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A Public Policy Perspective on Global Energy Security

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Despite an emerging literature on global energy governance, there so far is no extensive intellectual rationale for it. This article seeks to fill this gap by putting forward a public policy framework to analyze global energy. With that lens, energy security relates to problems of market failure at a transnational scale. These may occur due to imperfect competition; negative externalities; lack of information; or the presence of public goods. It is argued that major global energy risks such as oil price volatility, lack of transport infrastructure, and insufficient upstream investments can be convincingly conceptionalized as markets failing to provide for a crucial good—energy security. This article thus proposes market failure as an analytical justification of and as an intellectual foundation for further research in global energy governance, and sketches possible research agendas in that field.

Keywords: market failure, global public policy, energy security

Energy Security: The Call for a Global Public Policy Perspective

A growing literature seeks to explore energy security from a global governance angle.[1] Works in this emerging field challenge prevalent energy debates that tend to be dominated by geopolitical and hard-nosed security rationales (Bahgat 2003; Barnes and Jaffe 2006; Smith 2006; Deutch, Schlesinger, and Victor 2006; among others). Yet, despite an emerging literature on global energy governance, there is so far no established intellectual rationale for it. While some authors regard effective energy governance as synonymous to ''smart'' rules of the game in energy (Goldthau and Witte 2009, 2010), others focus on shortcomings in global energy governance in terms of both institutions and issues (Florini and Sovacool 2009, 2011) or on evaluating the potential of individual agencies to fill existing organizational gaps (Kirton 2006; Lesage, de Graaf, and Westphal 2009, 2010; Karlsson-Vinkhuyzen 2010). In short, while subscribing to a global governance perspective on energy, none of the existing works convincingly and

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[1]This article subscribes to a parsimonious standard definition put forward by energy authority Daniel Yergin (2006), framing energy security as reliable supply of oil and gas at stable or predictable prices for consuming nations and as reliable demand for oil and gas at sustainable prices for exporting ones. For a discussion of the various aspects of energy security, see, among others, Alhajji (2007).

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extensively justifies it. This article seeks to fill this gap by putting forward a public policy framework to analyze global energy. It argues that major transnational or global risks stemming from oil price volatility, a lack of transport infrastructure, or insufficient upstream investments can be convincingly conceptionalized in terms of market failure. It reframes the traditional security-oriented justifications for public policies in oil and gas as incidents of market imperfections, opening the field for the ''toolbox'' public policy theory offers. In that, this article proposes market imperfections both as an analytical justification for public intervention in global energy and as an intellectual foundation for further research in the field of global energy governance.[2]

The aim of this paper is twofold. First, it conceptualizes global energy security in classic public policy terms (market failure in global energy). It draws from textbook concepts on normative causes of and on economic justifications for public action based on incidents of imperfect competition, the existence of externalities or information asymmetry, and of public goods characteristics. Second, and based on this conceptual discussion, the article identifies key areas that need to be addressed by global energy governance and sketches elements of a research agenda that emerges in these areas (implications for research in global energy governance).[3]

Before starting the discussion, a few disclaimers may be in order. First, this paper deliberately focuses on oil and gas. This focus is driven by the fact that both fuels make up for almost 60% of global primary energy demand (BP 2010:41); that they are politicized like no other fuel; and that there exists cross-border trade of global scale and volume, which makes oil and gas subject to research in the field of transnational public policymaking and governance. None of these characteristics is projected to change anytime soon. While oil and gas together will continue to account for a roughly equal share of primary energy demand in 2035 according to International Energy Agency (IEA) projections in a ''New Policies'' scenario,[4] absolute demand in oil and gas will be going up significantly. Oil consumption is set to rise by 18% and reach some 99 million barrels per day in 2035, compared with less than 84 mbd today (IEA 2010:77). Gas consumption will surge by 44% and go up from 3.1 trillion cubic meters (tcm) in 2008 to 4.5 tcm in 2035—much of which will be traded internationally via liquefied natural gas (LNG), a market characterized by, if projections hold true, enormous growth potential (IEA 2010:179). Furthermore, while acknowledging that climate change is part of the global energy equation, this fact is accounted for only to the extent it affects energy security ''proper.'' Greenhouse gas emissions undoubtedly are a key externality of burning fossil fuels. Yet, the very fact that these social costs are not internalized properly lies in the way energy production and use is embedded in larger economic systems, not in the institutional design of oil and gas markets as such. Since the purpose of this article is to investigate the degree to which existing market structures for oil and gas are prone to fail with regard to the very good they are supposed to deliver—reliable supply or demand—climate change is not at the core of analysis. To frame this differently, the detrimental environmental effects of burning fossil fuels as such are not the subject of this paper's deliberations; by contrast, the question as to whether carbon markets and climate change–induced

[2]Bohi, Toman, and Walls (1995) is to the best of my knowledge the only attempt to conceptualize energy security in terms of market failure—though not consistently from a global perspective.

[3]Global energy governance is defined as an institutional structure facilitating the effective provision of global energy security in the absence of a global authority. In that, this paper subscribes to the definition of global governance as put forward by Rosenau and Czempiel (1992).

[4]The New Policies Scenario provides for energy demand and supply projections based on government pledges, assuming they would be put in practice and implemented. See IEA (2010:3).

legislation (or the lack thereof) affect supply or demand of fossils and renewables, certainly is. Moreover, though both fossils, oil and gas differ considerably with regard to key characteristic and the nature of their respective markets. While oil is a fungible commodity and traded globally, gas still remains by and large subject to regional exchange. As a consequence, incidents of market imperfections differ, as do related governance challenges. This article accounts for this fact by largely separating analyses of both commodities and markets. Finally, while acknowledging that there are numerous forms of *government* failure, including regulatory failure, subsidy policies, or rent seeking, this paper does not explicitly account for these aspects. Rather, its key concern is to assess various forms and formats of energy *market* failure and to draw conclusions on global energy governance. In a nutshell, rather than asking ''who governs'' global energy (Florini and Sovacool 2009), the starting point of this paper is to assess what actually is ''to be governed,'' and to draw conclusions on possible research agendas. In that, it aims at contributing to the ongoing debate on energy security by framing the issue as a case for public policy rather than one of geopolitics and by pointing to the governance challenges for global and regional energy markets that require public action.

Market Failure in Global Energy

It is an obvious but often forgotten fact that energy resources such as oil and gas are commodities. As such, they are primarily private goods, and subject to (private) market interaction, whether on the local, national, regional, or global level.[5] Yet, as any other market, energy markets may fail to provide for a good at the price or quantity it is demanded. While the role of government in modern economies remains contested and controversial, market failure is widely regarded as a justification for state action. In fact, in standard public policy literature, market failure is a key incident for states or state agencies to intervene in a particular market in order to ensure the delivery of a certain good, of welfare, or of the security of citizens (Bator 1985). Classic public policy models center on four key causes of market failure: imperfect competition; the existence of externalities; incomplete information; and public goods characteristics. The following section briefly discusses these four incidents of market failure and applies them to the cases of oil and gas.

Imperfect Competition

Markets can fail due to imperfect competition, arising from a concentration of market power. Monopolies or cartels on the supply side lead to an output below the quantity at which the marginal social benefit is equal to the marginal social cost of the last unit produced. Vice versa, monopsonies or cartels on the demand side may be able to dictate the terms of market exchange to their suppliers. As a consequence, the market price is either pushed above or below competitive levels.

In the global oil market, two classic examples of imperfect competition come to mind: the cartels of the Organization of Oil Exporting Countries (OPEC) and of the Seven Sisters. OPEC has arguably been able to put a premium on each barrel of consumed oil.[6] To the same extent, members of the Seven Sisters for a long time managed to maintain an internal transfer pricing scheme, which

[5]Private goods are characterized as rival and excludable in consumption.

[6]Since the early 1970s, oil prices have remained far above marginal production costs, which would be a direct indicator for the existence of such a premium.

secured enormous rents for participating oil companies.[7] In both cases, market failure of a global scale occurred—in the case of OPEC to the detriment of consumers, who had to bear a higher than optimal price, and in the case of the Seven Sisters to the detriment of producers, who did not earn an optimal income from their resource exports.

In contrast to the global and liquid oil market, natural gas markets have by and large remained regional in nature. This is mainly due to the fact that natural gas is a less fungible commodity than oil and for most of its cross-border trade traditionally relied on one single form of transport infrastructure: pipelines. With the notable exception of the North American gas market, long-term contracts, based on takeoff agreements, still dominate the scene. They usually also tend to peg the price of natural gas to the price of a substitute, in general, oil. On the Eurasian gas market, the supply side tends to be concentrated among a few suppliers, with the most dominant one being Russia's state-owned Gazprom; the (net) demand side is, by contrast, characterized by actor fragmentation. Interestingly, and with the notable exception of some Former Soviet Union (FSU) countries, this apparent imbalance in market power primarily does not translate into price distortions. Rather, it creates a veritable supply risk. Since the base price for gas is not formed on the basis of a Eurasian supply and demand balance, any tinkering on the supply side does not simply translate into price hikes. As we shall see when discussing the case of the European gas conflicts, it instead limits available volumes. LNG has recently gained market share, accounting for some 30% of traded gas (BP 2010:30). By 2035, inter-regional trade is projected to expand in absolute terms by more than three-quarters compared with 2008, mostly thanks to enhanced LNG trade (IEA 2010:192). As analysts note, this will likely lead to a change in gas market structures and contractual arrangements on the European and Asian gas markets, redirecting more gas to spot markets and providing for more liquid gas markets, comparable to oil. Yet, since more than 40% of current LNG production capacity is in the hands of OPEC countries (BP 2010:30), a figure that is likely to grow, this trend may also entail a change in market balances and open up possibilities to cartelize a growing global gas market.[8]

Addressing market failure in (global) oil and (regional) gas markets related to imperfect competition obviously faces clear limits in terms of public policy and state intervention. Supply-side problems caused by a producer cartel may simply not be subject to public policy actions of consumer nations; likewise, buyer cartels cannot usually be broken up by producers. As a second best option, scholars have made the case for the establishment and use of a countervailing monopsony if a cartel or monopoly exploits its market power and vice versa (Bohi et al. 1995:15). As for oil, the creation of OPEC in 1960 was a direct response to the oil market dominance of the Seven Sisters. In turn, the establishment of the IEA in 1974, following the first oil shock, may be an example of an attempt to pool demand-side market power (Keohane 1984; Colgan 2009; Kohl 2010). Likewise, a recent proposal launched by the European Commission

[7]The Seven Sisters consisted of Standard Oil of New Jersey (later Exxon), Royal Dutch Shell, the Anglo-Persian Oil Company (APOC, later BP), Standard Oil of New York (Socony, later Mobil), Standard Oil of California (Socal, later Chevron), Gulf Oil, and Texaco. For a history of the oil market, see Yergin (1991), Maugeri (2006), and Parra (2004).

[8]Note that large reserve holders of natural gas have formed the Gas Exporting Countries Forum (GECF), dubbed by some a nascent ''Gas OPEC.'' Within that forum, Russia, Qatar, Iran—holders of more than half of the world's natural gas—have created the ''Gas Troika,'' aimed at coordinating gas policies and projects among the three countries. For a discussion of the viability and impact of a gas producers' cartel see, among other, Stevens (2010), Stern (2010), and Hallouche (2006).

to set up a ''Caspian Development Corporation'' (CDC) as a ''block purchasing mechanism for Caspian gas'' (Barroso 2008; EU Commission 2008) can certainly be interpreted as a European attempt to establish a buyer's cartel in gas in order to re-shift the balance of power on the Eurasian gas market.

Externalities

Externalities generally refer to spillover costs or benefits of an actor's (economic) activity on some other actor's welfare (Buchanan and Stubblebine 1969). Externalities related to oil would primarily materialize as a movement in the price. As a result, they impact the fiscal situation or the economic activity of a nation—in a positive or negative way.[9] Since oil is a fungible commodity and traded on an integrated global market, a disruption of supplies anywhere in the world translates into higher prices for *all* consumers—whether citizens of an importing nation or of a self-sufficient one. In other words, while profiting from additional revenue during a price hike, oil-exporting nations also face a higher domestic price for oil—unless they possibly decide to leverage the latter through subsidies. Events triggering sudden price increases include domestic turmoil (for example, Nigeria's ongoing domestic conflict); political quarrels (for example, Venezuela's oil workers' strike of December 2002–February 2003); or regime change (for example, the Iranian Islamic Revolution of 1979), which—despite being limited to a single nation—all affected oil prices on a global scale. As a corollary, a sudden drop in demand in some parts of the world certainly has a revenue impact on all producer nations, not only on the ones supplying the economically depressed region. The 1998 price drop in oil, for instance, was partly triggered by a regional economic depression in Asia, but eventually translated into globally depressed crude prices. A change in global prices can even occur if actual supply is not altered at all. Sheer perceptions and the fact that market participants factor future uncertainties into price formation may well translate locally restricted events into veritable externalities for third parties.

Externalities of such kind are generally direct in nature. Yet, they can also be more indirect. In that case, price externalities materialize differently for producers (exporters) and consumers (importers). An oil-importing nation, affected by a price hike, would probably experience an economic slump due to sharply rising costs of a key economic input factor; it would suffer from rising inflation, or experience an increase in unemployment. In fact, as Brown pointedly notes, 10 out of 11 post–World War II recessions in the United States followed sharp oil price increases (Brown 2009). Producer nations, in turn, being affected by the same price hike, and while profiting from additional revenue, may experience an appreciation of their currency, due to additional income in foreign money. As a corollary, they may see deteriorating terms of trade of domestic industry. The much discussed ''Dutch disease'' is an infamous case in point of such a negative price externality for oil-exporting nations (Corden and Neary 1982). Several studies have estimated various types of cost impacts of oil price increases and have modeled the ''energy security gain'' of reduced crude imports for major consumer nations. While it is beyond the scope of this paper to discuss these studies' findings in detail, it is worth noting that the bulk of

[9]See Bohi et al. (1995) for an in-depth discussion of externalities in energy security. In addition, oil consumption as such creates other externalities, notably detrimental greenhouse gas emissions. As these types of externalities do not directly affect energy security and are prominently discussed elsewhere, they are not of primary concern of this paper. See also Pearce (2001) for an overview of externalities, particularly regarding the environmental dimension of energy policy.

price-related externalities occur as macroeconomic adjustment costs.[10] What follows from this is that the more frequently an economy needs to adjust, up or down, the more often these costs occur. Hence, it is particularly a high volatility of oil prices that creates externality costs. In other words, it is not necessarily the oil price level as such which matters in the long run (as an economy can overtime adjust to a new input factor price), but the extent to which and how frequently the oil price deviates from the standard. Price volatility has, however, yet another effect that qualifies as a (negative) externality, this time on energy security proper: it disincentivizes investment into costly upstream projects. During periods of high volatility, the oil price tells little about future price levels (Hunt and Markandya 2004:10). As a consequence of this uncertainty about future revenues, and given the fact that upstream projects are very costly and have lead times of several years, companies may simply abstain from investing into new projects.

As studies have proven, oil prices have indeed become more volatile since the mid-1990s and particularly since mid-2008. Since then, the world has witnessed a roller coaster from an all-time high of almost $150 per barrel in July 2008, to around $30 by the end of the same year, and up again to some $80 at the end of 2009.[11] This is in fact bad news for energy security, as price volatility of such an extent puts in question necessary investments in upstream projects, infrastructure, and energy R&D. In fact, an estimated $33 trillion—roughly equivalent to 2.5 times the entire 2009 US GDP—will need to be spent between now and 2035 to meet projected global energy demand (IEA 2010:93). Yet, since late 2008, capital spending on energy projects has been massively cut. Over 20 large-scale upstream oil and gas projects have been put on hold or canceled. Investment in renewables fell even overproportionately (IEA 2009a). True, it is certainly not only volatility that has caused this development, and the ongoing financial and economic crisis can partly be blamed for this slope in investment. Yet, faltering energy investment now will have serious effects on energy security 10 years down the line. And it will defer the necessary shift toward a low carbon future. For policies aimed at addressing externalities stemming from oil price changes, it is therefore of crucial importance to not only address the extent to which the oil price changes in absolute terms, but also the frequency which it changes.

Turning to natural gas, externalities look somewhat different. They tend to arise from the prevalent characteristics of market arrangements in Eurasia and Asia and the pipeline-bound nature of these markets. First, externalities may occur due to the fact that the bulk of internationally traded gas volumes is not directly traded between two contractual partners (that is, the producer and the consumer), but transited through third countries. As a consequence and neatly demonstrated on the Eurasian gas market, disputes involving a transit nation easily translate into negative externalities for the two main contractual partners. As some 80% of Russian gas exports transit through the Ukraine, and the remaining 20% through Belarus, conflicts between Russian monopolist Gazprom, Kyiv, or Minsk severely affect third parties on Eastern, Central, and Western Europe (Stern 2007; Yafimava and Stern 2007; Goldthau 2008; Stern, Pirani, and Yafimava 2009). Given the prevalent oil price-peg, such externalities have no implications in terms of changing gas prices but instead in terms of

[10]For recent papers on the European Union, see Arnold and Hunt (2009) or Hedenus, Azar, and Johansson (2010); for the United States, see Leiby (2007), Beccue and Huntington (2005), or Brown and Huntington (2009). For a literature survey, see Sauter and Awerbuch (2002). As for natural gas, and for the reasons discussed, it is very hard to quantify the externality costs associated with supply insecurities.

[11]For a recent discussion of the drivers behind the 2008 oil price hike, see Kaufmann (2010).

physical supply.[12] In that, externalities in gas differ considerably from the ones in oil. In January 2009, following a dispute over price schemes and payments between Russia and Ukraine, consumers in Moldova, Bulgaria, Romania, Serbia, and Bosnia-Herzegovina had their natural gas supplies cutoff for two weeks. This led to the shutdown of these countries' industry, the closure of schools and other public institutions, and deeply affected public life. Gazprom, in turn, had to bear revenue losses amounting to an estimated $1.5 bn (Kovacevic 2009:19; Stern et al. 2009:61).

Second, externalities may be caused by the above-mentioned price-peg that characterizes most off-take agreements in natural gas in Europe and the Asia-Pacific region. As discussed, the base gas price does not reflect the supply and demand balance in these markets. By contrast, it basically reflects movements in the oil market, usually lagged by some six months. A straightforward spillover effect following from this are price fluctuations that are caused by totally unrelated market fundamentals. In other words, gas price hikes of up to $380 per thousand cubic meters (tcm), as observed in 2008, reflected nothing other than a tight oil market and oil futures being in backwardation.

Public Goods

Technically, ''pure'' public goods are defined as goods that are non-rival and non-excludable in consumption (Samuelson 1954; Olson 1971). The tricky issue about public goods lies in the fact that their provision creates a free rider problem. As a consequence, they are barely produced by the market, or not at the quantities or the price that consumers are willing to pay for them. For sure, oil as such is not a public good, nor is gas. Both are private in nature, as their use by one consumer affects the amount available to others and as it is certainly feasible to exclude consumers from benefiting from it. Yet, in both the oil and the gas market, a number of examples can be found where market failure occurs due to the public goods nature of issues related to oil and gas.

A classic example in this regard are petroleum stocks. These stocks are created and maintained by consumer nations to buffer sudden supply shortages and the resulting price shocks. In that, they are a mechanism to fix a market failure stemming from externalities of a kind as discussed earlier (see also Jaffe and Soligo 2002). Yet, ironically, these mechanisms can themselves fall prey to market failure. As Leiby, Bowman, and Jones (2002) note, oil price stabilization is nothing else than a public good that benefits all oil-using economies. And so is strategic stock-piling, as its costs are concentrated, while its benefits are dispersed. In other words, for the same reasons that negative price externalities are of global scope, measures taken to buffer sudden supply shocks are non-rival and non-excludable in consumption. Apparently, such free-riding is a particular problem with regard to small economies, as they overproportionally benefit from stocks held and released by greater consumer nations (Leiby et al. 2002:9).[13] Yet, against the backdrop of rising consumers such as India and China, the problem gains additional traction. Following the 1973–1974 oil price shocks, major energy-consuming nations established the IEA that introduced distinct rules to provide a framework for two specific mechanisms of short-term supply (risk) management: the International Energy Program (IEP, founded in 1974) and the Coordinated Response Mechanism (CRP, 1979). The linchpin of the system is

[12]In that, this is not an externality in strictly economic terms. Yet, as it distorts the effective allocation of resources on a market, it still qualifies as an externality.

[13]In fact, as Leiby et al. (2002) note, only a few countries, such as the United States, are big enough for the benefits of holding stocks to exceed related costs.

national emergency oil stocks among members (Strategic Petroleum Reserves [SPR]) equivalent to at least 90 days of oil imports. This strict system responded to the earlier discussed problem of free-riding and ensured that all participating members contribute their individual share. As participation in the IEA is linked to Organization of Economic Cooperation and Development (OECD) membership, emerging consumers such as India and China are currently excluded from this system for formal reasons. Yet, even more importantly, both countries should have little incentive to build up their own stocks and align them with the IEA system. In fact, they can easily free ride on stocks held and paid for by OECD countries. True, both China and India began building up strategic petroleum reserves recently. China completed a first phase in 2008, whereas India is still in the process of developing stocks. Yet, in total, Chinese crude reserves account for only some 30 days of current net imports, whereas India's stock equal to approximately three weeks of its current net oil imports (Colgan 2009). In that, China and India not only fall short on the IEA's 90-day requirement; they also constitute an increasingly pressing problem to the security of all global oil consumers, as both countries represent the fastest growing consumer heavyweights in the market.[14]

A related problem occurs with regard to supply-sided mechanisms to calm down the oil market: spare capacity. Spare capacity is an essential element of oil market psychology, as it determines how ''safe'' market participants are against a price shock stemming from severe supply-sided problems. Some observers have even called spare capacity ''the most important single asset for the world's supply security'' (Harks 2010:253). Most of the world's spare capacity is currently held by Saudi Arabia. How crucial Saudi Arabia's spare capacity is for world markets has particularly become evident in the first Gulf War, during which Riyadh considerably ramped up production to buffer the supply losses from Iraq and Kuwait. As a consequence, price impacts have remained rather modest. Yet, reserve capacity, as strategic stocks, has a public goods character. While a certain country needs to develop the capacity and pay for it, no market participant can be excluded from the benefits of this additional, supply-sided buffer. In addition, for the producer country holding reserve capacity, this additional capacity costs money but does not create any return on investment.

As such, and according to theory, reserve capacity should not exist. The primary reason why Saudi Arabia is apparently willing to bear related costs but socialize the benefits is that reserve capacity is a welcome tool to enforce discipline within OPEC. The sheer fact that Saudi Arabia can threaten its fellow oil producers to create an oil glut, similar to the one in 1986, gives this country an unmatched power status within the cartel. A second reason may lie in the fact that Saudi Arabia, the world's largest reserve holder, has an interest in keeping consumers ''hooked'' on oil for decades to come. Hence, holding reserve capacity is an investment it makes in future demand security, enabling Riyadh to calm down markets and stabilize prices at an affordable level for consumers.[15] In other words, holding reserve capacity is still a highly rational move for the Saudis, but the underlying rationale is of a different nature than the one primarily discussed here.

A third global good of by and large public nature are secure sea lanes. Key to smooth functioning of the global oil market, secure transport routes are hardly

[14]The entire projected increment in global oil demand until 2035 will stem from non-OECD countries, notably Asian. By that time, China's oil consumption alone is about to double IEA (2010:104).

[15]A painful learning from the first and the second oil shocks in the 1970s for the producers was that consumers started to invest in energy efficiency, demand-reducing technology, and alternative supplies.

provided for by the collective of global producers and consumers. By contrast, the same collective action problem occurs as in the provision of strategic stocks or reserve capacity. Securing critical sea lanes is costly, as it requires a sizeable naval fleet that is able to credibly enforce free transit. And once one actor has taken on the task of investing into secure maritime transport routes, all others profit. Interestingly, the task of securing the Straits of Malacca and of Hormuz, the world's most famous choke points and crucial maritime transit routes for some 33 mbd out of 43 mbd of the globe's crude daily shipped by tankers (EIA 2008), is effectively taken on by one single market participant: the United States. In other words, world consumers and producers pass on the costs of energy security in transportation to the American tax payer. While estimates on the related costs vary widely and range from $13 billion to $143 billion per year, it can certainly be said that this translates into an additional cost of the American budget (see Crane, Goldthau, Toman, et al. 2009:63f). In the case of the Persian Gulf, the costs associated with maintaining the presence of the fifth fleet may serve as a direct proxy for a price tag to secure sea lanes in this region. The reason why the United States takes on these costs is, again, twofold. First, securing maritime routes may serve other purposes than supply security. In fact, many of the military forces included in planning for Gulf-based missions are included in plans for defending US interests in other world regions as well (Crane et al. 2009:74). In that, they provide for the public good of energy security in maritime transportation—as a ''byproduct.'' Second, the United States regards secure oil supplies as part of its interest and mission and therefore includes global oil transit in its force planning. As a positive externality of this, the world is provided with a global public good.

Turning to the Eurasian gas market again, one main public good-related problem arises in infrastructure investment. An individual consumer in, say, Bulgaria, aiming at enhancing his energy security in gas supplies would need to invest in diversifying sources; in infrastructure that would bring these alternative supplies to Bulgaria; in interconnectors that would link the Bulgarian grid to the neighboring pipeline systems; and in storage capacities that would hedge the country against short-term supply risks. Obviously, the benefits of these investments are by definition non-excludable and non-rival in consumption. In that, there is an inherent collective action problem related to the public goods character of the infrastructure investment needed to improve security of energy supply.[16]

Regarding storage infrastructure, another collective action problem among European consumer countries arises. Storage in gas is more expensive than in oil. Hence, setting up storage facilities requires clear prioritization of public policies (read: investments), in which storage may sometimes fall prey to zero-sum games in state budgets. In view of this, certain—particularly smaller and less wealthy—European countries have a clear incentive to ''outsource'' the costs of gas storage to other, wealthier fellow Europeans. In fact, as the last gas crises have demonstrated, some European gas consumers simply disguise their refusal to pay for expensive storage capacities by calls for ''solidarity'' once they are faced with a supply shortage. In the end, setting up individual storage capacity in Europe may easily end up being bound with a public goods character.

[16]A vivid illustration of this problem is the case of a gas interconnector between Veľký Krtíš in Slovakia and Vecsés in Hungary. Since most of the pipeline would need to be built in Hungary, the Hungarian partner would have to bear most of the costs of connecting both markets. Hence, a collective action problem occurred, as a consequence of which the interconnector would only materialize with third-party money. In fact, the European Commission has included the interconnector in a recent call. See European Commission (2009).

Lack of Information

Market failure in global energy can arise due to imperfect information. Information is a key for market actors to find the right price for a product, to estimate risks effectively, or to judge whether to make a certain investment. A number of reasons can lead to a low level of information for energy market participants. Centrally, these include insufficient data on supply and demand fundamentals characterizing the market; regulatory uncertainty in key producer and/or consumer markets; or arrangements that render price signals ineffective.

The oil market, while having become the world's most integrated, fungible, and globalized energy market, has at the same time remained notoriously non-transparent. Key producer countries such as Saudi Arabia abstain from officially reporting output levels, while data from key consumer nations such as China tend to lack accuracy (Holscher, Bachan, and Stimpson 2008; IEA 2009b:17). In addition, state companies have come to control the bulk of global oil and gas reserves (Energy Intelligence 2009). National Oil Companies (NOCs) tend to not have the same reporting requirements as their stock-market-listed international, private competitors, which adds to the lack-of-transparency problem. Adding to this, ''energy diplomacy'' has experienced a vivid renaissance during the last decade. It is particularly the newest consumers that tend to resort to bilateral deals and diplomacy when it comes to securing supply, with China's ''going out'' efforts being a case in point (for example, Downs 2005; Holslag 2006; Taylor 2006). To be sure, energy diplomacy is not a problem with regard to globally available supply. Crude brought on-stream by, say, Chinese NOCs either ends up on the global market, thus strengthening the supply side, or is shipped back to the Chinese home market, thus taking pressure off global demand. In other words, it does not matter who gets the crude out of the ground but rather how much oil becomes part of the global balance. In fact, Chinese NOCs may even improve the global oil balance as they tend to operate in areas where International Oil Companies cannot go, for political or economic reasons. Yet, bilateral deals Chinese NOCs strike in Africa, Central Asia, and elsewhere severely limit data availability, as this crude is no longer made ''visible.'' In that, energy diplomacy adds to the already existing transparency problems in the oil market. As a consequence, market participants are left with educated guesses on key fundamentals on the supply and demand side. Yet, as upstream investments in oil have long lead times and are highly capital intensive, insufficient data, a lack of accurate projections on supply and demand, and a general lack of transparency decreases the planning security of investors and companies. In that, necessary investment, even if profitable, may not take place, leading to market failure on the supply side.

Energy diplomacy may also entail an additional problem: it sidelines prices as key drivers of investment. In fact, investment decisions based on political calculations ignore some of the underlying business fundamentals of upstream projects. Chinese upstream investments in Africa tend to be informed by political opportunity influencing both investment location and volume. Projects identified on political rather than economic grounds are, however, often characterized by a lower return on investment compared to exploration and production projects driven by hard business fundamentals. In that, and as elaborated in more detail elsewhere, energy diplomacy may negatively impact an effective allocation of investment since money risks flowing into the ''wrong'' projects (Goldthau 2010). For an individual consumer country such as China, this may simply add an additional price chunk on the barrel, a bearable burden from a political point of view, which is driven by the goal to secure supply and not to optimize costs. Yet if this strategy is pursued by a large number of market participants, including producers, the aggregate effect can be highly detrimental. Allocation of capital becomes suboptimal which, in turn, implies a suboptimal development of available offer, eventually even translating into a supply gap. As a corollary, politically motivated and driven exploration and production projects may crowd out private sector investments, adding to the overall negative supply effect. Particularly financial state backing may be detrimental as capital markets may abstain from financing large-scale projects, which further decreases transparency regarding not only volume of investment but also business fundamentals (Evans and Downs 2006).

Turning to natural gas, prevalent Eurasian gas market arrangements and particularly its price-peg come with an information-related risk for market failure: the price ceases to function as a market signal. To be sure, takeoff agreements and the entailed price-peg have their own rights. Given lead times of no less than a decade in many major upstream projects, these arrangements allow splitting the risks related to uncertainties about the market environment 10 years down the line.[17] Yet, while strengthening planning security on produced and contracted volumes, this risk hedging arrangement obviously comes with a cost: it levers out the price mechanism. This has an important consequence as the price mechanism plays no role in valuing ''energy security.'' In theory, some consumers may highly value supply security and are willing to spend money now, thus improving their future security situation. Others may put more value on present consumption and regard potential future supply disruptions as a risk they are willing to accept and for whose mitigation they are not willing to pay. Yet, to the extent the individual ''valuation'' of energy security is concerned, the price-peg in prevalent gas market arrangements renders price signals meaningless. In fact, it prevents differing preferences from being catered. No European consumer can effectively account for his individual degree of risk aversion and pay less or more for energy security in gas supplies.[18] In addition, and as discussed above, if one consumer decided to invest in more individual energy security, any other consumer would be able to profit—stressing once again the public goods character of energy security in gas. In turn, suppliers such as Russia's Gazprom face the opposite problem: it does not receive price signals from the important European consumer markets on which it would base investment decisions. In other words, the prevalent market arrangements in natural gas limit available information on consumer preferences and thus may lead to market failure.

Further, and though this paper does not explicitly account for government-induced policy failure, it is important to note that regulatory uncertainty may negatively affect available information on markets, too. Cases in point are policies related to carbon emissions. Attempts to establish cap-and-trade (C&T) systems remain in their infancy and are regionally fragmented. The EU's Emission's Trading System (ETS), while widely regarded as a role model and front runner in C&T, is restricted to 27 countries (with the three non-EU countries of Norway, Iceland, and Liechtenstein joining by 2012) and covers not even half the EU's CO_2 emissions.[19] In the United States, by contrast, the establishment of a similar system got stuck in political quarrels in the Senate. Even if a US C&T scheme got off the ground, however, chances of linking both regional markets to emerging ones in Australia and elsewhere are generally low, given their

[17]The producer is left with the price risk, whereas the consumer is left with the volume risk.

[18]Note that there are also limits when it comes to individually pricing energy security in oil or other fuels. Yet, the main point made here is the fact that the in the Eurasian gas market, the price does not have any function in balancing supply and demand, nor in accounting for individual preferences.

[19]As Albert Bressand pointedly notes, Europe makes up for some 13% of global carbon emissions only and is just too clean already to make a difference (Bresssand 2010:31).

politico-economic incompatibility (Witte, Behr, Hoxtell, and Manzer 2009). Finally, recent attempts in Copenhagen to come to an agreement on a global C&T system have ended in no more than a vague and non-binding political statement, falling way short of establishing a global-level playing field on carbon pricing. This, as a consequence, leads to uncertainty among business on how future carbon policies will affect their costs, which—if standard economic theory holds true—will negatively impact investment decisions (IEA 2007; *Wall Street Journal* 2009; Blyth 2010; for a theoretical approach, see also Dixit and Pindyck 1994). Uncertainty will likely stem from fuel price risk, will lower incentives for low-carbon technologies, and put in question the competitiveness of both carbon- and non-carbon-based products. In that, it will impact businesses in both fossil fuel-exporting and importing nations alike.

Finally, a different kind of regulatory uncertainty exists on the Eurasian gas market, arising from the European Commission's efforts to liberalize gas markets within EU jurisdiction. Initiated to create a level playing field and to foster the establishment of a liquid and competitive European gas market, the Commission's liberalization efforts have got stuck in a hybrid of deregulation and protectionism. While Brussels' explicit goal was to unbundle gas sales from infrastructure—and though EU member countries tend to regularly pay lip service to this goal—nation states have shielded their national gas markets against ''foreign'' competition and have managed to retain oligopolistic structures on the market. Yet, while European governments tend to justify their protectionist stance on the grounds of enhancing national energy security in gas, this current deadlock in liberalization efforts may in fact have long-term effects on available supply. Crucially, it remains unclear whether the market structure based on long-term takeoff contracts will prevail or not. Gas-to-gas competition in a liberalized and liquid European gas market will centrally require a breakup of these takeoff arrangements and particularly their entailed destination clauses. In the case of a breakup of takeoff arrangements, there, however, no longer exists certainty on long-term contracted volumes. Key producer companies such as Gazprom may therefore be less incentivized to spend billions of dollars in expensive and technically demanding upstream projects on the Yamal peninsula or elsewhere. Even if long-term contracts remain untouched, however, producers are left with the current regulatory hybrid and a Commission's looming liberalization agenda. Hence, in both cases, planning security among producers may suffer. In sum, regulatory uncertainty on the demand side may imply that gas supplies are not brought onstream in the volumes needed.

Implications for Research in Global Energy Governance

As our discussion has revealed, global energy challenges can be conceptualized as market failure of global and regional scale, caused by the classic reasons of imperfect competition, externalities, lack of information, and public goods characteristics. Such market failure may occur along the entire ''energy value chain'' and among all components of the global energy system, including finance, production, transmission, and consumption. As illustrating examples have shown, not all incidents of market failures need to be addressed or justify action. Some of them may simply present trade-offs between competing goals, with Eurasian gas market arrangements being a case in point. Some others, such as security of sea lanes, are ''taken care of'' by actors whose decision to provide for the public good in question is based on a different rationale.

Nevertheless, and as discussed, incidents of market failure by definition make the case for public policy and public action. In light of this, a number of principal conclusions can be drawn from discussion above for further research in global energy governance. First, four key areas should ideally be addressed and ''governed'' by global public policy: market transparency and planning security; negative spillover effects of a global scale; free-rider problems; and the existence of global market imbalances caused by cartels. Second, and this is where ''reality'' kicks in, out of these four areas only three may be relevant for policy and research in global energy governance. As scholars like Bohi et al. clearly stress, incidents of policy-relevant market failure refer to situations that can actually be dealt with, compared with ones in which no cost-effective option is available at the very moment in time the market failure occurs (Bohi et al. 1995:10). The existence of OPEC, for instance, would clearly qualify for the latter category.[20] Third, while separated in theoretical debates, different incidents of market failure may be strongly interlinked and hence be addressed by similar policies.

What are the implications of these findings for research on global energy governance? The following section elaborates on the governance dimension of market transparency, spillover effects, and free rider problems in energy and sketches potential agendas for further academic inquiry.

Governance for Information and Planning Security

As regards information and planning security, the call on global energy governance is clear and straightforward. As discussed, investment challenges are tremendous—both to satisfy projected future primary energy demand and to meet climate targets of curbing global warming at 2°C. A lack of information and market transparency inevitably translates into lower inclination among risk averse market participants to invest. Three issues are key in this context: transparency in the oil market; transparency on carbon pricing; and transparency on future energy choices. Since the oil market is the globe's key energy market, its price signals are a key determinant for any other competing fossil or non-fossil fuel. A lack of available data on oil market fundamentals therefore simply translates into flawed price signals, for upstream investments in fossil fuels as in non-fossil ones. Flawed or incomplete information also translates into price volatility as traders tend to work under incomplete information and adjust their positions in a constant search process for ''true'' data and market equilibria. Further, as carbon pricing mechanisms play a crucial role in determining the competitiveness of carbon and non-carbon fuels, reducing regulatory uncertainty on emerging carbon markets is key to investments in fossil fuels and renewables. Finally, necessary investments, both in fossils and in renewables, require robust information on future energy paths consuming nations will be taking. From a global governance or global public policy perspective, it is therefore essential to provide for planning security for producers, investors, and consumers alike to provide for effective pricing signals and to channel sufficient investment into energy supplies and services.

In terms of research, several possible strands of inquiry emerge. First, studies would need to further explore the ''governance for transparency'' nexus in energy. Existing works tend to focus on mechanisms of data collection and exchange on the oil market, such as the IEA's energy data generating efforts, OPEC's oil market statistics, on existing methodological shortcomings therein, and on data availability and affordability to both empower individual choices and academic inquiry. Some more recent research has focused on emerging instruments such as the Joint Oil Data Initiative (JODI), designed to reduce information asymmetries in the oil market (Harks 2010:249). Further research would need to go beyond such a purpose-driven research agenda and treat

[20]Please note that a rich research agenda can still be built on examining the internal dynamics of monopolies, monopsonies, or cartels and the degree to which the latter are able to overcome collective action problems.

information both as a means and an end of global energy governance. Research would then range from formal institutional arrangements facilitating transparency and availability of data to best practice assessments across sectors, businesses, and countries. Second, further analyses on global energy would need to make greater efforts to integrate research agendas in climate and energy governance. Existing studies on global climate policy, environmental regimes, or carbon markets tend to be isolated from research on national or global energy policies (Speth and Haas 2006; Biermann, Pattberg, and Zelli 2010; Newell and Bulkeley 2010), a shortcoming which urgently needs to be addressed. Linking these research agendas more effectively would provide for opportunity to comprehensively assess the role of regulatory (un)certainty in investors' and consumers' energy choices and to add a transparency agenda to ongoing work. Third, global energy promises to be an interesting case to investigate the power of formal and informal regimes in building trust and facilitating complex transactions over time and space. Most existing studies have so far focused on institutional arrangements fostering producer cooperation within OPEC (for example, Claes 2001), enabling consumers to overcome collective action problems in the context of the IEA (for example, Kohl 2010) or ensuring the energy interests of an economic club, like the G8 (Lesage et al. 2009). Only recently some works have started to investigate less formalized global energy regimes such as the International Energy Forum (IEF) (Harks 2010). As some argue, the IEF provides producers with a more reliable picture of consumer nations' planned energy choices, a basis on which they can plan investments; consumers in turn profit from a clearer picture on upstream capacities and depletion strategies in major producing regions; and markets profit from both elements, finding prices more effectively, thus reducing volatility. In that, the IEF is a prime example of a regime that may reduce existing information asymmetry problems in global energy markets and enable parties to make informed long-term energy choices. The Energy Charter Treaty (ECT), a Eurasian free trade agreement complemented by an open access investment regime for natural gas, petroleum, and petroleum products and a dispute settlement mechanism, is an example of an energy regime on a regional level. While strongly disputed, the ECT regime has been set up to enhance the time horizons of and the trust among market participants.[21] Further research on such existing and emerging formats could build on a rich literature on regimes and regime complexes and in turn also enrich the theoretical literature by drawing insights from global energy as a case.

Governance for Spillovers

Negative spillover effects related to oil have somewhat similar implications for global public policy in energy as the above discussed information problems. In fact, a key externality identified earlier relates to oil price volatility. Producer countries, often relying almost exclusively on resource revenues, will only invest billions of dollars into finding new resources if they can expect a stable and sufficient return on their investment. In addition, their transition to a non-resource-based economy takes time and needs reliable funding. Shifting toward low carbon in turn also requires a reliable price environment for fossil fuels. Global public policies addressing externalities, however, also need to account for different and in fact diametric risk patterns among producers and consumers. While risks related to overinvestment are generally relatively small for consumers, considerable risks lie in underinvestment, as they are susceptible to cause

[21]See, among others, the contributions in Waelde (1996). For a recent pointed critique on the ECT, see Victor and Yueh (2010).

price hikes. For producers, in turn, costs related to underinvestment tend to be the smaller problem, whereas overinvestment and potential resulting price slumps may put their economies in danger.[22] As for spillover effects in natural gas, challenges rather stem from a veritable supply risk. In that, the call on global governance consists in providing for a mechanism that enables market participants to settle disputes in a smooth and cooperative manner, for example, by the help of a regime.

Research agendas investigating these challenges may be found along similar lines as projects addressing information deficits and planning security. Scientific inquiry may, however, additionally profit from assessing other policy fields characterized by strong externalities, such as CFC emissions, ''governed'' by the 1987 Montreal Protocol. Research may need to put particular emphasis on systematically and comparatively assessing strategies that players used in these fields to internalize ''hidden'' costs, to provide for stable expectations among involved parties, and to establish arrangements to implement and monitor joint policies.

Governance for Collective Action

As the discussion has revealed, public goods in energy are not necessarily underprovided, with global spare capacity in oil or secure oil transport routes being cases in point. Yet, as the underlying rationale of their provision is linked to different motives (for example, Saudi Arabia holding reserve capacity to dominate OPEC; the US securing sea lanes to serve its national security interests), the latter can change. In other words, a change in preferences (for example, due to regime change in Riyadh) or cost structures (for example, due to financial distress in the US budget) will inevitably lead to a harmful global collective action problem in oil transport. Hence, the call on global public policy in energy will be to find mechanisms of burden sharing. This will include making consumer nations cofinance maintenance of spare capacity, whose costs at present lie entirely with the producers; it will include finding collective mandates to secure crucial transport routes and hence a smooth functioning of the oil market; and it will include accommodating new consumer heavyweights such as China and India in collective mechanisms to buffer sudden supply shocks in the oil market. Research on global goods aspects will crucially need to center on rational choice informed inquiry, modeling possible (tit-for-tat) strategies that enable involved key energy players to leave overcome collective action problems and prisoner's dilemma type of situations. Analyses could build on well-established and sophisticated models on iterated interaction under condition of adverse incentives, on comprehensive empirical studies in game theory and—again—on extensive research on global regimes.

Turning to transnational infrastructure (notably in natural gas), theory does not allow making a general case for public action. The planned Nabucco project is a case in point. Proponents of the pipeline tend to implicitly argue on the basis of its alleged public goods character (Mirow 2009; Socor 2009). There is certain truth to this argument, particularly with regard to the fact that—given high upfront costs and inherent political risks—individual companies may not have enough incentives to build the interconnector which would foster gas-to-gas competition, build markets, and improve the energy security situation of European consumers. Infrastructure projects, partly characterized by public goods aspects, could therefore profit from targeted public involvement. Particularly, the

[22]In natural gas, takeoff agreements make sure that the contracted and produced volumes are indeed absorbed by the consumer, whether needed or not. Still, however, the price risks exist, though only indirectly, through the price-peg mechanism.

political risks associated with their transnational nature may, as discussed, easily translate into a prohibitive risk premium which may make it impossible for market actors to get the project off the ground. Vehicles that could be used for this purpose are multilateral lending agencies. As scholars have noted, the World Bank (WB), the European Bank for Reconstruction and Development (EBRD), or the Asian Development Bank (ADB) have great experience in financing infrastructure investments. As public entities, they can lever out or hedge political risks and thus strengthen the business case for the project.[23] However, there is also the danger of private companies socializing the costs and privatizing the benefits of that project—literally free-riding on the market failure argument. In light of this, further research into ''governing for transnational infrastructure'' would need to strongly contextualize the study object. Detailed case studies and thick descriptions, particularly on disputed projects such as Nabucco, may provide for interesting insights and add to our understanding of the conceptual limits of public goods. In that, rigorous empirical assessments of energy infrastructure projects may enrich the theoretical literature on market failure.

Finally, with regard to burden-sharing and free-riding in securing crucial sea lanes and tanker routes, some promising links to traditional security studies emerge. Financial cosponsoring arrangements would give the sponsors a call on US operations, which the United States may regard as limiting its ability and the degree to which it can exert power. Rationales from classic realist schools can therefore inform theoretical modeling and help identify governance arrangements in established institutional formats such as the UN Security Council.

Appendix 1 summarizes the discussion in the last two sections.

Conclusion

This article started off by arguing that the emerging literature on global energy governance so far lacks a convincing intellectual rational. Aiming at filling this gap, it conceptualized global energy security in classic public policy terms, that is, by assessing possible incidents of global market failure. To this end, it drew on textbook concepts on imperfect competition, the existence of externalities or information asymmetry, and of public goods characteristics. The discussion has focused on fossil fuels, that is, oil and gas, reflecting the dominant role these energy resources play in primary energy demand. Based on this, the article identified four key areas that should ideally be addressed and ''governed'' by global public policy: market transparency and planning security; negative spillover effects of a global scale; free-rider problems; and the existence of global market imbalances caused by cartels. Acknowledging the fact that global and, for that matter, also collective global public action may not be able to effectively address the existence of cartels, the latter have been excluded from further discussions. Finally, the article sketched several possible research agendas in the field of global energy governance that emerge from the proposed market failure lens.

In conclusion, it can be stated that energy security can be convincingly assessed by a (global) public policy framework. It is a potent analytical framework that offers promising routes for further research. In that, it may well serve as a basis for further scientific inquiry in the field of global energy governance. Still, the framework also faces clear limits. As the discussion has revealed, not all incidents of market failure lead to an underprovision of the good in question, with global reserve capacity or secure oil transport routes being key cases in point. It is also important to note that, though transnational in nature, not all

[23]For a discussion of the role of multilateral donor agencies in global energy governance, see Florini and Sovacool (2009).

market failures arise on global scale. Regionalized natural gas markets, for instance, can be grasped by a global governance perspective only to a limited extent. In that, energy security needs to be assessed on several, though deeply intertwined, levels of analysis. Moreover, it is of course subject to further discussion as to what extent the concept of (global) market failure can, and in fact, should at all inform public policymaking.[24] Some incidents of market failure may also simply fall prey to a global collective action problem that it is hard to overcome by institutional arrangements. And, finally, some may simply be dominated by hard security rationales which, as simplistically zero-sum as they may seem, inform governmental action since the carbon age started 150 years ago.

Appendix 1: Public Policy Lens on Global Energy Governance

Market Imbalance	*Lack of Information*	*Externalities*	*Public Goods*
Principal problem			
Monopolies, monopsonies, cartels push price above or below competitive level	Insufficient data on market fundamentals; regulatory uncertainty; blurred price signals	(Negative) spillover effects on third parties	Free-riding, underprovision
Incident			
OPEC, Seven Sisters, IEA, CDG	Intransparent oil market; NOCs; ''energy diplomacy''; uncertainty on carbon price; EU's flawed gas market liberalization; gas price-peg	Direct and indirect price and supply externalities on oil market and Eurasian gas market	Petroleum stocks; spare capacity; security of sea lanes; transnational infrastructure; gas storage
Policy challenge			
Balance, by monopsony or monopoly	Increase market transparency, enhance planning security	Decrease volatility, enhance planning security, address diametric risk patterns	Overcome collective action problem
Research agenda			
Investigate internal dynamics of cartel, monopsony, monopoly	Strengthen ''governance for transparency'' nexus in energy research; integrate research agendas in climate and energy governance; link research to rich literature on regimes and regime complexes	Systematically and comparatively assess strategies players used in other policy fields; focus on arrangements to internalize ''hidden'' costs, to provide for stable expectations, and to help implement and monitor joint policies	Use rational choice models to explore options to overcome adverse incentives; contextualize and provide for ''thick'' analysis of transnational infrastructure as a borderline case of market failure; establish links to security studies

[24] For a critical perspective on market failures, see Cowen (1988).

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