed.). 2011a. The Routledge Handbook of Energy Security (London: Routledge, 2011).
- Sovacool, BK, I Mukherjee, IM Drupady, and AL D’Agostino. 2011b “Evaluating Energy Security Performance from 1990 to 2010 for Eighteen Countries,” Energy 36(10) (October, 2011), pp. 5846-5853.
- Sovacool, BK. 2013. “An International Assessment of Energy Security Performance,” Ecological Economics (in press, 2013).
- Toman, M. 2009. International Oil Security Problems and Policies (Washington, DC: Brookings Institution Working Paper, February 27, 2009)
- U.S. EIA (2013a) <http://www.eia.gov/todayinenergy/detail.cfm?id=10871>
- U.S. EIA (2013b) (<http://www.eia.gov/oog/info/twip/twiparch/110525/twipprint.html> accessed 30 Jan 2013)
- Luciani, G. Security of Supply for Natural Gas Markets: What Is It and What Is It Not? (FEEM Working Paper Number 119.04, September, 2004).
- Morse et al. 2012. Energy 2020. Citi Bank. New York.
- Sovacool, BK (Ed.). 2011a. The Routledge Handbook of Energy Security (London: Routledge, 2011).
- Sovacool, BK, I Mukherjee, IM Drupady, and AL D’Agostino. 2011b “Evaluating Energy Security Performance from 1990 to 2010 for Eighteen Countries,” Energy 36(10) (October, 2011), pp. 5846-5853.
- Sovacool, BK. 2013. “An International Assessment of Energy Security Performance,” Ecological Economics (in press, 2013).
- Toman, M. 2009. International Oil Security Problems and Policies (Washington, DC: Brookings Institution Working Paper, February 27, 2009).