Where Willows Harmonize the Wind: China’s Renewable Energy Law and its Role in Wind Power Development

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Abstract:

 China’s central government planners publicly recognize the dangers posed both by global climate change and by the domestic pollution brought on by the country’s unparalleled growth. Policy-makers therefore set ambitious targets for clean-energy development, focusing especially on wind-generated electricity. To meet those targets, China’s developers must rely in large part on the feed-in tariff (FIT) regime established by the Renewable Energy Law (REL). However, the many obstacles faced by the FIT raise the question: will the REL’s FIT allow China to meet its targets for wind-power development? Of interest in this discussion are the history and structure of the REL FIT, in addition to difficulties encountered in the law’s enforcement. Two case studies illustrate instances where the REL has proven both highly successful and intensely problematic in its execution. Also of interest are other incentive mechanisms for renewable energy development that exist, or may exist in the future, in tandem with the FIT. These parallel mechanisms comprise the Kyoto Protocol’s Clean Development Mechanism and a recently projected renewable energy quota.

Introduction:

 China’s rapid economic growth in recent decades has been accompanied by a correspondingly rapid rise in energy demand. In particular, China’s large-scale electricity production is closely wedded to national trends in economic growth. China’s electrical sector is carbon-intensive, with coal-fired plants providing most of the overall load. China’s government recognizes the domestic and international environmental effects of such large-scale use of fossil fuels, and in response has established policies to encourage the development of low-carbon renewable energy sources. Wind power is a favored renewable source, and policies are now in place to provide new wind producers with adequate market and infrastructure access. Working with the encouragement of the Central Government, over the past decade developers have increased the role of wind generation in China’s energy mix at a startling rate. Moreover, the Chinese government has established goals for the future and continuing role of wind-generation that call for the long-term continuation of current trends in wind power development. The questions, then, are to what policies or domestic and international mechanisms does Chinese wind power owe its sudden growth, and whether those mechanisms will be enough to ensure that the Chinese wind industry meets state-set targets in the future.

 This study comprises an analysis of China’s feed-in tariff (FIT) regime, which is primarily derived from the 2009 amended Renewable Energy Law. Our central research question is whether China’s FIT will prove sufficient, by itself or in combination with other programs, to support wind-generation development on the scale required by central government projections. We begin with a synthesis of relevant literature, mostly English-language, detailing the development of China’s FIT over roughly the past decade. In our discussion of the challenges facing the FIT regime we also rely in part on interviews conducted with developers and regulators in Beijing in December, 2011. Those interviews also inform our discussion of other policy measures related to China’s renewable energy development, and the present and likely future relationships between those measures and the FIT. Through a case study on wind development in the Inner Mongolia Autonomous Region (IMAR), we discuss the historical development of China’s wind power industry and the role played in this process by the FIT. Another case study, focused on wind power development in Gansu province, allows us to focus more directly on the wind generation industry’s particularly fast growth just in the past few years. Here, we discuss the practical implications of such rapid growth, especially in light of the projected demands established by policy-makers, in addition to the shifts in law and policy associated with that growth. Finally, we conclude with a discussion of lessons learned and directions for further research.

I. The Growth of China’s Coal-Intensive Electricity Sector and its Environmental Impact.

 In the years from 2003 to 2008 China’s economy experienced double-digit growth rates, and slowed only moderately in the wake of the global fiscal crisis.[[1]](#footnote-1) Today, economic growth in China remains significant, even if more moderate overall. In the first two quarters of 2011, economic growth was held to 9.7% and 9.6%, largely supported by an 11% growth in industrial production.[[2]](#footnote-2) The importance of industry in contributing to China’s overall economic growth helps to illustrate the connection between economic development and increased energy demand. In 2000, total energy demand in China was estimated at 1,108 million tons of oil equivalent (Mtoe), with an increase to 2,271 Mtoe in 2009.[[3]](#footnote-3) In the same timeframe, energy demand in the United States decreased from 2,270 Mtoe to 2,160 Mtoe.[[4]](#footnote-4) This trend is expected to continue. China is now the world’s largest energy consumer, and in IEA Outlook scenarios it is projected to consume 70% more energy than the United States by 2035, and to account for 30% of global growth in energy demand between 2009 and 2035.[[5]](#footnote-5)

 Historically, electricity production accounts for the bulk of China’s energy sector. In 2009 China’s electricity demand rose to 3,643 terawatt hours (TWh), marking a 6% increase from the previous year and representing a demand 3.4 times that experienced in 2000.[[6]](#footnote-6) Industry constitutes the largest consumer of electricity in China, accounting for more than 70% of overall demand.[[7]](#footnote-7) As of 2009, heavy industry, which requires an especially high system load factor, accounted for 83% of industrial electricity demand.[[8]](#footnote-8) The high load factor of China’s electricity networks has helped to encourage a reliance on coal-fired thermal generation, which accounted for 78% of the national generation mix in 2009.[[9]](#footnote-9)

 Electricity production in China is therefore intimately connected both with patterns of economic growth and with the large-scale industrial use of coal and other fossil fuels. The environmental impact of this system, on both the domestic and international stage, is substantial. Coal-intensive energy production contributes to China’s high air pollution levels. Coal combustion results in high ambient levels of particulates, sulfur dioxide and nitrogen oxides in many urban centers, and also contributes to lead, mercury and other heavy metals pollution.[[10]](#footnote-10) Drawing on information from the World Bank and other independent researchers, a study released by the OECD in 2007 projects that, assuming the continuation of current trends, by 2020 China could lose up to 13% of its GDP in compensating for health problems related to air pollution.[[11]](#footnote-11) Such projected problems could include 600,000 premature deaths per year among the urban population, 20 million cases of respiratory illness per year, and 5.5 million cases of chronic bronchitis.[[12]](#footnote-12)

 On the International stage, China’s heavy reliance on coal-fired electrical power plants has helped make it the world’s leading source of carbon dioxide and other green house gas (GHG) emissions. For example, CO2 emissions resulting from China’s industrial sector alone nearly doubled from 2000 to 2007.[[13]](#footnote-13) In recognition of this trend, the Chinese government Ratified the Kyoto Protocol to the United Nations Framework Convention on Climate Change, following which China committed to voluntary reductions in GHG emissions. By ratifying the Kyoto Protocol, Chinese industries gained the ability to participate in the UNFCCC Clean Development Mechanism and other international programs meant to reduce global carbon emissions.

**Table1 : Energy Security Data for 2010: China, EU and USA**[[14]](#footnote-14)

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
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| --- | --- | --- | --- | --- | --- |
|  | Total primary energy supply per capita(ktoe) | Share of renewable entegy in primary energy supply (%) | Energy intensity(Btue per year | Grid Efficiency (%) | Per Capita energy-related carbon emissions(metric tons |
| China | 1.6 | 17 | 26,718 | 6 | 4.9 |
| USA | 7.1 | 11 | 7,280 | 6 | 18.4 |
| EU | 3.2 | 17 | 5,360 | 0.06 | 7.4 |

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**Table 2: Sources of Electricity Production in China as of 2009 (GWh)[[15]](#footnote-15)**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Coal and peat | Oil | Gas | Biofuels | Nuclear | Hydro | Solar PV | Wind |
| 2913122 | 16494 | 50813 | 2351 | 70134 | 615640 | 321 | 26900 |

II. China’s Low-Carbon Energy Policy.

 China began to address climate change at a policy level beginning in 1988, when the central government first gave the National Development and Reform Commission (NDRC) responsibility for coordinating official positions in then-upcoming international climate talks.[[16]](#footnote-16) More recently, the Chinese government has begun to look specifically to renewable energy sources as a means of mitigating pollution and GHG emissions. In 2007, for example, the NDRC released its “National Climate Change Programme,” followed by an affiliated “White Paper” in 2008, which contained specific commitments to renewable energy development as a means of curtailing climate change.[[17]](#footnote-17)

 However, it is the Twelfth Five Year Plan (FYP), adopted by the Chinese government in March 2011, that has brought environmental and climate-oriented concerns to the forefront of national policy. In the 12th FYP, the government set a range of binding targets designed to encourage transition to a greener economy and industrial sector. These targets include the following:

 - Decrease in energy intensity (energy consumed per unity GDP) by 16% by 2015.

 - Decrease in carbon intensity (carbon emissions per unit GDP) by 17% by 2015.

 - Increase in share of non-fossil energy in total energy mix from current 8.3% to 11.4% by 2015.

 - Increase in R&D expenditures from 1.8% GDP to 2.2% GDP.

 - Reduction in nitrogen oxide and ammonia nitrogen pollution, linked to industrial heavy metal pollution, by 10% by 2015.[[18]](#footnote-18)

FYP targets play an important role in the implementation of government policy and associated laws. The requirements listed above are binding targets, and therefore provincial and local officials and the heads of state-owned enterprises will be evaluated, and penalized or promoted, in part based on whether or not they meet said targets.[[19]](#footnote-19)

 The 12th FYP’s energy targets resulted from an ongoing trend towards low-carbon development in Chinese policy-making. Legal mechanisms encouraging the development of large-scale renewable energy sources have been in place for some time. The FYP targets are powerful enforcement mechanisms on their own, but are also meant to play a supportive role to existing and developing laws and regulations. Such interplay between law and policy is needed to navigate the necessary changes in the economic and technological infrastructure of China’s electricity system.

III. Wind Power and the Renewable Energy Law.

 For the purpose of this paper, our starting point is the FYP target calling for an increase in share of non-fossil energy in total energy mix from current 8.3% to 11.4% by 2015. This target includes all energy sources, of which electricity production makes the most significant part. At present, hydropower is the most prominent source of non-fossil electricity in China, and electricity accounts for the bulk of energy production. According to the China Electricity Council, in 2008 586.7 terawatt-hours (TWh) of electricity came from renewable sources, with the vast majority (563.3 TWh) produced by hydroelectric projects.[[20]](#footnote-20)

 Wind power ranks second after hydropower in renewable producers of electricity. In 2010, installed wind capacity was estimated at 42 GW.[[21]](#footnote-21) While this is still small compared with China’s hydropower capacity, it represents remarkably rapid growth. In 1996 China’s wind capacity was 28 MW, while today’s wind capacity is ten times that.[[22]](#footnote-22)

 China’s Renewable Energy Law, first passed in 2006 (REL 2006), has played a prominent role in encouraging wind power development. The REL 2006 established a coherent national system for renewable energy development, setting targets for renewables in the electricity market and, perhaps most importantly, an innovative pricing mechanism.[[23]](#footnote-23) The provisions of REL 2006 aimed in part to provide financial incentive for renewable energy development, beginning with Article 14, which required that relevant grid enterprises enter into grid synchronization agreements with local renewable energy producers, and that they purchase all available energy from said producers.[[24]](#footnote-24) In addition, Article 21 provided that grid operators could recoup the money spent on grid connection by incorporating the cost into the selling price of electricity.[[25]](#footnote-25) Meanwhile, Article 19 of the REL 2009 provided for the use of pricing arrangements by government administrators to actively encourage investment, and provided for a public bidding process to be applied in cases of renewable energy grid access.[[26]](#footnote-26)

 The provisions outlined in the 2006 REL were general in scope, and relied on plans and regulations implemented by regulating agencies in order to come into effect. The NDRC’s 2007 Plan, for example, set installed capacity targets for individual renewable energy technologies, including wind power and solar PV.[[27]](#footnote-27) In its associated *Medium and Long Term Development Plan*, the NDRC also established a target of three percent annual load to be derived from renewables for China’s ten largest power companies by 2010. This last provision was not a success, and by 2008 only one of the ten companies, state-owned enterprises who together account for sixty percent of China’s electricity, stood close to achieving the target.[[28]](#footnote-28)

 Two regulations by two different government agencies implemented REL 2006 Article 14. The first was the NDRC’s *Regulation on the Administration of Power Generation from Renewable Energy*, followed by the SERC’s *Measures on Supervision and Administration of Grid Enterprises in the Purchase of Renewable Energy Power*.[[29]](#footnote-29) These regulations set general rules for grid connection and required that utilities must provide grid connection service for renewables producers, and must subsequently purchase all the electricity produced.[[30]](#footnote-30)

 For our purposes, measures taken to implement REL 2006 Article 19 warrant the closest attention. Regulations promulgated by the NDRC (?) established pricing arrangements based on Article 19, resulting in two systems functioning simultaneously. The first, originally established in 2003, was the franchise-bidding system, while the second, established by the Article 19 regulations, was a system of fixed government pricing, or sanctions.[[31]](#footnote-31) This second system resembles a feed-in tariff system (FIT), in that it guaranteed a set purchase price for renewable electricity producers, while other regulations required that a producer’s electrical load be purchased by the local grid operator. Such systems have met with considerable success, particularly in Europe. Chinese policy makers have continued in recent years to further develop national and regional FIT-like pricing mechanisms based on the REL, and despite continuing challenges this direction holds much promise.

IV. The 2009 REL Amendments and Challenges to FIT-type Mechanisms.

 In August 2009 the National People’s Congress passed several amendments to the REL. The amendments represented minor changes overall, but two updated provisions suggest ongoing efforts to mitigate distinct challenges to renewable energy integration.

 Originally, Article 14 required only that grid operators provide grid connection and fulfill purchasing agreements.[[32]](#footnote-32) In its amended form, however, Article 14 required that state regulatory organs and the State Council promulgate an annual regulation governing grid purchases of renewable power.[[33]](#footnote-33) The regulation provides for the following:

 The department of the State Council in charge of energy affairs shall, jointly with the state power regulatory organ and the financial department of the State council, determine the percentage of the quantity of electricity generated from renewable energies in the total quantity of electricity generated during the planned period, and formulate the specific regulations on the priority power dispatching and purchase of the full amount of electricity generated from renewable energies by power-grid enterprises, in accordance with the national programs for the development and utilization of renewable energies. The foregoing regulations shall be implemented under the supervision by the department of the State Council in charge of energy affairs, jointly with the national power regulatory organ, within the year concerned.[[34]](#footnote-34)

The amended Article 14 goes into specifics where its prior incarnation left interpretation and compliance in the hands of state organs and local governments. While the process outlined in Article 14 appears “cumbersome” to some observers, it echoes a widespread concern that the REL 2006’s requirements lacked sufficient enforcement capacity, and that local governments and energy interests had developed a range of avoidance tactics.[[35]](#footnote-35) By establishing a clear program for central oversight of the Article 14 grid connection and purchase process, the central government moved to address the problem of local implementation of the law.

 Similarly, the REL 2009 provides for greatly increased penalties for grid operators who violate the law. Originally, the REL held that violators would be required to reimburse renewable energy producers whose electricity load went unconnected or unpurchased, and the law actively limited fines to no more than actual economic loss to the producer.[[36]](#footnote-36) In the REL 2009, Articles 29 to 31 require that relevant authorities shall require that violators come into compliance within a set timeframe, and that those authorities shall impose fines of up to double the economic loss of the client producer if that timeframe is exceeded.[[37]](#footnote-37)

 The amended REL 2009 also reflects another pervasive challenge faced by renewable energy developers in China. Grid operators face significant technological obstacles when required to integrate large-scale wind power sources into an electrical system built on coal power. Against this background, the amended Article 14 expanded on its requirement that grid operators purchase renewable electricity to provide for the following:

 Power grid companies shall strengthen the power grid construction, expand the scope of areas where electricity generated by using regenerable energy resources is provided, develop and apply intelligent power grid and energy storage technologies, improve the operation and management of power grids, improve the ability for absorbing electricity generated by using regenerable energy resources, and provide services for bringing electricity generated by using regenerable energy resources on grid.[[38]](#footnote-38)

Again, this amendment refines requirements already present, albeit in a more general form, in the 2006 REL. Here the central government set in law specific policy objectives meant to solve the technological problems faced by renewable energy developers. These requirements would normally be left to provincial-level authorities to interpret and implement, and the central government’s direct action in the REL amendments demonstrates the law’s importance as a means of achieving renewable energy targets. Moreover, the attention given to the goal of reliable grid connection demonstrates the importance of the REL 2009’s FIT-type programs as a means of reaching energy goals.

V. Integration of Renewables after 2009 and Continuing Role of the REL FIT program.

 In 2011, the NDRC, working together with the International Energy Agency (IEA), published the *China Wind Technology Roadmap 2050*.[[39]](#footnote-39) The *Roadmap* set ambitious goals for wind-powered electricity production:

 Some 15 GW of wind power capacity will be installed each year up to 2020. Cumulative operational capacity in that year will be 200 GW, up from 31 GW at the end of 2010, meeting 5% of electricity production (400 TWh), up from 1.3% today.[[40]](#footnote-40)

Unlike many of the Chinese government’s previous ventures into renewable energy policy, the *Roadmap* goes decades further:

 Between 2020 and 2030, some 20 GW of wind capacity will be installed every year, to reach 400 GW in 2030, equivalent to 15% of all installed power capacity, covering 8.4% of electricity production (840 TWh). From then up to 2050, this roadmap sees deployment on land and offshore of 30 GW per annum, around half of annually installed power capacity, meeting 17% of total electricity production (2200TWh).[[41]](#footnote-41)

The *Roadmap* therefore calls for intensive wind power development in both the short- and long-term. The process proposed by the *Roadmap* demonstrates a reliance on the REL 2009 FIT mechanism as an important tool in meeting these goals, as do other actions taken by the NDRC following the 2009 REL amendment.

 The power pricing system originally established by the 2006 REL allowed two pricing systems to coexist. The franchise bidding, or competitive tender system had been established in 2003, and accounted for five rounds of bidding for major wind power projects between 2003 and 2008.[[42]](#footnote-42) These bidding cycles resulted in dangerously low prices from the perspective of financial incentive-making, at first coming to 0.4 RMB/KWh and ultimately growing only to 0.5RMB/KWh.[[43]](#footnote-43) International observers criticized this system for a lack of transparency and for perceived favoritism directed towards SOEs.[[44]](#footnote-44) In addition, the competitive bidding process was not associated with established renewable policy goals, and so existed free of any link to a resource planning and portfolio management process.[[45]](#footnote-45) While Chinese reports credit the competitive tender system with lowering power prices overall, providing for more consistent grid connection, and accelerated diversity of investment, the problems outweighed the system’s benefits.[[46]](#footnote-46) In addition, the bidding system’s coexistence with the feed-in tariff program established by the REL 2006 exasperated the problems of price uncertainty and lack of transparency.[[47]](#footnote-47)

 In 2009, the NDRC replaced the competitive bidding system with the feed-in tariff program established by the Renewable Energy Law.[[48]](#footnote-48) The NDRC introduced this shift through the “Circular on Refining the Policy for On-Grid Pricing of Wind Power.”[[49]](#footnote-49) This document established fixed, or benchmark prices applied to on-shore wind power projects approved after August 1, 2009.[[50]](#footnote-50) The Circular divided China into four resource districts, with different prices, or tariffs, set for each district.[[51]](#footnote-51) Regional electricity tariffs vary in part according to the region’s existing on-line wind power capacity. For example, Inner Mongolia has high capacity installed wind capacity, and so theoretically requires less financial incentive for wind power development, and was therefore granted a lower tariff of 0.51RMB/kWh.[[52]](#footnote-52) Regions with the fewest wind resources, as in the Southeast, were granted higher tariffs of 0.79-0.89 RMB/kWh.[[53]](#footnote-53)

 The *Wind Energy Roadmap* built on the policy platform established by the “Circular,” using the FIT as a primary mechanism to achieve its wind industry goals. The Roadmap discussed the need to vary tariff pricing by region, and emphasizes the importance of providing grid access for wind power producers.[[54]](#footnote-54) In the “Key Actions to 2020” section, the Roadmap calls for the following:

 Strengthen priority grid access and dispatch of wind power; maximize the ability of northern provinces to accommodate locally produced wind power; facilitate inter- provincial transmission using smartest available technology.[[55]](#footnote-55)

The continuing need to address technological and institutional challenges in China’s electricity system is apparent here. The Roadmap, for example, predicts a maximum tariff of only 0.55 RMB/kWh by 2020, based on improvements in the overall investment environment.[[56]](#footnote-56) Such improved investment environment will require improved, “smarter” electrical grids, significant changes to the transport infrastructure, and better communication and cooperation between regional grid operators.

VI. Current status of Wind in China’s Electrical System, and Challenges Facing Implementation of REL requirements and FYP Targets.

 As reported in many international press outlets, as of 2009 some 30% of wind capacity installed in China, and particularly in Inner Mongolia, had yet to be connected to the grid.[[57]](#footnote-57) This statistic is often cited as a sign of systemic weakness in local enforcement of the REL 2009 and its required FIT. Questions involving any lack of central authority in local enforcement and interpretation of laws aside, there are basic technological obstacles that have interfered with grid connection at a basic level.

 Standardization across China’s electrical infrastructure, especially in matters of load-bearing flexibility, is lacking. Wind powered electrical generation results in a highly variable electrical load, very much unlike that produced by coal-fired generation, and therefore unlike the typical load experienced in China’s electrical grids. Wind generation installations can address the problem of variability through the integration of low-voltage ride-through (LVRT) systems.[[58]](#footnote-58) At lower capacity levels, a local grid can typically absorb the fluctuations caused by variable electricity generators, but at higher capacity levels the combined variation can overload grid connections. At present, central government organs have moved towards addressing this problem. As noted by a recent article in the *Financial Times*,

 LVRT systems help keep wind turbines in operation whenever there are large drops in voltage, like when the wind dies down for example. Without these systems, wind turbines will just disconnect from the power grid. To pass the SERC inspections, existing wind farms were required to upgrade these LVRT systems, said industry sources in China.[[59]](#footnote-59)

However, refitting existing wind installations with LVRT systems will prove to be a challenge given the industry’s growth over the past five years. In addition, whether the SERC inspections are carried out by officials connected to central government organs, rather than the local peoples’ governments, will continue to make a difference.

 Other challenges to renewable energy source integration include regional electricity transmission. China’s electrical system is divided into six regional grid clusters, each of which operates with relative independence.[[60]](#footnote-60) The East, Central, Northeast, and Northwest grids are operated by the State Grid Corporation of China (SGCC), which also operates part of the North grid.[[61]](#footnote-61) The China Southern Grid Company (CSGC) manages the South grid, while the western part of the Mongolia grid is managed by an independent company.[[62]](#footnote-62) Communication between the grids, and particularly between grid companies, is minimal. Inter-grid trade in electricity is also minimal, and in 2009 accounted for only 4% of total national production.[[63]](#footnote-63)

 Forging stronger connections between separate electrical grids could do much to compensate for the power fluctuations brought on by the large-scale incorporation of variable renewable power sources.[[64]](#footnote-64) The 12th Five Year Plan includes the goal of developing national-level smart grid technology, which likely requires greater national grid connection of itself. Meanwhile, the two national grid companies have begun to develop their own smart grid plans, which in the future might provide for greater ease of connection, and so greater integration of renewable sources.

 An additional example of the REL feed-in tariff’s reliance on technological improvement comes in the form of efficient high-voltage transmission. While Inner Mongolia’s coal reserves, for example, can be shipped to population centers to be used for fuel, in the case of Inner Mongolia’s wind potential the electricity must be generated on site, and then transmitted great distances. At present local incentives to comply with the REL depend on the central government’s ability to provide for both necessary grid flexibility and for efficient and high-volume long-range transmission.

 Finally, integration of renewable energy sources and enforcement of the REL face challenges in the form of the institutional structure of China’s electricity industry. While the FIT is market based, in that it relies on investment incentives to drive development, China’s electricity sector has never adopted an international-style cost of service model.[[65]](#footnote-65) While the goal of a feed-in tariff is to carve out market space for the integration of renewable energy producers, China’s electricity sector, being largely controlled by the two grid companies and the NDRC, does not traditionally respond in a market-based manner. Instead, the electricity sector continues to show the characteristics of a planned economy, where the FIT model was originally developed for the regulated, rate-based financing systems found in Europe and North America.[[66]](#footnote-66)

VI. The Clean Development Mechanism: support for the REL in promoting wind power development.

 While the REL 2009 has been instrumental in directing wind power development in China, it must share credit with the Clean Development Mechanism (CDM) established by Article 12 of the Kyoto Protocol. Pursuant to the CDM, a country committed to emissions reduction or limitation (an Annex I country) can finance an emission-reduction project in a developing country.[[67]](#footnote-67) Annex I countries earn certified emission reduction credits (CERs) from such projects, each of which is equivalent to one ton of CO2 and which counts towards Kyoto Protocol targets.[[68]](#footnote-68) However, CER credits are only valid if the project at hand results in emissions reductions that are additional to the reductions that would have occurred in absence of CDM funding.[[69]](#footnote-69) This last requirement is known widely as the doctrine of “additionality.”

 The purchase and sale of CERs produced by China-based wind power projects has proven to be a significant source of capital for China’s wind power developers. As of 2010, roughly half of the CERs in circulation were produced by projects in China, with roughly one third of China’s CERs being produced by wind projects.[[70]](#footnote-70) According to industry insiders, some fifty percent of all capital used in China’s wind power development has come from the CDM program.[[71]](#footnote-71) The CDM program has therefore furthered the REL’s goal of promoting the growth of wind-powered electricity generation, though it has not of course aided directly with the problem of grid connection.

 While the CDM has played a major role in the growth of China’s wind industry, developers are cognizant that the program faces an uncertain future in China. In 2009, the UN’s CDM Executive Board ordered a halt to the purchase of CERs generated by Chinese wind-power projects, pending investigation into whether the most recently proposed projects qualified unfairly.[[72]](#footnote-72) The Board was concerned that the 2009 REL’s benchmark pricing system had been used to artificially lower the domestic profits of wind projects. Pursuant to the doctrine of additionality, the drop in profits would render a wider range of projects eligible for the CDM.[[73]](#footnote-73) The Board therefore believed that the Chinese government might have engineered the 2009 REL specifically to abuse the CDM regime.[[74]](#footnote-74)

 Ultimately, the CDM board’s concerns did not pan out. The 2009 REL’s benchmark pricing represented a dip in profitability for some projects, but this was chiefly because the prior bidding system had kept prices artificially inflated. Currently, wind projects in China again generate CERs for the international market. As of April, 2012, some 88 CDM approved projects are listed as “newly approved,” with four new projects having been approved since March, 2012.[[75]](#footnote-75) The vast majority of these projects consist of some variety of wind farm.[[76]](#footnote-76) Still, the looming spectre of additionality remains, and as do uncertainties as to the form the CDM will take after the current Kyoto Protocol emissions reduction period ends after 2012. Developers therefore feel that they need to look beyond the CDM as a source of continued growth, and they generally feel that the 2009 REL is still a reliable source of growth.[[77]](#footnote-77)

VII. Case Study: Inner Mongolia

 The development of wind-generated electricity in China involves a complex interplay between state policy and law, the requirements of finance, and the constraints of technology. An analysis of this interplay as it develops in specific circumstances can tell us much about the relative importance of the REL in generating growth, and suggest what concerns are most likely to meet policy makers in coming years. In this case, a study of wind development in the Inner Mongolia Autonomous Region (IMAR) illustrates the role played by the REL in a region characterized by both long-term, steady growth of its wind power base and by a relative proximity to major urban centers.

 The Inner Mongolia Autonomous Region boasts the most extensive wind generation development in China. Wind capacity in the region has seen particularly rapid growth in the past decade, and as of 2010 accounted for over 500 MW installed capacity.[[78]](#footnote-78) Average wind densities in the region range between 200 W/m2 and 300 W/m2, with relatively low variation in wind speed.[[79]](#footnote-79) The land in this region is flat, with a relatively low population density, and combined with its natural wind resources this makes the IMAR ideal grounds for wind power development.

 Heavy investment in IMAR wind development has followed the REL 2009. By the beginning of 2011, grid-connected installed wind capacity in the IMAR reached 10.9 GW.[[80]](#footnote-80) In April, 2011, the NDRC subsequently announced approval of ten new large-scale wind projects, most in Inner Mongolia, accounting for up to 100MW each.

 However, the development trend has slowed somewhat in the past few months. Available incentive programs appear to have been successful in encouraging rapid development in base capacity, and even in grid connection, but technological difficulties remain. In the western IMAR, for example, long-distance transmission is a necessary and limited step in exploiting local wind resources. As of 2009, the western IMAR already boasted 6 TWh of wind-generated electricity.[[81]](#footnote-81) Although this accounted for only 6% of local energy supply, demand is limited in the region due to substantial local coal-fired energy interests.[[82]](#footnote-82) Producers must therefore sell off surplus power to other grid operators via two 500 kV transmissions lines.[[83]](#footnote-83) This is a very limited transmission capacity, and as a result the surplus during periods of high wind (and therefore high electricity production) cannot be transmitted.[[84]](#footnote-84) The IMAR is therefore a primary example of the existing electricity network’s challenges in the face of renewables generation.

 Partly as a result of the success of the REL’s FIT program in incentivizing development, wind power development has outpaced necessary reform in the grid sector. As a result, central government authorities have recently moved to enhance oversight of the wind power industry in the IMAR.[[85]](#footnote-85) In June, 2011, the NDRC issued a set of regulations requiring that firms involved in wind power development must have assets of at least RMB 1 billion (US $150million).[[86]](#footnote-86) This regulation is believed to be a response to increasingly common business practices linking wind power developers to equipment manufacturers. Local governments recently tended to support such relationships, which tended also to develop into multiple contracts among multiple subsidiaries, each with an independent and profitable position in the wind FIT scheme.[[87]](#footnote-87) The increasingly fragmented market that resulted from such practices bore a negative impact on the FIT’s ability to control growth. This is another example, and was the REL 2009 itself, of central authorities refining regulations in an attempt to better control the implementation of FIT programs at the provincial level.

VIII. Case Study: Gansu.

 Unlike IMAR, Gansu became a wind power base relatively late. The region is also yet more removed from the greater part of China’s electricity consumption. However, wind power growth in the region is currently unparalleled. A study of wind power growth in Gansu therefore illustrates the fullest potential of mechanisms meant to promote fast growth in the industry. Unfortunately, it also illustrates the problems that result from such rapid development.

 Gansu Province is currently the site of some of the more intense development in China’s wind power industry. In recent years, over 5,000 wind turbines have been installed in northern Gansu, resulting in an on-line capacity of 5,500 MW.[[88]](#footnote-88) In 2010 alone, a wind farm of 3.8 GW was built outside the city of Jiuquan, as part of what is projected to be China’s first 10 GW wind installation. This project is to some degree planned via central government organs, and the National Energy Administration (NEA) has established the Jiuquan wind operation as the first of a planned six 10 GW wind power mega-projects.[[89]](#footnote-89) The project is referred to as the “Three Gorges on the Land,” in the Chinese media, and is represented as an important and high-profile new player in China’s ongoing “Western Development” strategy, joining such other feats of large-scale engineering as the Sichuan-Tibet Railway and, of course, the Three Gorges Dam.[[90]](#footnote-90)

 The emergence of Jiuquan as a major global hub for wind power development is demonstrated by the substantial industry presence, as nearly every wind development company in China has established offices in the area. Such ready investment is a distinctly post-2009 phenomenon. Before the centralizing measures of the 2009 amendment’s FIT were implemented, provincial wind energy tariffs were set at a level as low as that for the far cheaper coal-fired generators.[[91]](#footnote-91)

 The Chinese government is moving in anticipation of the problems common to new variable energy sources. The local government has begun work on a $1.5 billion ultra-high voltage cable system to transmit electricity from the Jiuquan network to populated areas. However, flexibility issues common to the country’s grid as a whole will remain for some time.[[92]](#footnote-92)

IX. Future Policy Developments and the REL

 With CDM funding no longer certain for China’s wind-power industry, we can expect that central government policy-makers hope to develop new mechanisms to further promote and manage wind-generated electricity. In particular, the management role of energy policy is likely to warrant more attention at this stage. Capacity has quickly outgrown the abilities of transport systems to integrate new generators, and so new capacity must be better coupled with new developments in grid technology, and should likely be more limited, or controlled, in its pace of development.

 Signs of a new policy direction have already appeared. On February 27, 2012, China’s NDRC announced a plan to develop a national quota regime intended to encourage renewable energy development.[[93]](#footnote-93) This system will define a required mix of renewable and conventional electricity sources to be applied on a region-by-region basis.[[94]](#footnote-94) While this program looks ready to provide an added layer of incentive for wind developers, it appears more oriented towards containment and regulation of the industry as an intrinsic part of the over-all national electricity system.

 A Oct 31, 2011 article in the *China Energy News*, a newspaper put out by the People’s Press and focused on China’s national energy industries, predicted just such a cool-down phase.[[95]](#footnote-95) In this piece, Han JunLiang, board chairman of the HuaRui Group (a major state-owned renewable energy developer), claimed that wind power in China had come to a “re-adjustment period,” where annual increases of 100-200% are simply not sustainable.[[96]](#footnote-96)

 An article in the same publication, published in February 2012 by Wang Xiuqiang, connected this cool-down stage of development with the new need for a quota system. The quota system, according to Wang, will require that markets incorporate a specific percentage of electricity from renewable sources, varying by region.[[97]](#footnote-97) In the process, generators and grid operators will earn credits, which in turn they can trade on a domestic market.[[98]](#footnote-98) According to Wang, this system will serve to better unite the interests of generators and grid operators through both market forces and through the threat of greater penalties where grid operators fail to connect renewable sources.[[99]](#footnote-99)

 With proper planning, the REL 2009’s FIT should effectively work in tandem with the new renewables quota system. In *Feed-in Tariff Policy: design, implementation, and RPS policy interactions*, Cory, Couture and Kreycik observe that a FIT can aid in helping industries meet energy quotas by providing for project-financing support, a hedge against project delays, and support for emerging technologies.[[100]](#footnote-100) At present, most of the literature focuses on FITs or RPS/quotas as mutually exclusive options, but given the reliance on the FIT demonstrated by wind-power developers in China it is most likely that policy-makers will consciously engineer the renewables quota system to work in harmony with the FIT. In the process, they will do well to work towards tempering the over-production of capacity, as distinct from the need for grid-connection, that is made possible under the REL.

IX. Conclusion.

 It is difficult to predict with any confidence whether the 2009 REL’s FIT regime will prove sufficient to meet projected central government targets for China’s wind-generated electricity development. The obstacles to the REL’s uniform enforcement, especially where mandatory grid connection for wind-generators is concerned, remain a matter of concern. In particular, the enforcement problems endemic to China’s political and legal systems are exaggerated by the technological difficulties inherent to the integration of wind power on this scale, making it difficult to fully analyze the roadblocks awaiting the wind-power industry as it continues to develop. All the same, central government policy-makers have made numerous adjustments to the FIT over the past decade, and its design incorporates the numerous lessons brought by challenges to enforcement and the technological base. Even with CDM funding in doubt, developers feel that the FIT is the most reliable, market-driven incentive system for further development. The developers are most likely correct, especially if the new renewable energy quota system is designed specifically to work in tandem with the FIT, as we have every reason to think it will be.

 Of course, the quota itself must prove enforceable. If the central government does succeed in establishing uniform enforcement of the quota system, and especially if its associated credit market flourishes, it may be enough to ensure that wind-power generators and grid operators learn to concentrate on the country’s overall goal: that of bringing unprecedented amounts of wind-generated electricity on-line for consumers. Further research, then, should concentrate on the potential interactions between China’s FIT and the quota regime, and on the strength and the various market mechanisms involved in encouraging greater integration between the efforts of generators and grid operators.

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