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Wind Power in China and in the EU: Comparative Analysis of Key Political Drivers

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Abstract

Although China and the EU differ vastly in their preconditions for environmental governance and investment, both have expanded their capacity for wind-power generation greatly over the past decade. The EU member-states have generally been regarded as modern and prosperous, with high and stable energy consumption and large, high-tech wind industries. China, in contrast, is an emerging economy under authoritarian rule, with rapidly-increasing energy consumption and comparatively little domestic R&D in wind turbine technology. What can explain the fast development of wind-power production capacity in the EU and in China, despite the very different political systems and basic preconditions? Applying the method of ‘most-different systems design’, this paper shows how, in both regions, large-scale investment in wind power has come about through a specific set of political motivations. These include strong governmental support policies based on similar main aims, like security of energy supply, creating future-oriented industries and employment, and reducing greenhouse gas emissions and local pollution. Combined these three factors together, broadly perceived might also explain political motivations driving rapid investment in new renewable energy sources elsewhere.

Keywords: Environmental governance; wind power; renewable energy; transformation; energy policy; EU; China.

1. Introduction

Transforming the world’s energy systems to sustainable standards will require investment in renewable energy production. Today wind energy has the potential to supply more than 20% of global electricity demand \cite{1}, and has been seen as the most mature of the new renewable technologies. Thus, investment in wind power production might
also be viewed as a typical case to understand what drives investment in renewable energy in the world in general, provided that there is significant power potential for a renewable energy source and that the technology has reached a certain level of maturity. Wind energy production costs are reaching grid parity in an increasing number of markets, among them Argentina, Brazil, Italy, Portugal and the UK [1, 2]. Yet, only a handful of countries have invested heavily in wind power. The People’s Republic of China (hereafter China) and the European Union (EU) have enormous potentials for increasing their energy production of wind power, given their long windy coastal expanses, large mountainous areas and plains with high winds [3, 4]. Both have also made considerable investments in renewable energy more generally – and wind energy, bio energy and solar energy in particular – in the past decade [5]. Few studies have conducted causal comparative analysis of what has spurred the large-scale development of wind energy production in the EU and in China. Thus, we ask: What factors might explain why the EU and China, despite enormous differences, have had similar large-scale expansion of wind power in the past decade?

These factors will probably be the same/similar as the factors driving new renewable investments in general, as politicians generally seek to satisfy broader targets for society when they create and implement energy policies. As electricity from wind energy has been more expensive to produce than energy from for example coal, economic stimulation has been a prerequisite for wind energy deployment and innovation. Therefore, we focus on the political motivations behind the creation of support mechanisms, binding targets and other important legislative measures regarding wind power in the renewables policies of the EU (perceived as the EU + EU28) and China. Building more wind-power installations does not necessarily translate into stimulating wind turbine technology innovation, but the two are interconnected: a domestic market for wind power can nourish a domestic industry with considerable potential for learning and ultimately innovation. Such innovation drives technology prices further down, incentivizing large-scale deployment and ultimately helping to facilitate energy-system transformation.

### Nomenclature

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
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<tr>
<td>FiT</td>
<td>Feed-in tariff</td>
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<td>GHG</td>
<td>Greenhouse gas</td>
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<td>GW</td>
<td>Gigawatt</td>
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<td>LNG</td>
<td>Liquefied natural gas</td>
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<td>MW</td>
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<td>TWh</td>
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### 2. Method and data

This paper draws on historical comparative analysis and the most-different systems design. This design singles out for comparison cases with similar outcomes on the dependent variable, but different values on all independent variables relevant to the outcome, except for one or very few. Similar values on that single (or small set of) independent variable(s) then should be able to explain, or at least shed light on, the similarities in outcome. This method is useful for minimizing the number of possible causes, since independent variables where the cases score differently can be eliminated as single causal factors (although they may still be involved in multivariate causation) [6]. In a comparative design involving China and the EU, for example, the presence of a democracy, or a high level of economic development, can be excluded as necessary causal factors, as these do not apply to the case of China. The scope for generalization in the present study is global: the causal relationship under scrutiny is deemed valid across different regime types, levels of development, etc. If we can isolate an operative cause of wind-power expansion in both the EU (e.g. EU policies + the EU28s policies) and China, that cause might thus be expected to apply to other political systems elsewhere at the country and international regional levels. The time scope spans from around 1980 until 2014; it is in this period that modern wind turbine industries were established in European countries and in China and, wind turbine technology reaching technological maturity, started producing energy in
significant amounts. The analysis is mainly based on literature review†, supported by 12 semi-structured interviews with professionals, experts and government officials connected to China’s wind industry autumn 2011, and one interview with a professional representing the European wind industry spring 2013.

3. Historical background

3.1 The EU

In Europe, the market for wind power grew steadily from the 1980s onwards. Denmark, with no hydroelectric power production and a population negative to nuclear energy, was the first to invest in large-scale wind power. The introduction of explicit support mechanisms spurred the rapid expansion of Danish wind power in the 1980s [7]. Elsewhere in the EU, wind power expanded markedly after the introduction of feed-in tariffs, especially the electricity feed-in law (Stromeinspeisungsgesetz, StrEG) of 1990 and a package of other measures in Germany in the 1990s. As this system, combined with other support mechanisms, made wind power the most attractive renewables technology in Germany at the time, most of the German expansion of renewable energy in that decade came from wind power. This development continued with the renewables law of 2000 (Erneuerbare-Energien-Gesetz, EEG) [8]. Since 2000, also other EU countries have launched a range of support mechanisms to promote investment in wind power in order to expand their wind capacity [9].

The EU has made renewable energy a core strategic priority in order to achieve various aims, like fulfilling its commitments under the Kyoto Protocol, increasing energy security and becoming an international leader in the development and innovation of renewable energy technology. Measures have been launched to spur the production of renewable energy—notably, the 2001 Directive on the promotion of electricity from renewable sources in the internal electricity market (Directive 2001/77/EC) and the 2009 Directive on the promotion of the use of energy from renewable sources (Renewables Directive, Directive 2009/28/EC). The latter sets binding targets whereby member-states must expand their production and use of renewable energy. By the year 2020, an average of 20% of energy consumed will stem from renewable sources [10]. The choice of support mechanisms and strategies to achieve the targets is left to the individual states. The EU’s own policies to stimulate renewables expansion are the Strategic Energy Technology (SET) plan and projects supported through the fund NER300. The goal is for wind energy to supply the EU countries with 20% of their electricity needs by 2020, and 33% by 2030, in addition to creating 250,000 new jobs in the wind industry by 2020.

Wind-power policies in the EU and its member states have had profound impacts; in 2012, total EU production capacity from wind energy passed the milestone of 100 GW and reached 106 GW. In Denmark, Spain, Portugal, Ireland and Germany, wind power represented more than 10% of gross final electricity consumption [11]. According to estimates from the European Wind Energy Association (EWEA), the European wind industry employed approximately 136,000 persons directly and an additional 102,000 indirectly in 2010 [12]. This is a high-tech industry where European companies like Vestas, Siemens, Enercon and Gamesa are world leaders in research and development of new technologies [5].

[…] lots of renewable energy in general, but particularly wind energy is a European success story, the pioneering Spain, Germany and Denmark rule the World in terms of not just the finished turbines, but also in terms of components, in terms of expertise, in terms of the development of wind farms and the construction of wind farms […] (interview EWEA, 2013).

Today the frontiers of wind-power technology are moving offshore: wind power produced at sea has an estimated potential to cover 13.1% of EU electricity consumption [13]. The UK, with the EU’s greatest offshore wind potential, has become a particularly ambitious investor. Despite the economic crisis, installed capacity in the EU has generally been increasing steadily. However, the crisis might have a negative impact on future wind-energy growth, in particular in countries hard hit.

† Please contact the authors if you have questions about the references. Not all references could be included in this document.
Clearly, a map of the economic crisis and a map of where wind energy is being built out more or less fast is quite similar (interview EWEA, 2013).

3.2 China

China has pursued a double strategy of securing electricity generation from grid-connected turbines and simultaneously building up a manufacturing industry. Manufacturers began testing prototypes from 1985, but failed to commercialize them. The first subsidies for promoting wind power in China came with rural electrification programmes through small wind farms in Inner Mongolia in 1986, where imported turbines were used. In the 1990s, the Ride the Wind Programme was introduced, and since the turn of the millennium various policies have been launched [14, 15]. Current support policies for solar and wind power include tax credits, feed-in tariffs, preferential land-use policies and low-interest loans [16, 17]. The authorities have also implemented other policies; for instance, China’s Renewable Energy Law of 2006 requires power-grid operators to connect renewable energy production facilities to the grid, and mandates power companies to produce renewable energy [18].

China has increased its production capacity for wind power from a few turbines some twenty years ago to 91,412 MW by the end of 2013, making it the world’s leading wind market. Since 2006, its wind industry has been growing at a high pace [9]. Most of this electricity is produced in the northernmost regions, whereas major load centres are located along the eastern coast. Therefore, much of the power produced must be transported long distances, entailing major challenges for the electricity generators, wind-equipment manufacturers and the two grid companies, State Grid and Southern Grid. Introducing large amounts of intermittent power into the grid requires careful planning of a kind that has been in short supply in China, as pointed out by several studies and reports [19, 20]. The grid infrastructure is the major bottleneck as regards production of wind energy, and will have to be developed and expanded to transport greater amounts of power, and managed more flexibly, if it is to satisfy present and future needs. The national government has set a target of 200 GW of installed capacity by the year 2020. Indeed, according to China Wind Power Outlook 2012, by 2020, capacity could soar to between 200 and 300 GW [21].

However, the industry is not yet mature and Chinese-made wind turbines have a shorter track-record than those manufactured in Europe. Moreover, China lacks skilled personnel: there have been accidents linked to inadequate training of employees and poor management (interviews, November 2011).

4. The driving forces

The EU and China differ greatly on most parameters, including political system, history, economy, general level of R&D and population size. What can then explain the similar outcomes? We will argue that since wind energy has been dependent on various types of stimulating measures, and energy policy is a heavily regulated field, political leaders’ motivations have been paramount. Several such motivations are identified in the research literature. In the case of China, it can include in particular poverty reduction and exploiting macroeconomic comparative advantages like extensive manufacturing experience and access to cheap labour. Increasing the number of market actors to enhance competition is another identified motivation. Moreover, replacing nuclear generation capacity might be a strong motivation, for example applying to several countries after the Fukushima nuclear meltdown. However, since the EU + EU28 and China score very differently on these variables, all must be ruled out in the elimination procedure of the most different systems design as the necessary historical factors driving wind energy growth, and thus also ultimately spurring renewables growth worldwide. Therefore, after having conducted an extensive literature review, we argue that the similarities in outcomes are due to three predominant political motivations:

4.1 Increased climate awareness and reduction of pollution

The EU aims to be a leader in issues like as mitigation of GHG emissions: EU member-states also constitute the bulk of countries that must reduce such emissions according to the Kyoto Protocol. To this end, EU has launched various policies, notably its Climate and Energy Package. This includes the EU Emissions Trading System (ETS), legislation on energy efficiency and carbon capture and storage, as well as the earlier-mentioned Renewables Directive. Further, the EU has set ambitious targets like reducing GHG emissions by 80–95% by 2050, compared to
1990 levels [22]. The EU’s comparatively green and progressive energy and climate policies have been subject to intense debate for decades. Also several member-state governments have highlighted GHG mitigation and economic restructuring towards a ‘green economy’. For example, Germany now has an initiative to rebuild the economy to make it sustainable [23]. Sweden, Denmark and Germany aim at supplying all their energy needs from renewable and low-carbon sources by the year 2050 [e.g. 24].

Climate-awareness is increasing also in China, as for example Stensdal [25] has pointed out. In international climate negotiations, China has generally held that it should not be required to restrict its GHG emissions now because it is still to be accounted as a developing country. From 2007 onwards, climate change has become a national priority and mitigation issues an important target in long-term central planning. As regards climate change, the Chinese government has launched several policies. Most prominent of these is the Mid- to Long-Term Plan for Renewable Energy in 2007, according to which non-fossil fuels are to cover 15% of final energy consumption by 2020 [26]. Massive problems with pollution and environmental degradation are also likely to have contributed to the greater focus on environmental issues in China, as they cause severely increased mortality and morbidity, to large popular protest [27]. ‘We will resolutely declare war against pollution as we declared war against poverty’ the Chinese Premier Minister proclaimed at the opening of the Parliament in March 2014 [28].

4.2 Improving energy security

Chinese energy consumption has risen rapidly in the past decade, as a result of double-digit economic growth, population growth and urbanization. This economic growth has made China an ‘emerging economy’, although not a ‘developed country’. As of 2012, China was the world’s largest emitter of GHGs in absolute terms, although far behind Western countries in terms of emissions per capita. China’s energy supply is still based primarily on fossil fuels such as coal (66% of total energy consumption in 2011), oil and natural gas, and its industries are generally very energy-intensive. The rapid rise in energy consumption has made China’s coastal areas increasingly dependent on imported energy [29, 30]. Unlike the EU member states, China frequently opens new coal-fired power plants, and plans to expand its nuclear power significantly [31, 32].

In contrast, EU energy consumption has basically stabilized, and the energy intensity of energy use is declining significantly. There are few nuclear power plants currently under construction in the EU. Scepticism towards nuclear power has increased in recent years, further accelerating in the wake of the Fukushima nuclear meltdown in 2011, although some member-states are still positive. Coal consumption has generally declined over the past two decades, but has seen resurgence due to low prices caused by the ‘shale gas revolution’ in the USA leading to low prices and thus making coal cheaper than for example natural gas. Still, EU countries remain heavily dependent on the import of fossil fuels including coal; according to the Commission [33, 34], about half of EU energy consumption is covered by imports from outside the EU. Forecasts show that the dependency will grow if the EU and its member-states do not alter their energy policies. Heavy oil and gas import dependence, and insecurity of supply caused by factors like unstable Russian energy policies, and volatile energy prices have made diversification of energy supply an important target for both China and the EU, as a whole and in its member-states [35-37].

China has pursued diversification through a range of measures. It has built oil and gas pipelines to Kazakhstan and Turkmenistan, and entered into several long-term supply contracts for natural gas and LNG; China has also constructed coal-fired and nuclear power plants. Another part of this strategy is creating domestic industries and markets for renewable technologies such as wind and solar power [35-37].

Seeking diversification of energy supply is also the case in the EU + EU28. Numerous strategic EU documents highlight the importance of renewable energy expansion for increasing energy security [e.g. 34, 38]. The member states have undertaken various measures aimed at enhancing domestic energy security – such as expanding energy import by building gas pipelines from Central Asia, Russia and Norway; building LNG terminals; reducing energy consumption; and stepping up domestic energy production. One means of increasing domestic energy production has involved large-scale investment in renewable technologies like wind and solar power, during the past decade in particular.
4.3 Boosting the economy and seeking global leadership in a promising technology

The EU aims to become a global leader in renewable energy technology innovation, as stated *inter alia* in its Energy Roadmap 2050 [39]. According to the Commission [33] ‘European companies currently dominate the global renewable energy manufacturing sector, employing over 1.5 million people, with a turnover of over EUR 50 billion’. If such growth continues, the Commission believes that this can create another million jobs and triple turnover in the sector. Thus, highlighting and supporting the renewables industry can be ways of creating successful industrial policies that are also in line with other important EU objectives, like sustainability and standing out as a global environmental leader. Being the first in this new technology may entail various advantages: for instance, companies can gain market shares and develop specialized expertise that can give extra benefits, creating efficient systems of delivery at an early stage and large-scale manufacturing facilities, and establishing brand names and solid reputations [40]. Danish firms have become market leaders because of their first-mover advantage [40, 41]. Wind-energy investments in Germany and Denmark have long been motivated by leadership ambitions and the wish to boost their economies, not least by job creation [23, 42]. This motivation seems to be well supported by empirical research: Grubb, Hourcade and Neuhoff [43] emphasize that continuing the development of low-carbon technologies, renewable energy in particular, is essential for achieving a ‘secure, low-carbon economy’. This appears to be the case for China as well:

China has used an aggressive industrial policy to ensure it captures commercial benefits from the worldwide race for energy. Nowhere is this more apparent than in wind power, where China now leads the world in both demand and supply [44].

China, the ‘workshop of the world’, has considerable experience in manufacturing all kinds of goods; Chinese companies are generally eager to supply an item whenever a new demand arises. Furthermore, the government wants the country to be a global green-tech leader. Over the past decade, the Chinese government has launched a range of policies to stimulate growth and innovation in wind power-related manufacturing and enhance capacity in wind-power production. In 2010 the government elevated renewable energy technologies to one of seven key strategic policy areas deemed vital for ensuring economic development, facilitating innovation, and promoting domestic technology development. This plan entails investing some $231 billion in the wind sector from 2011 until 2020, according to Pan et al. [45]. As in Europe, wind investment appears to be an efficient labour-market strategy. Renewable energy in general is also seen as being a good investment object for the next few years [16]. The interviewee from Bloomberg New Energy Finance put it this way (interview 2011):

From the government perspective they are going to have a huge employment problem, and a huge, huge social stability problem unless they can create new sectors that create jobs, and new avenues to ensure economic growth. This is one reason the government has supported China’s wind industry.

The European and Chinese wind industries have had many mutually beneficial interactions. Thus, the wind development in the two cases is not totally independent of each other. China’s wind-turbine industry has been based predominately on licensing technology from abroad, from German firms in particular. Such licenses tend to be expensive, and the revenues are often invested in further R&D to create new competitive turbines – making it harder for Chinese market entrants to develop the best new technology on their own [46]. European wind companies have established production facilities in China because of a law requiring all turbines to consist of at least 50% components made in China from 2004 to 2005, and a 70% local content requirement from 2005 to 2009, after which it was removed. Mergers and acquisitions between companies have not been central, but for larger Chinese firms this has become an important strategy for tapping into global innovation networks [15, 47].

5. Conclusions

What factors might explain why the EU and China, despite enormous differences, have had similar large-scale expansion of wind power in the past decade?
This study has explored why the EU and China, despite their differences as regards obvious possible explanatory causal factors such as economic development, have both opted for large-scale investment in wind power during the past decade. Employing the method of most-different systems design, our analysis indicates that three factors shared by both entities influenced the decision to establish national wind industries, and their goals for wind-generation capacity. These three factors are: enhancing energy security, creating a domestic industry, and taking action on mitigation of GHG emissions/pollution. The intermediate variables here are efficient support mechanisms, relatively stable investment conditions and industry interlinkages, such as technology licensing and shared R&D efforts.

Are these really the main drivers? One way of controlling our conclusions would be comparison with other wind countries with sizeable wind power potentials, like the USA and India. In fact, all three arguments have been present in sustaining the wind-energy sectors of both the USA and India, as shown by several studies [9, 48]. Moreover, our findings confirm earlier studies like those by Urban et al. [49] and Bambawale and Sovacool [50] who discuss the political motivations underlying the various policies for strengthening renewables policies. We may therefore conclude that these three causal factors in combination should be recognized as enabling resources from which government and non-government actors can draw their arguments in favour of a domestic green technology industry.

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References
