Part I Global Energy: Mapping the Policy Field

The Handbook of Global Energy Policy, First Edition. Edited by Andreas Goldthau.

Chapter 1

The Role of Markets and Investment in Global Energy

Albert Bressand

Introduction: A Political Economic Perspective on Energy Markets

The term "energy markets" is misleadingly simple. True, in a world of 7 billion people, energy is one of the fundamental factors of production, comparable in importance to labor, capital, technology, and commodities in the satisfaction of human needs. Yet, at first look, the energy industry differs from the rest of the economy in four essential ways. The first of these is its capital intensity, the second the endogenous nature of many energy transportation infrastructures and the elements of natural monopoly they often exhibit. The third differentiating feature is the importance of rent and of conflict over rent distribution. Resulting in part from these first three specificities, but also rooted in security concerns, the fourth distinctive feature is the eminent role of the state in the ownership, control, and development of energy resources, with major implications regarding the role of policy, regulation, and geopolitics. In many countries, the role of the state extends to setting prices and conditions for the consumption of, notably, petroleum products and renewable electricity. Let us consider briefly these features before we put forward a political economic framework adapted to the study of energy markets and investment.

The World's Most Capital Intensive Industry

Energy is the world's most capital intensive sector, with major implications for relations over energy resources. A half-century perspective often governs energy investment and it is not infrequent to have to gather in excess of $10 billion for a given project, with major undertakings absorbing over $100 billion as is the case for the development of the Kashagan oilfield in the Kazakh part of the Caspian Sea or of the redesign of national electricity grids in Europe to adapt to intermittent and decentralized power sources. Turning enough in-place deposits (coal, oil, gas, uranium . . .) and natural forces (wind, sun, hydro . . .) into actual energy resources and bringing them to consumers in various

The Handbook of Global Energy Policy, First Edition. Edited by Andreas Goldthau.

markets can be an amazingly expensive proposition. According to the International Energy Agency (IEA), and subject to the policy assumptions in its New Policies scenario, cumulative investment in energy supply infrastructures will amount to no less than $38 trillion (year 2010 basis) over the 2011–2035 period, the equivalent every year of a tenth of the US GDP, or of the whole GDP of Spain. Of this investment, about $17 trillion will happen in the power sector and $24 trillion in total in non-OECD countries. The term infrastructure as used by the IEA is closer to fixed capital, as it encompasses upstream investments for the replacement and exploitation of reserves ($8.7 trillion for oil, $6.8 trillion for gas, $1.1 trillion for coal mining (IEA 2011a: 96–97)) as well as transport and distribution infrastructures in the more usual usage of the term.

A Largely Industry Specific and Industry Produced Energy Transport Infrastructure

Whereas labor, capital, technology, and even raw materials are easily mobile using general purpose infrastructures, many forms of energy can only reach their market through the construction of dedicated and costly pipelines, power grids or distribution networks that often exhibit natural monopoly features and are also typically subject to stronger forms of political control than is the case for most other industries. Although oil and coal can be carried in trains and trucks, the provision of the infrastructure needed to transport and distribute almost all of natural gas and electricity, most of crude oil, and a part of petroleum products is endogenous to the sector, provided as part of a three-tier value chain of upstream, midstream, and downstream.

No other industry features such a clearly identified midstream, which introduces an additional layer of connection between energy resources and territory, and therefore political control. This gives transit states nuisance power that may be exercised in the non-economic manner, well illustrated in Russia–Ukraine relations among others. The oil and gas midstream abounds indeed in "pipeline wars." While landlocked producer countries have little alternative, others can opt for seaborne transport of energy, for which investment is limited to vessels and port infrastructure, with fewer claims on territory and more limited options to exercise territorial control. In the case of natural gas, however, and leaving aside the still limited use of compressed natural gas, seaborne trade is not the magic bullet for depoliticization it is often made to sound; liquefaction is a prerequisite and comes at a high cost of $4–20 billion dollars depending on specific site circumstances, which makes it uneconomic compared to pipelines over short and medium distances and which also calls for complex licensing in light of national interest considerations, as can be seen in the US presently. Nevertheless, seaborne transportation gives producers access to a diversity of markets, thereby reducing the potential for counterparty opportunism so frequent in the case of dedicated, land-based infrastructures.

In the case of electricity, seaborne transportation is not an option and grids exhibit features similar to oil and gas pipelines. The difference however is that, currently, international trade in electricity is limited to a few regions and is often of a more symmetrical nature (as any country can produce electricity, unlike oil and gas), reflecting differences in daily and seasonal patterns of consumption and production. This may change however, as can be seen from massive projects to carry "green electrons" across the Mediterranean and as large-scale interconnections are needed to offset some at least of the unpredictability of intermittent solar and wind energy. One should be prepared for the possibility that midstream issues will become as important, and potentially as politicized, in electricity as they are in oil and gas.

Rents and Subsidies

A third distinctive feature of energy markets and investment is the importance of economic rent. Indeed, as the point is restated by Bassam Fattouh and Coby van der Linde, "sizable economic rents have been a prize deemed worth fighting for, far beyond the normal competition among market players. They have guaranteed persistent involvement by governments everywhere, either as producers or tax collectors" (Fattouh and van der Linde 2011). Rents exist in all markets but, under normal competition, they tend to reflect comparative and competitive advantages that can be reduced or eliminated through innovation, economies of scale, marketing, and other techniques endogenous to productive activities. Rent is far more pervasive, lasting, and protected in energy markets than in most other markets.

Deliberately limiting a company's or a whole country's production below the production that could meet demand at a given price, as happens in oil and gas, is fairly uncommon in most markets, especially if competition rules are in place to proscribe abuse of market power.

In oil markets, production by the low-cost OPEC producers is subject to production quotas. Even if they tend to be only loosely respected, such quotas make higher-cost production indispensable, placing high-cost producers in the position of marginal suppliers to the market. OPEC members meanwhile denounce the petroleum taxes levied notably by European countries as unfair tools to snatch rent away from them. The high rent embedded in oil and to some extend natural gas prices reinforces calls for subsidized energy. To the public in the Arabian Peninsula countries, paying oil at a price close to extraction cost rather than reflecting rent captured in the international market sounds natural even if the national oil companies are keenly aware of what this means in terms of foregone export revenues. Several hundred million final hydrocarbon customers benefit from subsidies that the OECD estimates to have grown from $340 billion 10 years ago to about $409 billion now for countries for which numbers exist, and probably half a trillion dollars in total. Such subsidies very significantly change the outcome of market interactions toward higher usage of energy resources. A good case in point is Saudi Arabia, which registered an absolute increase of its domestic consumption of oil of 1.2 mbd (million barrels per day) over the 2000–2010 decade, second only to China's (4.7 mbd) and higher than India (1.05 mbd), although the kingdom's population is below 30 million while it is well above one billion in India and China. The same European customers who pay high taxes to consume petroleum products often benefit from subsidies for coal-generated electricity. Altogether, producer rent and consumer subsidies play an essential role in shaping substitution effects across energy markets and in investment patterns, leading to patterns of resource allocation that differ profoundly from what would result from free market forces.

Resource Nationalism and Enlightened Resource Mix Tinkering: Omnipresent States

While supported and reinforced by all three features just reviewed, the fourth distinctive feature of energy investment and markets, namely omnipresent states, has strong roots of its own, notably in national security. The present rise of state power over energy decisions tends to be described under the heading of "resources nationalism," a cliché which assumes that some producer countries (notably OPEC members and Russia) treat energy as a political or geopolitical resource and constitute the major source of interference in energy markets (Gustafson 2012). Yet, as illustrated by the gamut of subsidies, taxes, renewable energy portfolios, feed-in tariffs, and other policy mandates, consumer states are also essential players in the energy arena. As observed by the IEA in its latest WEO report, "Renewable energy subsidies jumped to $88 billion in 2011, 24% higher than in 2010, and need to rise to almost $240 billion in 2035 to achieve the trends projected in the New Policies Scenario" (IEA 2012).

States take a direct interest in the consumption of energy as a condition to maintain support either from green-minded constituencies or from purse-constrained consumers, with the former weighting more in Europe and Japan and the latter more important in the US, Asia, and the Middle East. Europe as well as 28 States in the US and the District of Columbia conduct policies aiming to shift energy consumption away from what would result from the free operation of markets, by requiring a significant proportion of biofuels in transportation fuels and/or of renewable electricity in power brought to the market. While they often do it with the objective to "correct market imperfections" and notably to avoid a "market lock-in" of higher carbon energy sources, it remains true that resource allocations reflect a combination of market forces and policy mandates. This is true also of nuclear energy, as some countries set limits on it (France in 2012 decided to do so in ways still to be articulated) or ban it altogether (Italy, Germany).

With resource nationalism a poor guide, a typology of energy policy environments should be organized in terms of the combination of sovereign objectives and market objectives that exist in all countries (Bressand 2009). In the US, market objectives play an essential role, but nevertheless "energy independence" objectives and, increasingly, environmental policy mandates also have a profound impact. CAFE standards have proven powerful to reign in transportation fuels consumption. At the other extreme countries like Mexico and Saudi Arabia perceive energy as essential to their independence and national security. In between, countries like the Russian Federation attempt to strike a balance between sovereign objectives and market dynamics, with the development of national energy champions a major objective. The existence of international sanctions (most notably currently on Iran's oil exports and on investment in its gas resources) create another category, as do policies to reach energy independence through the facilitation of international investment in countries like Colombia. Altogether, six different groups of countries can be identified on matters of hydrocarbon policies and of investment and market conditions (Bressand 2009).

As a result, investment in energy and the working of energy markets differ significantly from what standard economic models would predict based on usual patterns of relatively free competition. Implications from the four specific features just reviewed include massive subsidies, enduring fragmentation of global gas markets, the fact that oil resources are being developed in deep water at costs 10–15 times higher than lower-cost resources still abundantly available in the Middle East, as well as the fact that some countries eagerly invest in large-scale power generation from non-competitive renewable technologies as an effort to create, over time, the set of market signals supporting the type of energy mix that their energy policies will have put in place.

A Northian Perspective on Resources, Institutions, Transactions, and Power

Altogether, energy is a domain in which some of the world's most liquid global markets and most capital intensive investments coexist with and are influenced by political, cultural, institutional, and geopolitical considerations. An analysis of energy investment and markets therefore calls for a fully fledged political economic perspective that can illuminate how economic relations are shaped by the factors we listed. In this vein, the analytical framework we see as most conducive to a comprehensive, forward-looking analysis of energy markets and energy investment consists of four interrelated components:

- A description of the *physical resources* and of the manner in which they are defined and relate to one another. In a traditional perspective, such resources are stocks of subsoil deposits and flows of water, wind, sunlight or heat. New resources such as stocks of carbon sink capacities may materialize from the world of "nature" to that of the economy (Heal 2000) while others may be subtracted at least temporarily from market interactions through nationalization or heavy-handed regulation;
- A set of *institutions and governance mechanisms* setting the regimes that apply to interactions within and about the energy system, including but not limited to markets and regulatory structures that govern the exercise or the trading of rights over energy resources;
- The *power structure* that determines which actors are in the position to exercise control over production or transit of energy assets and which actors can influence the governance of institutions setting the stage for energy market transactions. Such power may manifest itself, for instance, through the creation, design, and operation of energy markets. In oil, the power structure once revolved around a small number of international energy companies (the infamous Seven Sisters) before shifting in part to states bent upon challenging the existing international order, as OPEC did in the 1970s. Today, actors of influence include states, national energy companies, international energy companies, large-user groups, legislators, and political organizations such as the EU. Various civil society groups are also in a position to bring their values to bear onto the energy arena, such as Greenpeace and the Extractive Industry Transparency Initiative (EITI) among many others (Shell 2005).
- The *transactions* over energy assets and energy products and services themselves across the whole value chain from upstream to midstream and downstream. These transactions can happen in markets ranging from traditional commodities markets to esoteric futures markets or they can also unfold in state to state relations.

This four-dimensional framework, which emerges quite naturally from an informed look at the energy system, draws inspiration from the work of Nobel economic laureate Douglass North (North 1990). It is rooted in political economy, the branch of economics that defines its ambitions not in terms of what can be modeled but of what needs to be understood of the world in which politics, national sovereignty, conflicts, and power relations operate alongside the quintessential law of supply and demand. These four dimensions are relevant throughout the economy but, usually, a relatively stable and pacified power structure tends to support a relatively stable market-friendly institutional framework, making it easier to focus on two dimensions, namely resources (or "economic opportunities") and transactions. In the energy system, neither the institutional layer nor the power structure can be considered as having reached such levels of stability and market-friendliness; they tend to be contested and remain very significant. Appropriate for studying the emergence and working of energy markets, this Northian political economic framework will inform the rest of the present chapter. Each of the four dimensions in this analytical structure, however, is influenced by and influences all three other dimensions, with a tetrahedron a more relevant description of interdimensional relations than a linear sequence as the one just exposed. We shall begin with resources, then consider which institutional framework presides over investment and transactions in energy, notably when and how markets are the locus for investment decisions and transactions. The power structure and notably the role of states and the competition over rent will be discussed as a major influence on this institutional framework, before we turn to transactions over investment and in the market-place.

Energy Resources: The Paradigm Shift

Which resources can actually be mobilized is an essential consideration for energy markets, and so are substitution options among energy sources or "fuels." Resources however, in the Northian sense of economic opportunities, are not given once and for all – as the image of "oil in the ground" misleadingly suggests – but are a function of what existing technology and social practices render economically usable both on the production and the consumption sides.

Over the long term, the picture of energy resources is anything but stable. Forms of energy that had become archaic, such as the windmills of Europe's Middle Ages, can make spectacular comebacks as they did twice, first in the late nineteenth and early twentieth century when no less than 600,000 wind pumps provided US farmers with access to underground water (Gipe 1995) and today in the form of wind turbines. Some resources materialize, literally, out of the blue (but with major state involvement) as would be the case with carbon credits but also as is proposed in the Desertech project, whereby Northern African countries would supply Germany and Northern Europe with solar electricity from their desert lands. Resources that had been proclaimed nearing exhaustion (or at the "peak" preceding exhaustion) now appear plentiful, as is the case for natural gas for which no less than two centuries of reserves are now at hand; the IEA foresees the possibility of a golden age of gas that few would have predicted only a handful of years ago (IEA 2011b). Meanwhile investment in nuclear power generation was made uncertain in the wake of the Fukushima accident in Japan, with countries like China forging ahead after a few months of technical reassessment while Germany, Italy, and Switzerland lead a move out of nuclear energy. As a result, the present period is one of accelerated transition; a different energy system is taking shape, the main contours of which have begun to emerge. Uncertainties on the resources side have to do with geology (the peak oil debate), with technology (most vividly illustrated by the shale gas revolution in North America), and with the social and political acceptability of some resources, whether directly (nuclear power generation) or in light of the technologies needed for their production (tight oil and gas in continental Europe).

Peak Oil or Not Peak Oil?

An essential consideration throughout the energy system is whether oil resources have reached the limit beyond which investors need to run faster and faster on the Exploration and Production (E&P) treadmill without being able to offset a natural exhaustion in oil production. Views about "peak oil" are of importance not just for oil companies but for the overall structure of relative prices in the energy system, as declining oil production can be expected to go with rapidly increasing extraction costs for remaining oil reserves, which in turn should direct investment away from oil toward other energy sources – ideally renewables but in practice also coal even in green-at-heart countries like Germany. After decades of gradual decline that were widely interpreted as validating the views of Shell geologist M. King Hubbert when he coined the phrase "peak oil" (Hubbert 1956), the production of the 48 continental US States is on the increase again as a result firstly of a resumption of investment in US E&P after decades of underinvestment, and secondly of technology progress that reflects the experience gained with shale gas. Peak oil theory, further developed by energy economists in the ASPO,[1] is challenged, even if all can agree that stocks of in-ground resources are finite, arguing about "when" rather than "whether." In the words of a leading industry analyst, "the concept of peak oil is being buried in North Dakota, which is leading the U.S. to be the fastest growing oil producer in the world" (Morse 2012).

It is often overlooked that, for practical purposes, the economic resource on which transportation and the petrochemical industry depends is not "oil" – the general term in public discussions – but "liquids," a notion referring to a certain group of hydrocarbon molecules (such as middle distillates used to produce diesel, gasoline, and jet fuel) among those that are extracted from any given "oil" or "gas" reservoir. Crude oil, which comes in almost as many varieties as there are reservoirs on the planet, is the most accessible but not the only source of liquids. Liquids can be produced from gas (a process pioneered by Shell in its Bintulu plant in Malaysia and then brought to scale in the complex and expensive Pearl plant in Qatar) as well as from coal (as pioneered by Sasol in South Africa in the apartheid era) and even from biomass. According to IEA scenarios, the sum of gas-to-liquids and coal-to-liquids production should reach about 2 mbd in a couple of decades (IEA 2012: 106–107). Even within crudes, however, and leaving aside important considerations about sulfur content, three major distinctions must be made to distinguish "conventional oil" from, respectively, heavy oil, deepwater oil, and tight oil as these four types of liquid sources are developed and produced through quite different technical systems and, in part, by different economic actors.

- The first distinction is about viscosity (measured in API gravity degrees) with heavy crudes (lower than 15 API gravity degrees, or 20 in some other definition) and extra-heavy fuels (lower than 10 API) needing significant processing in upgraders to be made usable.
- A second important distinction also rooted in technical production systems is whether reservoirs can be exploited from fixed on-shore or shallow-water off-shore platforms, as opposed to having to be accessed from deep water thanks to very complex and costly floating structures that only a few energy companies are able to build and operate. The present limit for conventional platforms not requiring special design and capacities is about 400–500 meters.
- The third distinction is about the rock from which oil is produced, as it may either lend itself to the natural migration of hydrocarbon molecules to the wellhead (the conventional case) or, by contrast, require that such migration be caused by rock fracking and by the injection of massive amounts of sand and solvents to keep production flowing.

With these distinctions in mind, and observing that the term unconventional, a relative term, is not precisely defined and that the parameters mentioned here can be set slightly differently, "conventional oil" can be defined as crude oil of more than 15 degrees API found in rocks that do not require fracking, either on-shore or from waters no deeper than 400 meters.

An important additional consideration for students of energy investment and markets is that a reservoir categorized in terms of the dominant resource it contains (oil or natural gas) usually includes other types of hydrocarbons (condensates or natural gas liquids, in short NGL) that will be monetized on a different market. Presently, for instance, the economics of investment in US shale gas plays is very strongly influenced by such joint production consideration, leading to the development of plays that would not be economically viable at today's low US market prices for gas. While bankers will not hesitate to describe such "liquid rich plays" as producing "oil" as well as gas, the physical reality is different as the jointly produced resource is not oil but NGL, namely ethane, propane, and butane, each of which is sold on distinct markets at an average price influenced by specific regional considerations such as demand for ethane and butane in connection with the production of heavy oil, or the use of propane to power tractors and serve other fairly specific needs. Most economists writing about "the price of oil" or "investment in oil and gas" tend to ignore the importance, if not the existence, of these joint production features and distinct markets. The apparently irrational (from a perfect-market arbitrage perspective) price differential between the two major crude benchmarks, West Texas Intermediary (WTI) and Brent (itself consisting of three different crudes, the cheapest of which determines the Brent price at any given moment) has drawn attention to another aspect of the importance of the production system, in this case the need for complex and often customized midstream and downstream installations to create value out of the production of oil.

As these considerations suggest, the peak oil debate is in fact a peak liquid debate. In this vein the good news (from an ASPO perspective) is that King Hubbert has been proven right: conventional crude oil production did peak in 2005 and is on a 1.2% decline. While its share is expected to stabilize at around 65% of OPEC production thanks to large reserves in the Gulf producing states, conventional oil should represent less than half of non-OPEC production in the 2030s (Leonard 2012). Yet the three sorts of non-conventional crudes we just described and "liquids" produced from gas, coal, and biomass see their production rise fast enough to postpone by several decades the time of reckoning. Considering the existence of large untapped sources of hydrocarbons, notably methane hydrates floating deep in some oceans, it is too early to announce a production decline. Indeed, the planet may end up having too much hydrocarbons rather than too little as peak theory would suggest. A roundtable organized by Stephen Kopits in June 2012 led to a description of a long and sustained "oil plateau" extending from 2005 to probably the late 2030s or early 2040s thanks to successive peaks in various types of liquid resources, first in conventional oil (2005), then in deepwater oil (early 2020s), and lastly in tight oil (2030s?). The production of NGL is not an autonomous production process but the result of natural gas production (conventional gas or shale gas) as well as of the operation of refineries; it is expected to grow at about 3% per annum. Production of heavy oil is expected to keep growing throughout that period.

Another essential resource now determining economic opportunities in energy investment and markets is the earth's carbon sink capacities, a resource that no one even considered as such two decades ago. Unlike oil, carbon sink theory follows a pure "peak" logic to the extent that what really matters (in terms of human welfare and health) is a given envelope trajectory for Global Greenhouse Gasses (GHG) emissions compatible with relatively tame climate change (defined by diplomats as change of less than 2 °C on average). According to the IEA, GHG emissions under current and foreseeable policies (the New Policies scenario) are on a trajectory that will soon require the use of more carbon sink capacity than is available under this climate constraint and, notwithstanding a brave but globally irrelevant European effort, policies are not on a trajectory to modify this perspective (IEA 2011b).

The Electric Grid as the Energy Sources Integrator

A central element of the paradigm shift is the growing role of electricity and therefore of electricity markets in influencing demand for primary energy sources across markets.

Daniel Yergin, in his seminal history of the previous energy revolution (Yergin 1991), documented the substitution of King Coal with King Oil; we are now on the cusp of a new era in which King Electron presides over the restructuring of the energy system and of energy resources markets (Konoplyanik 2009).[2] One major implication is a greater substitutability between diverse energy sources.

Power can be generated directly from flows of energy (hydro, wind, sun, geothermic heat, and properly managed biomass) that are renewable in the sense that what is consumed now does not reduce flows available in the future or through the transformation of stocks of primary fuels (oil, gas, coal, and uranium). This diversity of power generation sources to produce the exact same resource (electrons) makes electricity markets powerful energy system integrators. Further electrification of the economy has begun to extend to transportation. Electric cars, like the Chrysler Volt or the Opel Ampera, and plug-in hybrid cars that can be powered from the grid are making their appearance, even if still timidly. The massive development of the Chinese car fleet now under way will probably be the major testing ground for the role of electric and hybrid cars (IEA 2011, 2012: 91). As a result, new substitution effects develop at the interface between the market for oil and markets for the fuels used in power generation, which today includes primarily markets for coal, natural gas, nuclear energy, and three main renewable power sources, namely hydro, wind, and solar energy. Whether such developments are part of the greening of the economy is a more open question as electric and plug-in hybrid cars can run on coal just as easily as on wind energy, depending on choices made by the power generation companies. Another less spectacular but important integration process is at work between the markets for power and for heat, namely cogeneration (the joint production of power and of hot water or steam), which has an essential role to play in increasing overall energy efficiency.

Looking even further ahead, scientists such as Klaus S. Lackner at the Columbia School of Engineering foresee a world where hydrocarbons will be produced from hydrogen extracted from the sea thanks to abundant, cheap solar energy and from the CO_2 that will, in their view, be in significant excess in the planet's atmosphere (Lackner *et al.* 2010; see also Lackner 2010). Should such a vision become true, energy markets will then rest squarely on the market for electricity. This will further exacerbate the role of what we call the Northian tetrahedron in shaping outcomes in energy investment and markets.

Energy Institutions: A Pre-WTO World Meets Post-Modern Synthetic Markets

A Northian perspective leads to ask how institutions facilitate, hamper or otherwise influence the definition of marketable rights and market processes over the resources we have just described. The institutional framework in which energy market interactions take place is far from having stabilized. In addition, as we have begun highlighting, this institutional framework sets limits on the role of markets that can be far more constraining than is the case in most other industries.

The capital intensive nature of the energy system means that the regime applicable to investment is at least as relevant to its overall evolution as is the regime applicable to trade in energy fuels and products. The failure to negotiate a Multilateral Investment Agreement at the OECD in the 1990s shows how far the world is from a multilateral, market-centric investment regime, with thousands of Bilateral Investment Treaties (BIT) providing only a very crude proxy.

In oil and gas, an essential aspect of competition between market participants is about access to upstream resources, namely "acreage" in which to explore for and, ideally, develop resources now that the lion's share of new discoveries happens in non-OECD countries – with a large part of the rest in Canada and the US. The investment regime prevailing in each resource-holding country is therefore an essential influence on the type of market opportunities that can be accessed and the merit order in which such opportunities will be developed. Major resource-holding countries regulate such access in a very discretionary manner. Except in a few places (most notably private land on the US mainland) such resources belong to the state. Hence the paradox whereby expensive, challenging resources are developed while lower-cost resources are not. A number of market processes are at work in the energy upstream, such as auctions for the development of oil and gas fields, but always within a policy-determined national energy framework. In many cases, access to investment opportunities is conditional to the creation of joint ventures with local partners, quite often with the national energy company. In some cases, international investors are excluded altogether and the development of energy resources is conducted under very close supervision by the state. Mexico, again, illustrates how far this approach can be pushed since the Mexican national energy company, Pemex, operates largely as an arm of the government, allocating a large, policy-determined share of its revenues to the national budget (significant reforms are likely to be introduced by the Mexican President-elect from 2013 onward).

In the US, an essential producer, the investment regime includes concessions, a term reminiscent of the Seven Sisters era but which applies in this case to private leases negotiated, usually through "land men," between investors and private landowners. Farmers in the US Northeast count on subsoil gas resources to take them through the challenging times many farms are going through. Resources on public land are accessed through a licensing and auctioning process which the Obama administration has endeavored to make faster and less litigation-prone (C-Span 2012).

Governance and the Uncertain Provision of Public Goods Essential to Market Operation

In all countries, even the most market-friendly ones, the production of private goods to be traded in markets (whether oil barrels or kilowatt-hours) depends in part on the availability of public goods reflecting the state of the governance of the energy system. Three public goods are most relevant to the working of the energy system, namely provision of a level playing-field in energy trade and investment (most noticeable by its very incomplete provision), energy security, and energy sustainability. As we review now, such public goods may or may not be present in whole or part of the energy system, with major implications for the existence and the operation of specific energy markets, as market participants often have to find alternatives through contractual arrangements.

Pre-Modern and Post-Modern Markets

Paradoxically, energy markets are both more "archaic" and more "modern" than the rest of the economy. More archaic because, together with armaments and water, significant parts of the energy field are among the few sectors not covered by the international trading regime (Keohane and Nye 1977) that emerged since the signing of the General Agreement on Tariffs and Trade (GATT) in 1946 and the commencement of the World Trade Organization (WTO), its successor since 1995. This exemption from WTO rules is true of natural energy resources such as crude oil that are not "products," as opposed to refined petroleum products (Desta 2003). Reinforcing this *sui generis* trade regime, the importance and the variability of economic rent that can accrue to investors, as observed by Honoré Le Leuch in Chapter 8 below, will lead most resource-holding countries to consider that "efficient taxation of upstream oil and gas projects cannot be achieved by using only the general taxation applicable to any economic activity." Developed countries like the UK are no exception and they do not hesitate to opportunistically modify tax schedules in light of evolving market conditions.

A telling illustration of this difference between parts of the energy sector and the rest of the economy was provided by two apparently contradictory actions that the US took in 2012: on March 14, the US joined Japan and the EU to sue China before the WTO for refusing to export enough of the "rare earth" metals for which China is the almost exclusive producer; yet earlier on February 14, US opinion and trade lawyers found nothing surprising or infringing on other countries' trade rights when ranking Democrat House Representative Edward Markey introduced a Bill that has to be cited as "The American Natural Gas Must Stay Here Act." The US, which for many years has banned the export of oil crudes, is far from alone in holding trade in energy to different standards from trade in other goods and services.

And yet, few markets are more complex, more open to design by regulators and business innovators than oil future markets and, even more strikingly, modern power markets. City dwellers switching on the light when returning home would hesitate to do so if they had to list, let alone understand, the various markets on which the timely and reliable supply of electrons depends. As described by Sally Hunt, to insure second per second matching of supply and demand, a fully deregulated power market requires the joint operation of half a dozen markets (Hunt 2002). The challenges of bringing higher-cost renewable energy sources into the electricity grid and the fact that wind and solar energy are intermittent in nature creates yet another layer of market design challenges that may lead to qualitatively different market structures, organization, and outcomes. Should markets, for example, deal only in power (kilowatt hours) or also in capacity (kilowatt installed) to reflect the need for back-up capacity for intermittent power generation? Should renewable resources always be used, even when fetching negative prices? This and many similar questions illustrate how power markets, at the heart of the overall energy transition, are open to innovators' and designers' imagination in ways that can only be compared with financial markets. The difference is that governments and international organizations rather than Wall Street strategists play an essential role in coming with market designs that they believe will produce outcomes better aligned with their political and value preferences.

The Power Structure Influencing Energy Investments and Market Relations

International investment relations over oil and gas have gone through four eras (Bressand 2009). First came the Concessions era in which many states outside of the US had only limited ways of monetizing their resources at a time when oil had not fully become the world's central energy commodity. The second era began with the seizure of power by OPEC in the context of two oil shocks, though it did not involve the much heralded emergence of a producer-controlled price formation mechanism that could sustainably substitute for the system of posted prices by which international companies used to appropriate most of the rent (Mabro 2005). The very success of OPEC countries then triggered a massive effort of energy efficiency and led international energy companies to prioritize OECD countries (North Sea, Gulf of Mexico) in the development of hydrocarbon resources. This third era was one in which market principles seemed to be gaining ground at the expense of the direct role of the state. A fourth era is now under way in which states (producer states but also those net importing states engaged in far-reaching energy policies) have reclaimed the central role. One reason in the shift to this new phase is that OECD energy resources have been dwindling, although the shale gas revolution in the US may change the game. In this fourth phase, large international oil and gas companies (referred to as IOCs or "energy majors") have had to rethink their positioning in light of the tighter control exercised by states over energy resources and of the competition by national oil companies (NOCs) for easily accessed hydrocarbon reservoirs. IOCs act therefore as a combination of technology companies and banks able to develop challenging resources beyond other companies' reach, to shoulder projects beyond many states' funding capacity, and to finance major technology development from their retained earnings. In short, IOCs are technology and finance houses that happen to specialize in energy. The importance of financial resources in preserving their role leads them to try to keep gearing ratios low enough to enjoy AA or A ratings. It also implies that they secure returns in the high teens or above to absorb project costs while strengthening their balance sheets and financial wherewithal.

In some circumstances, NGOs and local communities are also able to play a role in setting the framework for energy interactions. This can reinforce market mechanisms by reducing the scope for corrupt practices, as is the case of EITI when countries and companies agree to make public all payments they receive or make. The power of NGOs can also be harnessed in support of local content objectives and of broader sharing of the fruits of energy resources development (how broader depending on how independent and widely based such NGOs are, as captured NGOs may also be created by some politicians in a position to do so). In such cases, the role of NGOs in the power structure will end up facilitating departures from pure market price formation, for reasons that are politically and socially legitimate, a legitimacy dependent in part, again, on the integrity of the process. Ideally, tripartite relationships can develop in which investors, the host country, and local communities supported by NGOs can balance their various objectives toward sustainable development of oil and gas resources (Bressand 2011).

Transactions Over Energy Resources: Energy Value Chains and Energy Markets

Following up on this politico-economic perspective on energy decisions, we can now take a look at the bread and butter of energy economics, namely transactions over energy assets, products, and services, leaving detailed discussion for the relevant chapters in this volume.

Oil Markets, OPEC and the Oil Price Discovery Regime

The market for oil is home to the broadest market interactions subject, as we saw, to two essential caveats, namely the distinction between markets for crude oil and markets for petroleum products such as gasoline and diesel, and the role played by OPEC in the markets for crude oil.

Regarding the present price-setting process for crude oil, we shall follow Oxford's Robert E. Mabro's analysis showing how futures markets for crudes (Brent, WTI, and Dubai) have become central in setting the price for oil within the broad limits discussed above (i.e., the role of high-cost producers as marginal suppliers in spite of large undeveloped low-cost resources in the Gulf). The three types of crude grouped as Brent are traded on the London-based ICE electronic market; spot and future contracts for WTI are traded on the New York Mercantile Exchange (Nymex). OPEC then tries to influence these prices as they emanate from these liquid futures markets through the use of its quota system. This leaves OPEC as a price taker, able to influence market trends at the margin, most effectively when "sailing with the wind" through the direct use of production quotas and through the signals and expectations that OPEC quota decisions and policy debates generate. As stressed by Mabro, a cartel only exists when it is able to enforce price discipline including through oversupply by the core members to punish free rider strategies by cheating members. In this sense, paradoxically, OPEC operated really as a cartel only on a small number of occasions, the most remarkable of which was the enforcement of "netback prices" by Saudi Arabia in 1985. This episode led to a collapse in oil prices which Saudi Arabia was unable to transform into a rapid return to the higher prices it wanted to foster. Since then, and leaving aside the two or three slightly different price-setting regimes that existed after the collapse of the Posted Price regime, OPEC has given up setting prices, content to make its quota decisions based on adjustable, announced or non-announced, price bands. Within this framework, OPEC members are constrained by their own needs for revenues which have greatly increased since the Arab Spring and range from around $70 per barrel to as much as $100.

Structural shifts in demand are the strongest influence on oil price trends. Between 2000 and 2010, as shown by Christopher Allsopp and Bassam Fattouh in Chapter 5 below, oil demand growth in non-OECD consumption increased by around 13 mbd, while OECD oil demand dropped by 1.5 mbd (BP 2011). At the heart of this growth lies the Asia-Pacific region, which accounted for more than 50% of the incremental change in global oil demand during this period. As we discussed, structural changes on the supply side reflect the peaking of conventional oil in 2005 with investment redirected toward deepwater sources (which accounted for half of the new production in the past decade), heavy oil, and tight oil as well as toward liquid-rich natural gas plays in North America.

Natural Gas Markets

The market for natural gas is far from having achieved the same stage of globalization as the market for oil. Indeed, as we write, the same unit of natural gas is being traded at prices that oscillate between $2 and $3 per million btu ($/mbtu) in North America, $10/mbtu in Europe, and between $15 and $20/mbtu in the Pacific region. Not only are prices diverging but the price discovery mechanisms also differ profoundly, with the North American market the only one in which a fully fledged competition exists (referred to in industry parlance as gas-to-gas competition!), whereas natural gas is traded in Europe and the Pacific under longer-term contracts that include the significant element of indexation to oil prices. An essential question is how far further integration could proceed. The export of liquefied natural gas from the US would be a major factor of price convergence. In the institutional context we described – one outside of WTO rules – the possibility exist for various lobbies to prevent or limit such exports in the name of energy independence or simply to keep gas and electricity prices lower for large American industrial users.

Technological Innovation as an Essential Feature of Energy Markets, Notably for Renewable Energy Sources

As observed by Mel Horwitch and Mike LaBelle in Chapter 7 of this volume, "innovation is at the core of the global energy sector" in a manner consistent with the political economic perspective presented here since, in their words, "the choice of technologies is dependent on the cooperation of businesses, governments, and society" as part of a more general regulatory regime defined by "synergetic relationships, with private and public activities partially reinforcing each other" (Knill and Lehmkuhl 2002). This is especially visible in markets for renewables, whether biofuels – a pure product of agricultural policies parading as national security or environmental policies – or renewable power sources which, as said, depend on policy mandates and price support schemes like feed-in tariffs.

Evolution in all energy markets reflects directly (oil, gas, renewable electricity) or in larger part indirectly (coal) an ongoing flow of technological innovation commensurate with the need for major breakthroughs such as those associated with deep sea drilling or with photovoltaic production of solar electricity. In oil and gas, the innovation process is unrelenting; witness how better reservoir mapping and drilling techniques keep increasing the share of in-place reserves that can be economically produced. Game-changing innovations can be the result of entrepreneurial strategy on the part of smaller players deploying smaller levels of capital, a telling example being the adamant effort by US oilman George Mitchell to develop shale gas resources that were known to exist in large quantities, and had been exploited on a very small scale for one century, but were deemed uneconomic. While the breakthrough reflected entrepreneurial spirit and persistence in the face of repeated failures, a true inventory of the capital mobilized in this case should also include amounts spent at the initiative of the state. Mitchell Energy's breakthrough drew on the federally funded Eastern Gas Shales Project of 1976 and benefited from federal funding for the first horizontal well in the Barnett shale as well as from unconventional-gas tax incentives under Section 29 of the US tax code.

Conclusion

Altogether, an analysis of the contemporary global energy scene should shun black and white opposition between market and state, or good market-friendly states and bad resource-nationalist ones to capture instead the manner in which states and a plurality of actors interact throughout the energy value chain and across energy sources. How states, civil society groups, and investors interact is best apprehended from a political-economic perspective such as the one used here to assess economically relevant resources, the institutional framework in which they can be accessed and developed, the power structure governing the evolution of these rules, largely outside of the WTO framework, and the interaction of all players in markets for hydrocarbons, renewables, and power.

Notes

1. For views of the Association for the Study of Peak Oil (ASPO) founded by Colin Campbell see http://www.peakoil.net/. See also Deffeyes (2001). For the opposite view see Mills (2008).
2. For other work by Dr Konoplyanik see www.konoplyanik.ru.

References

BP. 2011. *Statistical Yearbook of World Energy*. London: BP.

Bressand, Albert. 2009. Foreign Direct Investment in the Oil and Gas Sector: Recent Trends and Strategic Drivers. In K. Sauvant, ed. *Yearbook on Investment Law and Policy*. Oxford: Oxford University Press.

Bressand, Albert, ed. 2011. *Getting It Right: Lessons from the South in Managing New Hydrocarbon Economies*. New York: UNDP Special Unit for South-South Cooperation.

C-Span. 2012. Interior Secretary Ken Salazar on US energy policy, April 24. Available from http://www.c-spanvideo.org/program/305624-1.

Deffeyes, Kenneth S. 2001. *Hubbert's Peak: The Impending World Oil Shortage*. Princeton, NJ: Princeton University Press.

Desta, Melaku Geboye. 2003. The Organization of Petroleum Exporting Countries, the World Trade Organization, and Regional Trade Agreements. *Journal of World Trade* 37, 3: 529–538.

Fattouh, Bassam, and Coby van der Linde. 2011. *The International Energy Forum, Twenty Years of Producer-Consumer Dialogue in a Changing World*. Riyadh: IEF.

Gipe, Paul. 1995. *Wind Energy Comes of Age*. New York: John Wiley & Sons, Inc.

Gustafson, Thane. 2012. *Wheel of Fortune: The Battle for Oil and Power in Russia*. Cambridge, MA: Harvard University Press.

Heal, Geoffrey M. 2000. *Nature and the Marketplace: Capturing the Value of Ecosystem Services*. Washington, DC: Island Press.

Hubbert, Marion King. 1956. Nuclear Energy and the Fossil Fuels. Paper read at Spring Meeting of the Southern District, American Petroleum Institute, March 7–9, at Plaza Hotel, San Antonio, Texas.

Hunt, Sally. 2002. *Making Competition Work in Electricity*. New York: John Wiley & Sons, Inc.

IEA. 2011a. *World Energy Outlook 2011*. Paris: OECD/IEA.

IEA. 2011b. *World Energy Outlook 2011 Special Report: Are We Entering a Golden Age of Gas*? Paris: OECD/IEA.

IEA. 2012. *World Energy Outlook 2012*. Paris: OECD/IEA.

Keohane, Robert O., and Joseph S.Nye. 1977. *Power and Interdependence: World Politics in Transition*. Boston: Little, Brown.

Knill, Christoph, and DirkLehmkuhl. 2002. Private Actors and the State: Internationalization and Changing Patterns of Governance. *Governance – An International Journal of Policy and Administration* 5, 1: 41–64.

Konoplyanik, Andrei. 2009. Gas Transit in Eurasia: Transit Issues between Russia and the European Union, and the Role of the Energy Charter. *Journal of Energy & Natural Resources Law* 27, 3: 445–486.

Lackner, Klaus. 2010. Washing Carbon Out of the Air. *Scientific American* 302 (June): 66–71.

Lackner, Klaus, Christoph Johannes Meinrenken, Eric Dahlgren, et al. 2010. *Closing the Carbon Cycle: Liquid fuels from Air, Water and Sunshine*. New York: Lenfest Center for Sustainable Energy, Columbia University.

Mabro, Robert. 2005. The International Oil Price Regime: Origins, Rationale and Assessment. *Journal of Energy Literature* 11, 1: 3–20.

Mills, Robin M. 2008. *The Myth of the Oil Crisis: Overcoming the Challenges of Depletion, Geopolitics, and Global Warming*. Westport, CT: Praeger.

Morse, Ed. 2012. Resurging North American Oil Production and the Death of the Peak Oil Hypothesis. *Commodities Strategy (Citi)*, February 15 (Citigroup).

North, Douglass. 1990. *Institutions, Institutional Change and Economic Performance*. Cambridge: Cambridge University Press.

Shell. 2005. *Shell Global Scenarios to 2025; The Future Business Environment: Trends, Trade-Offs and Choices*, ed. Albert Bressand. Washington, DC: Peterson Institute for International Economics.

Yergin, Daniel. 1991. *The Prize: The Epic Quest for Oil, Money, and Power*. New York: Simon & Schuster.