The complicated geopolitics of renewable energy

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BIO:

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ABSTRACT:

A recent UN climate agreement has the potential to shift global energy consumption from a mix dominated by fossil fuels to one driven by low-carbon technologies. It is clear that if this happens, fossil fuel-producing countries will have to adjust their economies to reflect lower export earnings from oil, coal, and natural gas. The rise of renewable energy may create new centers of geopolitical power. As renewable resources become widely distributed, supply-side geopolitics are expected to be less influential than in the fossil-fuel era. Instead of focusing on just two major resources, oil and natural gas, low-carbon energy geopolitics may depend on many additional factors, such as access to technology, power lines, rare earth materials, patents, storage, and dispatch, not to mention unpredictable government policies. Despite uncertainty, there is no question that the balance of power in energy geopolitics is shifting from fossil-fuel owners to countries that are developing low-carbon solutions.

Meeting the goals set at the 2015 climate conference in Paris calls for dramatic changes in the global energy mix. One-hundred and ninety-five countries agreed on the objective of limiting the global average surface temperature to “well below” 2 degrees Celsius above pre-industrial levels (United Nations 2015). To achieve this target, a shift to zero- and low-carbon energy-producing technologies will be required in the near future (IPCC 2014), with wide deployment of negative-carbon technologies—those that remove carbon dioxide from the atmosphere—in the second part of the century.

The 20th and 21st centuries were profoundly shaped by energy geopolitics, which can be defined as the way countries influence one another through energy supply and demand. There is a vast literature that shows how securing the energy supply, especially in the form of natural gas or oil, was and still is an important consideration in many political decisions (see, for example, Victor et al. 2006 and Harris 2009). Both the high oil prices of the 1970s and today’s low oil prices can be attributed to geopolitical considerations. The latest price decline is driven by traditional producers trying to prevent losing market share to US producers who are using new technology to extract oil from shale formations, now known as the “sheikhs versus shale” standoff (The Economist, 2014).

Today, the balance of power in energy geopolitics is shifting away from the owners of fossil fuel resources, to countries that are developing low-carbon energy sources. Many believe that alternative technologies, like wind and solar electricity, will lower the geopolitical power of traditional energy producers because low-carbon alternatives will provide diversification and increased energy security, especially to those countries that are heavily-dependent on fossil fuel imports (Larson 2007; Scholten and Bosman 2016).

That said, predicting the winners and losers is very difficult, because there are so many elements to consider. In the geopolitics of traditional energy, there are clear centers of power on both the supply side, where Saudi Arabia-led OPEC, Russia, and the United States dominate, and the demand side, where China, the European Union, and, again, the United States are the most important markets. The participants are familiar with the expected behavior of the major players. The geopolitics of renewable energy, on the other hand, is a much more complicated affair with numerous decentralized players. Moreover, instead of focusing on just two major resources, oil and natural gas, low-carbon energy geopolitics may depend on many additional factors, such as access to technology, power lines, rare earth materials, patents, storage, and dispatch (that is, rules that prioritize use of different energy sources), not to mention unpredictable government policies.

Despite this very complex road ahead, it is possible to take stock of the factors that will determine which nations gain and lose power as the world seeks to lower carbon dioxide emissions.

Clean energy versus fossil fuels. Though the cost of producing some non-fossil-fuel energy has recently decreased, for it to achieve substantial market penetration still requires supportive government policies, among them direct subsidies, carbon pricing, regulations requiring renewables use, and feed-in tariffs. Such climate-friendly policies reduce demand for fossil fuels and lower the prices that coal, oil, and gas producers are paid for their products (Paltsev 2012). If fossil-fuel producers believe that such "tight" climate policies are a reality here to stay, and foresee that fossil fuel resources may become a stranded asset, they may increase production today despite decreasing oil and gas prices (Paltsev 2016). For fossil-fuel producers, it is better to profit on the resource while it is still valuable, even if they are not getting prices as high as they once were. If they increase production and lower prices to make these gains while they can, it would make development of wind and solar power more challenging, as these renewable technologies would find it even harder to compete.

The stringency and timing of climate policy will affect the balance of geopolitical power between fossil-fuel and non-fossil-fuel energy producers. As the Paris Agreement signatories showed, the world recognizes the dangers of climate change and a need for action. At the same time, it is clear that the pledges countries submitted under the Paris Agreement, which declare how much and by when they will cut emissions, are not sufficient for the stated goal of limiting the increase in temperature to below 2 degrees Celsius. (MIT Joint Program 2015). Many pledges are contingent on financial support and technology transfers that may or may not materialize, therefore it is not clear how large the differences might be between what countries pledged and what they actually do. In addition, the Paris Agreement relies on goodwill, and there are no penalties for non-compliance. Even if the agreement is fully implemented, the world energy system would still mostly rely on fossil fuels in 2030, the date for which the current targets are specified (MIT Joint Program 2015).

As a result, neither fossil-fuel nor non-fossil-fuel energy producers have much certainty about the direction of future government policies, and whether they are likely to see penalties or support. Regardless of this uncertainty, major energy consumers like China, the European Union, and the United States are rapidly developing their non-fossil-fuel energy sources. For example, the United States increased the share of wind and solar from 0.5% of total power generation in 2005 to 5% in 2015. And by the end of 2015, China had become the country with the largest installed capacity for both wind power (145 gigawatts) and solar power (45 gigawatts). This trend will reduce the geopolitical power of traditional fossil-fuel suppliers, like the Middle East and Russia, and increase the technological advantage of major players in the renewable energy sector, like China, Germany, the United States, and Japan.

Clean energy versus clean energy. Non-fossil-fuel energy technologies compete not just against fossil fuels but against one another. Low-carbon resources are quite diverse. While in some places, notably the European Union, clean energy equals wind and solar, in other parts of the world technologies like nuclear, bioenergy, and carbon capture and storage (CCS) also receive attention. The economics and politics of wind and solar are quite different from those surrounding other low-carbon technologies, because wind and solar are more decentralized and do not require the kind of large up-front capital investments needed for a nuclear power station or coal- or natural-gas-based CCS facility. It is easier to raise capital and get government approval for a wind farm than for, say, a nuclear plant.

As a result, policy makers and investors tend to pay the most attention to wind and solar electricity, while high-capital baseload technologies like nuclear and CCS-enabled coal and natural gas are currently politically and economically less attractive, as suggested by their difficult fate in the European Union and United States. The notable exception is China, which continues to develop its ambitious nuclear energy program: From 2011 to mid-2016, China connected 22 new reactors to its grid, and 20 more are presently under construction. While it looks like wind and solar power are currently winning the technological competition, some researchers (Delarue and Morris 2015; Perez-Arriaga et al., 2016) caution that at higher penetration levels, development of these renewables might be more challenging. They have an intermittency problem, meaning that they cannot provide energy consistently at all times of day. As such, they require back-up capacity, a massive expansion of transmission lines, and a change in the way electricity markets are organized. Currently, power producers are mostly remunerated only for electric energy delivered to the grid. Amid a high volume of renewables, power companies would need to charge for both energy-related services (such as electric energy, operating reserves, and firm capacity) and network-related services (such as network connections, voltage control, power quality, and network constraint management).

Fossil fuels versus fossil fuels. Different types of fossil fuels emit different amounts of carbon dioxide per unit of energy output, with coal being the most carbon intensive, oil producing 25% to 30% less, and natural gas being the cleanest fossil fuel, emitting 45% to 50% less carbon dioxide than coal (Energy Information Administration 2016). Air pollution related to coal burning is also substantially higher in comparison to oil and natural gas. As a result, coal became the lowest-hanging fruit in efforts to reduce emissions in many countries, most prominently the United States (Grunwald 2015). The decline of coal was helped by the fact that there is a cheap alternative in the United States, natural gas.

Driven either by the opportunity to promote natural gas or simply by witnessing the “war on coal” and wanting to avoid being the next target, some oil and natural gas companies decided to publically support the 2 degrees Celsius target. Ten companies representing 20% of global oil and gas production formed the Oil and Gas Climate Initiative. Its major goals include increasing the share of natural gas in the global energy mix (Oil and Gas Climate Initiative 2016). However, so far it looks like a strategy to escape a bear by running faster than the slowest guy running from the bear. Unless natural gas is combined with CCS, it remains a major source of greenhouse gas emissions, but most of the scenarios that keep us below the 2 degree Celsius limit require zero or near-zero anthropogenic emissions in the second half of the century (IPCC 2014). Moreover, the current state of CCS development is rather grim. With only one operational commercial-scale CCS power plant in the world, two under construction, and many recently cancelled projects, the role of the technology in carbon mitigation is very uncertain (Herzog 2015).

To be sure, natural gas can be used as a source of back-up power for intermittent renewables, but studies show that at stringent mitigation targets, the requirement for natural gas capacity might be substantial, even if actual use of natural gas ended up being quite limited, because plants would have to be ready on stand-by for times when wind or solar were not available (MIT 2011). If the world is serious about the Paris Agreement targets, then even natural gas producers will have to eliminate greenhouse gas emissions. Otherwise, even the cleanest fossil fuel is too dirty for the stated goals.

Power to the people. One of the unique features of some non-fossil-fuel technologies is that they provide opportunities for distributed generation, such as through rooftop solar power and remote wind turbines. The design of power dispatch conditions will play a large role in the profitability of different projects. For example, in China, the presence of must-run heat-and-power coal-fired plants, combined with inflexible power pricing, reduce attractiveness of renewable projects, while in Germany, current dispatch practices provide greater flexibility for renewables. Rules on whether and when small-scale producers can provide electricity back to the grid may greatly affect the economics of different projects. Real-time pricing and “smart grids” (which use digital communication technology to quickly react to local changes in usage) may alter the interests of consumers, who also become producers, and change the balance of power between individuals, regional authorities, and central governments.

Issues surrounding electricity transmission will be as important for non-fossil-fuel energy as tankers and pipelines are for oil and natural gas. A key question will be who controls the major power lines and grants permission to build them. Even in the United States, some electricity transmission lines are no easier to get approved than the notorious natural gas pipelines (such as Nord Stream II, Turkish Stream, and South Stream) that Russia has tried or is trying to build to Europe. Obtaining permission from state and local authorities to build transmission lines is also difficult in many other regions.

As with fossil fuels, transit countries in the electricity trade are crucial. Most of the geopolitical games involving Russian natural gas are played not between buyer and seller—there are few problems with the Nord Stream pipeline that directly connects Russia and Germany by sea—but between a seller and a transit country—for instance, the never-ending problems with transit through Ukraine. Renewable energy could end up in a similar situation, with power in the hands of whoever is in control of major power lines. For example, as Ethiopia develops hydro power, it may want to sell its excess electricity to Egypt, but they will need to come to an arrangement with a transit country, Sudan. Such a deal should provide long-term stability for seller, buyer, and transit country.

Unfortunately Russia and Ukraine, the same countries that have given researchers so many examples of natural-gas geopolitics, have also already provided an example of electricity geopolitics at work. After the standoff between Russia and Ukraine over Crimea, in 2015 Ukraine destroyed its power transmission lines to Crimea, creating severe electricity shortages there until power lines from Russia were built. At the same time, the situation provided an example of a possible clean-energy advantage over fossil fuels: Electric power lines can be built faster than oil or natural gas pipelines.

Attitudes towards different advanced technologies often play a determining role in which one emerges on top. The difference in prospects for nuclear energy in Germany and China is not driven by economics, but rather by public perceptions. As a result of differing views on the safety of nuclear energy, Germany decided to shut down its nuclear power stations, while China is aggressively trying to become a leader in nuclear technology. Similar issues exist elsewhere. Public perception and local opposition stopped CCS development in Germany, while Texas has no problem with the technology, as carbon dioxide has been used there as part of enhanced oil recovery for a long time. Public perception also dramatically changed prospects for the bioenergy industry. Many people believe that increased ethanol production will lead to food price increases, creating poverty and malnutrition in poor countries. This view (whether correct or not), along with concerns about deforestation, changed EU policy on bioenergy.

Energy storage winners. Scholten and Bosman (2016) offer the following three observations on the geopolitics of renewables as compared to the geopolitics of fossil-fuel-based energy. First, renewables shift the emphasis from getting access to resources to strategic infrastructure management. Second, renewables shift who has strategic leverage, both from producers to consumers, and to countries able to provide balancing and storage services. Third, in a renewables-dominated system, most countries will be both producers and consumers of energy, and the reduced need for energy imports may greatly reduce any form of geopolitical concern.

Indeed, wind and solar resources are more abundant than fossil-fuel resources. However, the availability of renewable resources differs among regions because they are strongly dependent on climate and latitude. As a result, the cost of wind and solar power in various regions can differ substantially. Depending on how transmission lines develop, this could potentially create a situation similar to today’s fossil-fuel dominated world, in which low-cost producers enjoy geopolitical power. This could lead to redistribution of energy centers within countries and between countries. Just as oil producers in Alaska might not be as profitable as oil producers in the Middle East, wind and solar producers in North Carolina might not be as profitable as wind and solar producers in Texas. Likewise, the cost of generating renewable energy will be low in northern Chile, where dry desert, high elevation, and wind and sun conditions are substantially better for renewables than conditions in, say, some parts of Bolivia and Paraguay.

Due to its intermittent nature, renewables require energy storage, which can come in the form of batteries, large-scale hydro resources, or pumped-storage hydroelecricity. Batteries create concerns regarding the availability of certain elements. For example, as lithium has become the main element in the current generation of batteries, it has been dubbed the "new gasoline," with spot prices for lithium increasing from $7,000 per metric ton (or tonne) in 2015 to $20,000 per tonne in early 2016. Access to hydro and pumped hydro also depends on geographic factors and requires an agreement from the regions or countries that have these resources, potentially giving them geopolitical influence.

Decisions amid transition. As the world adopts non-fossil-fuel energy, producers, consumers, and governments are stuck making decisions amid great uncertainty—decisions that will in turn affect which energy sources will come to dominate in the future.

As with any new industry, low-carbon energy producers try to win political allies to advocate for preferential treatment of their technologies, in the form of investment tax credits, grants, loan guarantees, renewable power mandates, and so forth. Experience in many countries shows that once these preferential treatments are introduced, they are difficult to remove. At the same time, Germany and Spain provide examples of countries where financial support for renewables has changed dramatically. For instance, Germany reduced its solar subsidy, a feed-in tariff for photovoltaic roof systems, from 55 Eurocents per kilowatt hour in 2005 to 12 Eurocents per kilowatt hour in 2016. Changes in financial support dramatically impact new installments of renewable energy. New installation of solar photovoltaic capacity in Spain declined from 2700 megawatts in 2008 to 160 megawatts in 2012, when its government changed the structure of support for solar energy.

During the transition to low-carbon energy, regions and countries need to make many decisions without substantial experience in the new technologies, with potentially large geopolitical implications. For example, to lower its carbon dioxide emissions, in August 2016 Massachusetts passed a bill requiring electric utilities to purchase both offshore wind, which supports European wind firms, and hydroelectricity and other large-scale renewable power, which supports hydro from Canada. This kind of legislative decision affects prospects for the further development of these options. The required hydroelectricity purchases also give new bargaining power to the New England states located north of Massachusetts, where new transmission lines from Canada will have to be built.

Anyone trying to predict outcomes should also keep in mind that the geopolitics of both traditional and renewable energy will co-exist for quite a while. Some decisions in this transition period have led to peculiar outcomes. The closure of the Vermont Yankee nuclear power plant in 2014 resulted in larger reliance on carbon-emitting natural gas in New England. The pending closure of other nuclear power plants, such as two run by Exelon in Illinois and California's Diablo Canyon Plant, may lead to increases in carbon dioxide emissions, with nuclear power most likely replaced by a combination of renewables and natural gas. Germany has experienced a similar issue, de-commissioning nuclear power plants but building lignite (dirty brown coal) plants to back up renewables. This has resulted in a negative impact on the environment despite the stated goal of reducing emissions.

Despite the uncertainty and backwards steps, there is no question that the balance of power in energy geopolitics is shifting from fossil-fuel owners to countries that are developing low-carbon solutions. China, for example, is trying to become a leader in providing nuclear, solar, and wind technologies, both by using them domestically and building its capacity to export them. Globally, government support for low-carbon energy sometimes results in price wars for wind and solar generation equipment. For example, in 2013 the European Union imposed anti-dumping and anti-subsidy measures on imports of solar cells and panels from China. In 2016 it extended these measures to Chinese transshipments via Taiwan and Malaysia (European Commission 2016).

A historical analogy may help illustrate how complex geopolitics could become in a world of renewable energy. Geopolitics in the traditional energy sector is akin to the Cold War standoff between the United States and the Soviet Union: There were many confrontations, but also clear centers of power, alliances, rules for managing the conflicts, and ongoing contacts and negotiations between the two sides. Similarly, we know who the major buyers and sellers of oil and gas are, and the two sides have decades of experience negotiating.

The geopolitics of renewable energy, though, is more like the post-Cold-War world, where it is often not clear what the next challenge will be, what form it will take, or where it will come from. The players are numerous and decentralized.

As they negotiate access to resources, technology, transmission lines, and more, governments and industry players have a lot to learn about navigating the energy transition, even as the policies that determine the pace of change are highly uncertain. We can be sure only that supply and demand for energy will continue to influence the global balance of power for many years to come.

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