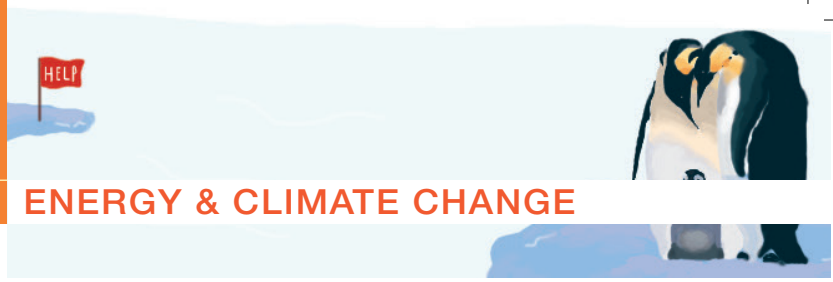

Can low-carbon societies deliver on energy security?

The impact of low-carbon policies on energy security depends on both the timing and intensity of these policies, and the definition of energy security: security of what?; security for whom?; and security from which threats? The priorities of the EU's 2030 climate/energy package and energy security show little if any alignment. Global climate stabilization policies benefit the energy security of India, China, and the EU, but may have negative impacts on export revenues of the U.S. and other energy exporters.

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Introduction

With rising energy demand in Asia and the crisis in Ukraine threatening gas supplies to Europe, energy security is on top of the political agenda. Can low-carbon societies deliver on this political priority? Answering this question is crucial to understand the political implications and drivers of low-carbon policies.

In this article, I argue that to answer this question both "low-carbon societies" and "energy security" need to be defined. After providing such definitions, I explore the tension between energy security and two examples of low-carbon policies: (1) Europe's 2030 climate/energy package and (2) global long-term climate stabilization policies. I show that the relationship between energy security and decarbonization depends on the time horizon and on the way energy security is defined.

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Defining "low-carbon"

Low-carbon transitions may imply different extents and speeds of decarbonization. On one end of the spectrum there are near-term policies to introduce renewables and improve efficiency. It is important to know how such concrete policies will affect existing energy security concerns. At the same time, stabilizing the global climate requires much more radical and comprehensive de-carbonization over a longer time scale. The analysis of energy security under such scenarios is less focused on today's energy security problems, but can at the same time lend insight into longer-term political drivers of deep decarbonization.

In this article I pose two questions: one about shorter-term climate policies and the other about longer-term decarbonization:

- What impact would the EU2030 climate/energy package have on energy security?
- What impact would climate stabilization have on energy security?

Defining energy security

Conceptualizing and measuring energy security is more difficult than defining low-carbon transitions. Energy security is a political, not a scientific concept, and as a result means different things to different people. This does not mean that energy security cannot be conceptualized, on the contrary, such conceptualization is necessary and it should explain rather than ignore different views.

Effective measurement of energy security should start with answering three basic questions: "security of what?", "security for whom?" and "security from which threats?" [1]. These three questions are captured in the definition of energy security as "low-vulnerability of vital energy systems". A vital energy system is an energy system which supports critical social functions. Identifying a vital energy system and its boundaries clarifies the questions: "security of what?" and "security for whom?".

In the case of the EU's 2030 climate/energy package, I evaluate the energy security of oil and gas in the EU as a whole and in individual member countries, and their vulnerabilities to import disruptions (Table 1).

Exploring the energy security implications of longer-term energy scenarios requires a broader definition of vital energy systems and their vulnerabilities since both can fundamentally change under a radical energy transformation. Thus, I build on three historically persistent perspectives on vulnerability which link it to: (1) hostile actions by foreign actors (the sovereignty perspective), (2) natural and technological risks and trends which can be predicted and managed (the robustness perspective), or (3) from uncertain and unpredictable risks (the resilience perspective) [2]. For each perspective and each vital energy system I use simple indicators: energy trade for sovereignty, resource depletion for robustness, and diversity of energy options for resilience [3].

Short-term interaction between climate policies and energy security in Europe

The EU's 2030 climate/energy package sets the following targets for 2030: decrease GHG emissions by 40% below 1990 levels, increase the share of renewable energy to 27%, and increase energy efficiency by 30% [8]. What impact would these energy system changes have on EU's energy security?

Gas is clearly at the top of the EU's energy security agenda. Europe imports 65% of its natural gas and relies on it for over 40% of heating which makes natural gas a vital energy system. However, strictly speaking, oil is a bigger energy security challenge. Not only is the oil import bill five times higher than that for natural gas, but the oil share in the vital transport sector is almost 90% (Table 2).

For the Union as a whole, modeling results suggest that the EU's climate energy package would lead to a modest decrease in Europe's oil imports but may either decrease or increase natural gas imports depending on the assumptions [4].

However, one of the reasons why natural gas ranks so high on Europe's agenda in is that certain countries are much more vulnerable to natural gas disruptions than the Union as a whole. In fact, natural gas vulnerabilities vary widely across Europe – from Sweden, where natural gas imported from Denmark is used in one municipality, to former Eastern bloc countries such as

	What impact would the EU2030 energy goals have on energy security?	What impact would climate stabilization have on energy security?
Security of what?	oil and gas	imports, resources, energy options
Security for whom?	EU + European countries	major economies
Security from which threats?	import disruptions	import disruptions, price volatility, resource scarcity and unknown threats

TABLE 1 Exploring the energy security implications of low-carbon societies requires answering three fundamental security questions

Gas	Oil	Data source and year
40% heating & 20% electricity	90% transport	IEA for 2010
65% imported	>85% imported	Eurostat for 2012
50 €billion/year import bill	350 €billion/year import bill	Bloomberg for 2012

TABLE 2 Oil is a universal European energy security challenge even though gas dominates the policy discourse

Lithuania and Latvia, both importing all of their natural gas from Russia and whose district heating systems are almost entirely dependent on it.

The heterogeneity of natural gas vulnerability is well-recognized in EU policies. In the latest communication from the Commission on energy security, all but 5 of the Commission's 27 key security-of-supply projects for natural gas are located in the former Eastern bloc countries [5]. These projects are crucial to ensuring security of natural gas in the new member states but will have little to no climate impact other than pulling away resources from developing low-carbon energy sources [6].

Thus, over the short-term, the priorities for energy security and low-carbon policies are different. For energy security, the priority is to protect the most vulnerable European member countries, which are often the smallest and lowest emitters. But for climate, the priorities are decarbonizing the biggest countries, which account for a greater proportion of GHG emissions.

Long-term interaction between climate policies and energy security in major economies

Evaluating long-term energy security under radical energy transformations is conceptually challenging, since energy security is fundamentally a short-term issue focused on the stability of energy systems. Nevertheless, understanding how energy security might develop under radical energy system changes is necessary to anticipate and mitigate any risks which might emerge during de-carbonization. Using six long-term energy system models, I look at how energy trade, resource depletion and diversity of energy options evolve under both a business-as-usual (BAU) scenario without any climate policies and a climate stabilization case[4].

In the BAU scenario, global trade rises with coal trade overtaking oil trade by the end of the century in most models. Additionally, global oil reserves become completely depleted in several models [4]. Under the climate stabilization case, global energy trade is up to ten times lower and oil extraction stays within existing reserve and resource estimates.

In addition to analyzing global energy security, we examine how major economies – China, India, the EU and the US – fare in deep de-carbonization scenarios [4]. Energy security impacts differ from one region to another. China and India are the biggest winners of climate policies. Under the BAU scenario, they experience rising imports, resource depletion and low or declining diversity of energy options. Under climate stabilization their energy imports are up to 10 times lower and the diversity of energy options for electricity rapidly rises as they shift to domestically-produced renewables and increase energy efficiency. In the EU, energy imports also drop under climate policies. However, for the EU, the difference in energy imports between the BAU scenario and climate stabilization one is not as pronounced as for China and India, since the EU has already high diversity of electricity production and already manages high energy imports.

The results for the U.S. are in stark contrast to the other three major economies because it will likely become energy independent in the next three decades and, hence, should not have to worry about rising energy imports under a BAU development. Quite the contrary, it will probably be interested in maximizing its exports. Long-term climate policies are likely to reduce these potential energy export revenues in the US as they will for the traditional energy exporters (the Middle East and Russia). In fact, some have suggested that the development of cheap non-conventional resources

in the US has led to a shift in policy discourses about climate policy in the Republican Party [7].

Conclusions

In this article, I examine the interaction between low-carbon policies and energy security. I define energy security as low vulnerability of vital energy systems which is both specific enough to explain today's policy concerns and, at the same time, generic enough to be applicable in low-carbon societies. Evaluating energy security requires answering three key questions – "security of what?", "security for whom?" and "security from which threats?".

To examine the energy security impact of low-carbon policies over the short term, I evaluate the impact of the the EU's 2030 climate/energy package on oil and gas imports. The EU's 2030 climate/energy package would slightly reduce oil imports, but may either increase or decrease natural gas imports. At the member state level, the priorities for energy security and climate change mitigation diverge. For climate mitigation the priorities are to reduce emissions of the biggest emitters – which are the biggest countries. However, for energy security, the priorities are to reduce the vulnerability of the most vulnerable countries – which are generally the small former Soviet Bloc countries and are not significant from a climate mitigation point of view.

Over the long term, climate stabilization policies globally lead to lower trade, lower resource scarcity and higher diversity of energy options. But this impacts major economies differently. China and India experience up to ten times lower imports and higher diversity of energy options under the climate stabilization scenario. Climate policies have similarly beneficial though more modest impacts on the EU's energy security. The US in contrast becomes energy independent under the business-as-usual scenario and may lose energy export revenues under climate stabilization.

In sum, the impact of low-carbon policies and measures on energy security depends on the definition of low-carbon, the time horizon, and the answers to the key security questions. Over the short term, the priorities for energy security and low-carbon transitions may diverge: the highest priority for climate are the biggest emitters but the highest priority to improve energy security are the smallest and most vulnerable countries. Increasing use of domestic coal may benefit energy security but harm climate. However, over the long term these two energy objectives are more in line with each other in most economies – with climate policies curbing imports (including coal), resource depletion, and increasing diversity of energy options. However, even in such a climate-friendly world there would be regional losers – most notably energy exporters, who would lose their export revenues.

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