Contradictions in EU-China clean energy relations

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Abstract: This paper is a first, exploratory draft of a study examining whether the Sino-European relationship in clean energy is cooperative, competitive or conflictive. Focusing on two key renewable energy sectors, wind and solar PV, the paper attempts to decompose EU-China clean energy relations by conducting an analysis of power, interests and outcomes along the "global value chain" in both sectors. The analysis suggests that competition in one part of the chain (e.g., manufacturing) can co-exist with cooperation in other parts of the chain (e.g., innovation). It also suggests that bilateral trade frictions between China and the EU are part and parcel of a global wave of clean energy trade frictions that needs to be resolved at the global level. The paper concludes that, contrary to popular myths, we are not on the brink of a clean energy trade war and that there is sufficient scope to develop a mutually beneficial relationship between Europe and China in the area of clean energy. It explores pathways to settle the issue through the negotiation of a global agreement on environmental goods and services.

Keywords: EU; China; clean energy; trade; global value chains

1. Introduction

The EU and China are critically important actors in the transition toward climate-friendly energy technologies. The EU has long assumed a leadership role in international climate diplomacy and several European companies have been early movers in the development of green industries. China is the world's largest polluter (in absolute terms, not per capita) but has also emerged as the world's champion in the production of low-carbon technologies, such as wind turbines and solar photovoltaic (PV) panels. Moreover, China has also emerged as the "epicenter of clean energy finance" attracting more investment in solar, wind and other renewables than any other country in the world in 2012 (Pew, 2013). China also accounted for almost a quarter of all added clean energy capacity in the world in 2012, indicating a shift in the position of China from pure manufacturer and exporter to an increasingly important buyer and consumer of clean energy.

These rapidly-evolving trends have given way to contradictory interpretations. Some observers stress the high interdependence between the EU and China and point to the plethora of collaborative initiatives that has developed both at the bilateral and multilateral levels. For example, in his speech at the EU-China High Level Meeting on Energy, in May 2012, EU Commission President Barroso stressed that China and the EU have been building up "a strong energy partnership" over the last years. Others, by contrast, characterize the EU-China clean energy relationship as conflictive and fear that recent trade disputes, such as the EU anti-dumping investigation of Chinese solar panels, might spiral out of control and develop into real "trade wars."[1] This pessimistic perspective that paints the image of a zero-sum relationship between China and the EU in clean energy has emerged as the prevailing view.

This paper examines whether the Sino-European relationship in clean energy is cooperative, competitive or conflictive. It focuses in particular on two important renewable energy industries: wind and solar. This focus is justified because both China and Europe have made heavy investments in those sectors over the past couple of years. Their push into these new energy sectors is driven by similar factors. These drivers can be summarized as security of energy supply, environmental concerns, and the economic opportunities that they see in developing low-carbon energy sources, particularly to promote the competitiveness of their own industry and create jobs in sectors thought to have great potential. While solar energy can be generated through different technologies, the focus in this paper will be on photovoltaic (PV) solar panels, since these have generated the most trade friction.

Focusing on these two key renewable energy sectors, the paper attempts to decompose EU-China clean energy relations by conducting an analysis of power, interests and outcomes along the "global value chain" (Gereffi, Humphrey and Sturgeon, 2005) in both sectors. The paper investigates the division of labor that has emerged between Europe and China in both renewable energy industries and examines the distributional consequences of possible trade defense measures. The analysis suggests that competition in one part of the global value chain (e.g., production) can co-exist with cooperation in other parts of the chain (e.g., innovation). The paper concludes that, contrary to popular myths, we are not on the brink of a clean energy trade war and that there is sufficient scope to develop a mutually beneficial relationship between Europe and China in the area of clean energy.

The paper proceeds as follows. First, it gives an overview of the latest key facts and figures concerning the renewable energy industries in China and Europe. Second, it surveys the emerging trade frictions arising between China and the EU in the wind turbine and solar PV sectors. Then, the paper delves into the recent debate on the necessity and feasibility of a negotiated multilateral solution to the emerging clean energy trade war, which extends well beyond the bilateral relationship between China and Europe. Finally, the conclusions are presented.

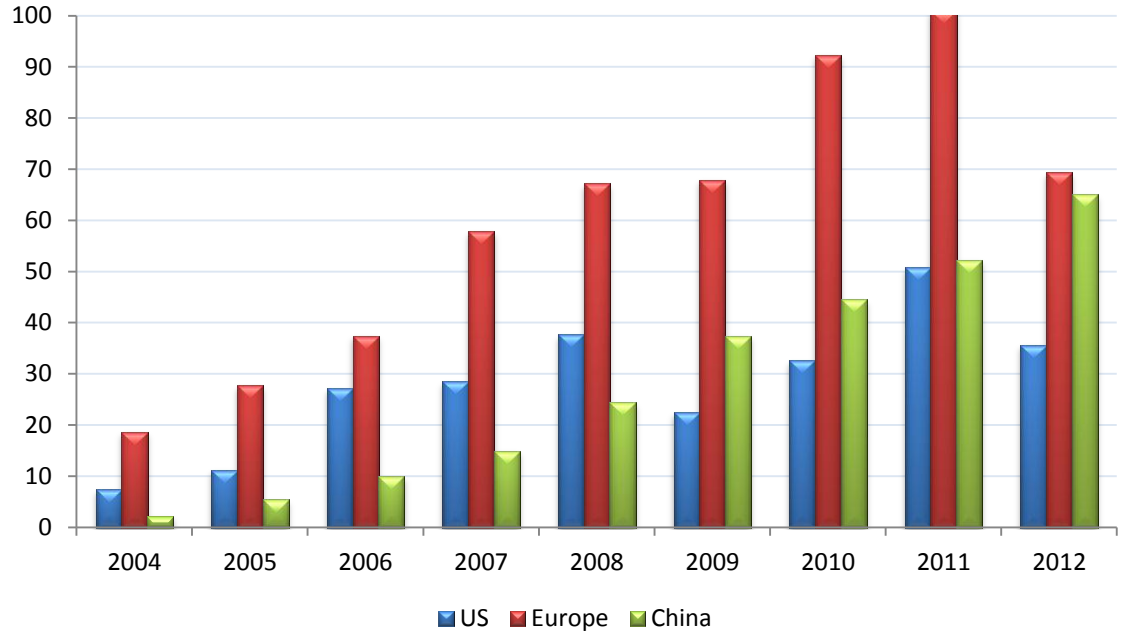
[1] To give just one example: Robin Emmott and Michael Martina, "EU and China stumble towards solar trade war," *Reuters*, 21 February 2013.

2. Trends in wind and solar manufacturing and deployment

This section presents some basic facts and figures about renewable energy development in China and the EU.

Figure 1 shows new annual investments in renewable energy in the United States, the European Union, and China, which have attracted the largest investments worldwide. It shows that, on the whole, the clean energy sector is moving forward, though not in a linear fashion. For example, the global economic downturn is well reflected in overall investment figures for 2009 and the recent scale back of support mechanisms for renewable energy in many mature European markets, such as Germany, the UK, Spain and Italy, is clearly visible in the 2012 data. Most importantly, perhaps, it displays the inexorable march forward of China on the global clean energy scene. In 2012 it captured no less than 25 percent of all solar energy investments, 37 percent of all wind energy investment, and a dazzling 47 percent of the investment in the "other renewable energy" category that includes small hydro, geothermal, marine, and biomass.[2]

Figure 1: New investments in renewable energy, billion USD



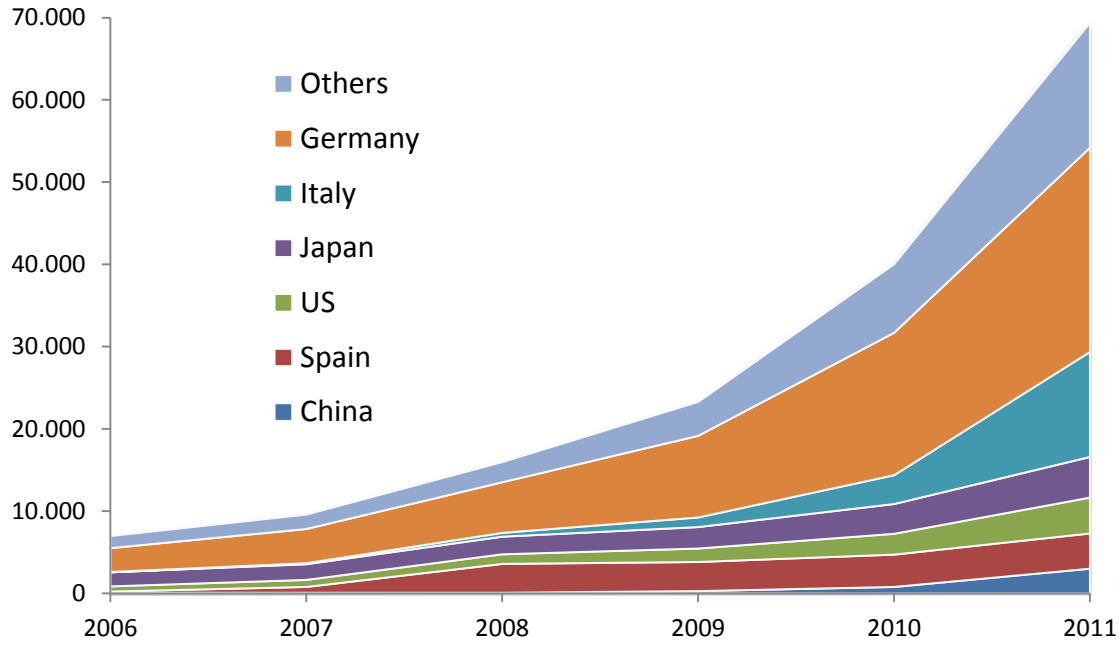
Source: data for 2004-2011 come from UNEP (2012); data for 2012 come from PEW (2013).

Figure 2 illustrates the relatively high concentration of installed solar PV capacity in just a handful of leading countries. In 2011, the leading solar PV countries in terms of installed capacity were Germany (accounting for 35,8 percent of total worldwide capacity), Italy (18,4 percent) and Japan (7,1 percent). In other words, still 61,3 percent of all PV solar panels currently in use are installed in merely three countries. Here too, China is making big progress, with its total installed capacity growing from 100 Megawatts (MW) in 2007 to 800

[2] Pew, 2013.

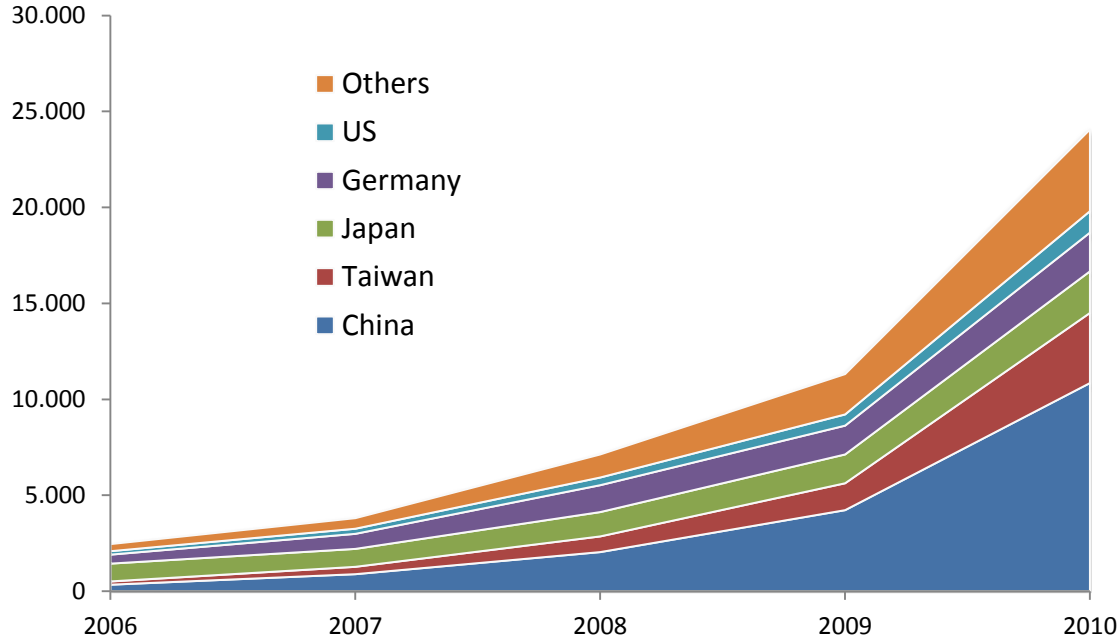
MW in 2011. Globally, though, it is only the sixth largest solar PV market and the gap with countries like Germany and Italy is still very big. European countries clearly dominate this sector with 72,2 percent of all installed capacity in 2011. China's share of 4.3 percent pales in comparison (BP, 2013).

Figure 2: Cumulative installed solar PV capacity, Megawatts



Source: BP (2013).

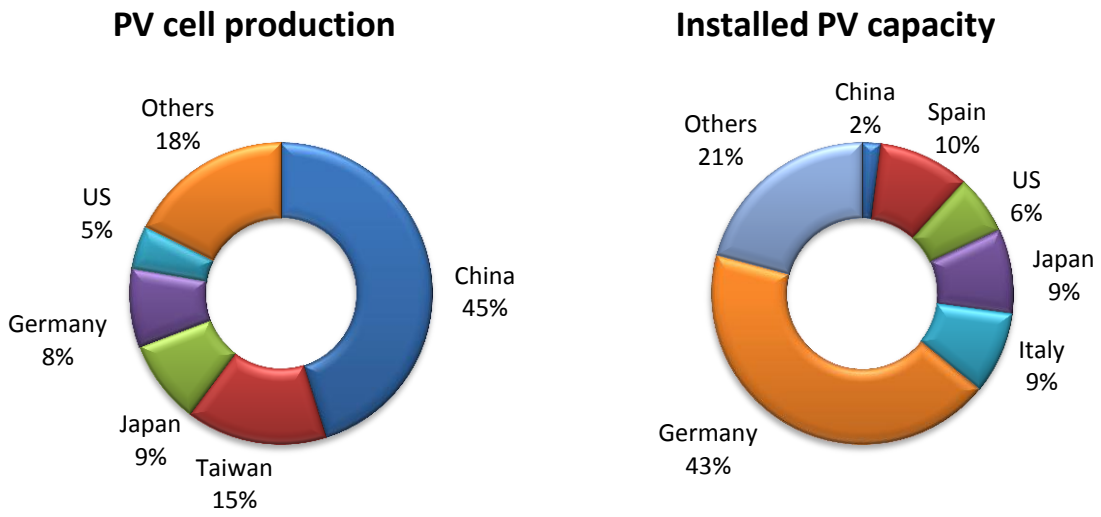
Figure 3: Solar PV cell production, Megawatts



Source: EPI (2011).

Figure 3 displays the most important solar PV cell producers in the period 2002-2010 as well as the evolution of their positions. Here, Japan and the US were early leaders. In 2002, Japan manufactured no less than 46 percent of all solar PV cells globally. Germany has emerged as an important contender, producing almost as much solar PV cells as Japan in 2010. Taiwan has also rapidly joined the ranks of top producers, holding a 15 percent global market share in 2010. Yet, China's performance eclipses all others. From a marginal position just a few years back, it now has a market share of some 45 percent.

Figure 4: Geography of solar PV cell production and installed capacity, 2010



Source: EPI (2011)

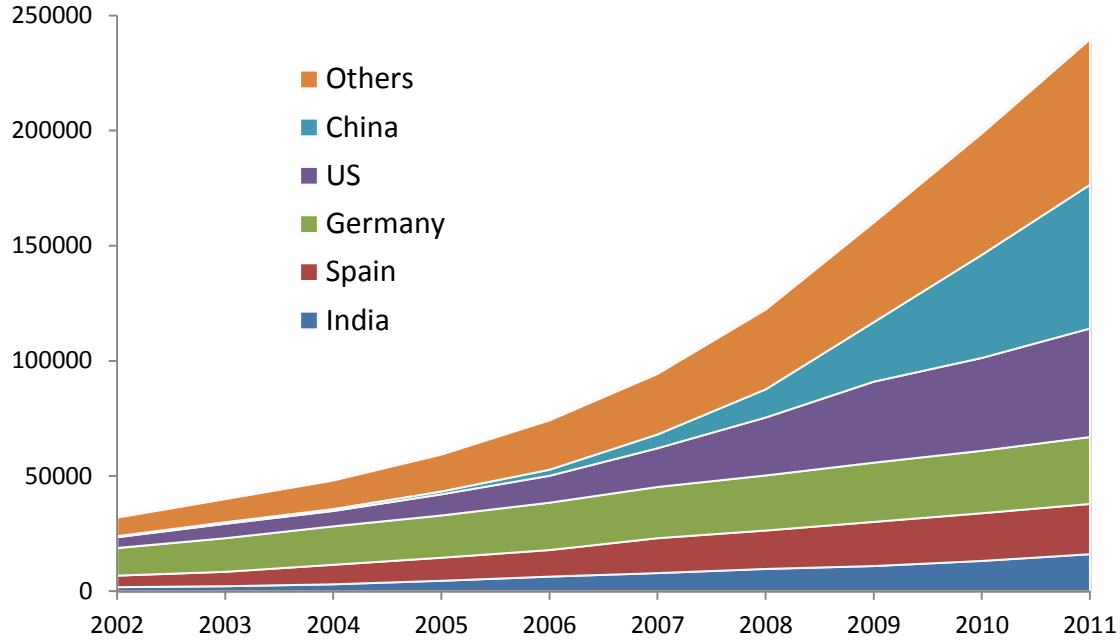
Source: BP (2013)

Figure 4 offers a static, comparative snapshot of the geographies of solar PV cell production and installed capacity for the year 2010. This picture clearly shows how, in the solar energy sector, the countries that lead the world in the production of solar PV cells are not the same countries that lead in the deployment of solar technology. In 2010, the leading markets in terms of installed solar PV panels were Germany, Spain, Italy, and Japan. That year, Chinese firms clearly led in global PV technology production, outpacing their competitors from Taiwan, Japan and Germany. Ever since, China's leading position appears to be only increasing. In 2011, six out ten of the top solar manufacturers were Chinese, with Suntech in the first place for the second year in a row. No European and just one Japanese manufacturer made it to the top ten in terms of global market share in 2011 (REN21, 2012).

Turning to the wind sector, Figure 5 illustrates the growth of the installed wind turbine capacity in key markets. Here, China assumed a leading global position in 2010 when it overtook the United States as the biggest market in terms of installed wind turbines. In 2011, China accounted for 26,1 percent of all installed wind turbines in the world. Besides China and the US, other countries in the top five are Germany, Spain and India. Together, these five countries accounted for 73,7 percent of all wind turbines installed in the world in 2011. Thus, as in the solar PV sector, the markets for wind energy are still very concentrated. While China is leading in terms of installed capacity compared to individual EU countries, Europe as a

whole still ranks first globally, with about 40 percent of all installed wind turbine capacity (BP, 2013).

Figure 5: Cumulative installed wind turbine capacity, Megawatts



Source: BP (2013).

Table 1: Top ten wind turbine manufacturers 2003 and 2011 (world market shares)

2003			2011		
Origin	**Firm**	**Share**	**Origin**	**Firm**	**Share**
EU	Vestas (DK)	21,8%	EU	Vestas (DK)	12,9%
US	GE Wind	18,0%	CN	Goldwind	9,4%
EU	Enercon (DE)	14,6%	US	GE Wind	8,8%
EU	Gamesa (ES)	11,5%	EU	Gamesa (ES)	8,2%
EU	NEG Micon (DK)	10,3%	EU	Enercon (DE)	7,9%
EU	Bonus (DK)	6,6%	IN	Suzlon	7,7%
EU	Repower (DE)	3,5%	CN	Sinovel	7,3%
EU	Nordex (DE)	2,9%	CN	United Power	7,1%
EU	Made (ES)	2,9%	EU	Siemens Wind Power (DK)	6,3%
JP	Mitsubishi	2,6%	CN	Mingyang	2,9%
	Others	5,3%		Others	21,5%

Source: Lema et al. (2011); REN21 (2012).

Table 1 shows how the wind turbine manufacturing industry has evolved globally between 2003 and 2011. While Europe is the traditional leader in turbine production (in 2003, eight out of ten of the top wind turbine manufacturers were of European origin), the market has become more fragmented in recent years. The ascent of Chinese enterprises, in particular, is very notable, though China's manufacturers do not dominate the global wind turbine sector as

much as they dominate the global solar industry. It is important to keep in mind, however, that many of the European turbine manufacturers, including Vestas and Gamesa, have (re)located production capacity to China (Lema et al., 2011; Wang et al., 2012).

Overall there appears to be a closer approximation between the countries leading in wind power deployment and those leading in wind turbine manufacturing than there is in solar deployment and manufacturing (Lewis, 2012). The greatest imbalance occurs in China with regard to solar PV cells. In 2010, China produced 45 percent of all solar panels globally, of which it installed only a fragment domestically. The overwhelming majority of solar panels "made in China" are thus exported to other markets, where consumer demand has often been artificially inflated through various support schemes. This imbalance has helped to fuel trade disputes between China and its most important client for solar PV cells, Europe.

3. EU-China clean energy trade disputes: Cases to date

3.1. Wind power

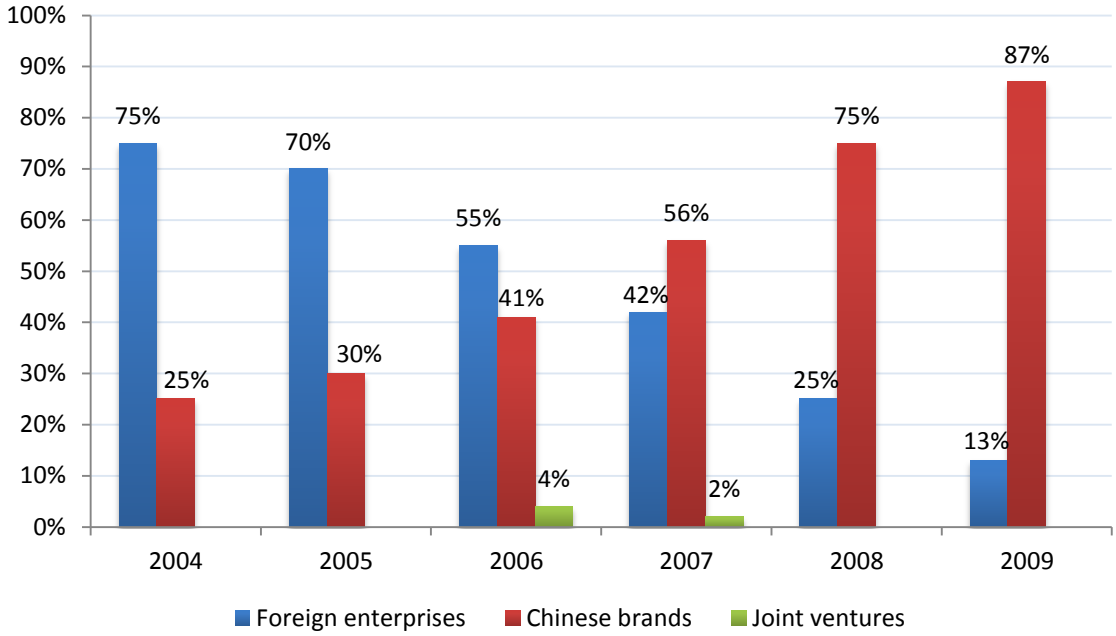
China has rapidly developed a domestic wind power industry (see Figure 5 and Table 1). Particularly in the years 2005-2009, its domestic wind technology sector grew at breakneck speed, with capacity expansions exceeding 100 percent a year. It allowed China to realize a 20-fold increase in installed wind power capacity over this 4-year period and assume a leading position globally by 2010 (Wang et al., 2012). This rapid growth in installed wind power capacity was accompanied by a shift away from reliance on foreign turbine manufacturers towards local ones. Whereas, until 2005, the Chinese wind power market was largely dependent on foreign technology produced by subsidiaries of mostly European turbine manufacturers, in just four years the tables had turned. By 2009, the market share of local enterprises increased to 87 percent, as is depicted in Figure 6 (Li et al., 2010).

This rapid shift in the market sales away from foreign and towards Chinese wind energy firms was facilitated by a number of domestic wind industry policies and regulations, some of which may be seen as violating international trade law, including: joint ventures and technology transfer; customs duties and import tariffs; local content requirements; and wind-power related subsidies (Lewis, 2007). It is important to note, however, that China is far from the only country to have put in place policy support mechanisms that are colliding with the established principles of international trade law (Lewis and Wiser, 2007; Rivers and Wigle, 2011).

Joint ventures and technology transfer. Since the latter half of the 1990s, the Chinese government has been trading opportunities to develop wind firms in China's potentially lucrative market in exchange for the transfer of foreign turbine technologies to local companies. Spanish and German companies were among the first to have been involved in such joint ventures with local, Chinese enterprises. In return for their agreement to transfer wind turbine technology, they not only got access to the Chinese market but also received financial support from government technology funds. Strictly speaking, such cases where

technology transfers have been required as a pre-condition for doing business in China could be questioned under WTO rules (Lew, 2000; Lewis, 2007).

Figure 6: Domestic and foreign shares in newly installed wind capacity in China



Source: Li et al. (2010: 37).

Customs duties and import tariffs. China has also alternatively loosened or tightened customs duties and import tariffs on wind turbines and/or components. From 1990 to 1995, imported wind turbines were exempted from customs duties in order to promote domestic wind power deployment. As from 1996, China put a higher customs duty on imported turbines (12%) and a lower duty on important components (6%) to encourage local turbine manufacturing, which then still heavily relied on international supply of components (Liu et al., 2002). Again, such practices could be seen as barriers to international trade and, thus, a violation of WTO law (Lewis, 2007).

Local content requirements. A third supportive measure for China's wind industry that is dubious under international trade law are local content requirements. Beginning in 2003, the National Development and Reform Commission (NDRC) started to auction off the rights to develop large wind farms. In selecting the winning bids for these concessions, local content percentages became a key determinant of the evaluation (Lewis, 2007). More specifically, from 2004 to 2010, the Chinese government demanded from local governments to source more than 70 percent from domestic sources when planning wind power projects.

Wind-power related subsidies. Government subsidies have also been used in China to support wind power technology research, development and demonstration (RD&D). Some of these have specifically targeted Chinese wind turbine manufacturers and promoted the use of

locally produced technology over foreign technology, which could be contested as a non-tariff barrier to trade under WTO rules (Lewis, 2007).

Surprisingly, other key wind power countries either completely refrained from challenging these Chinese policies and industrial policies, some of which were clearly questionable under WTO law, or they challenged it at a very late stage only. The US, for example, filed a request for WTO consultations on Chinese government renewable energy subsidies, only in December 2010.[3] Even though the 5.800-page petition of the United Steelworkers that spurred this move sought action against a wide range of allegedly WTO-inconsistent Chinese policies on wind and solar, advanced batteries, energy-efficient vehicles, and other goods and services, the US government only challenged China's wind power equipment subsidies (USW, 2010).[4] Both parties managed to settle the issue through bilateral consultations. The case was resolved in June 2011, after China had agreed to remove the subsidy program in question. As Lewis (2007: 5) observes, though, "such programs had likely already served their purpose by the time they were questioned by the US government."

Perhaps even more puzzling is the fact that the EU did not pursue action against China's domestic wind industry support mechanisms. Prior to 2005, European wind companies had the strongest position on the Chinese market, so they had most to lose from China's local content provisions. Moreover, when the Canadian province of Ontario established a feed-in tariff to support renewable energy in 2009, and included domestic content requirements in the law, the EU was quick to join Japan in its effort to bring this to a WTO panel. In December 2012, the WTO Dispute Settlement Panel found that Ontario's program is inconsistent with WTO rules.[5] Although both Canada and the EU have chosen to appeal to the WTO Appellate Body, this ruling appears to support the case for challenging discriminatory support measures for wind energy under international trade law.

The explanation for the restraint exercised by the EU in the Chinese case seems to be concern on the part of European wind energy companies to lose out on the attractive Chinese market. As Keith Brasher aptly observes:

> Companies like Gamesa have been so eager to enter the Chinese market that they not only bow to Beijing's dictates but have declined to complain to their own governments, even when they see China violating international trade agreements. [Although] the company's market share in China has atrophied, the country's wind turbine market has grown so big, so fast that Gamesa now sells more than twice as many turbines in China as it did when it was the market leader five years ago. [The] Chinese government bet correctly that Gamesa, as well as G.E. and other

[3] WTO, Dispute Settlement Case 419, "China – Measures Concerning Wind Power Equipment," available at: http://www.wto.org/english/tratop_e/dispu_e/cases_e/ds419_e.htm.
[4] Interestingly, it was the United Steelworkers, a labor union, and not the American wind turbine producers, who urged the US government to pursue action against China's wind power subsidies. They feared to lose jobs as American producers shifted their manufacturing to take advantage of the subsidy (Wu and Salzman, 2013).
[5] WTO, Dispute Settlement Case 426, "Canada – Measures Relating to the Feed-in Tariff Program," available at: http://www.wto.org/english/tratop_e/dispu_e/cases_e/ds426_e.htm.

multinationals, would not dare risk losing a piece of China's booming wind farm business by complaining to trade officials in their home countries.[6]

3.2. Solar PV

The number of trade frictions between the European Union and China in the area of solar panels and related equipment has grown rapidly in recent months. In early September 2012, the European Commission launched an anti-dumping investigation into imports of solar panels and some of their key components (namely, solar cells and solar wafers) originating from China.[7] Two months later, in early November, it also opened an anti-subsidy probe into the same set of products.[8] In February 2013, the European Commission launched a new anti-dumping investigation into imports of solar glass from China, emphasizing that this was "a stand-alone investigation concerning a clearly distinct product" from the solar panels cases of late 2012.[9]

The first two investigations were initiated after EU ProSun, an association of European solar equipment manufacturers, lodged a complaint with the Commission alleging that their Chinese rivals were selling their products on the European market at prices below market value, and that they received unfair government support. Most of the members of ProSun prefer to stay anonymous though it is well known that the coalition is led by SolarWorld, a German company that produces solar panels in the US and Germany.[10] The third investigation was initiated by EU ProSun Glass, a separate coalition of solar equipment manufacturers.[11]

Speculation has since grown that the EU could follow in the footsteps of the US and impose tariffs on Chinese solar panels. In March 2012, the US Commerce Department already imposed preliminary anti-subsidy tariffs of 2.9 percent to 4.73 percent. Two months later, these were complemented with preliminary anti-dumping tariffs of at least 31 percent on Chinese solar panels. In October 2012, the US imposed heavy anti-dumping and countervailing tariffs on solar panels from China ranging between 31 to 249 percent.

The European case, however, is already four or five times larger in terms of value than the American investigation, simply because the EU is a far bigger importer of Chinese solar panels and related equipment than the US. In fact, the EU accounts for as much as 80 percent of all Chinese solar equipment sales worldwide. In 2011, this import was worth 21 billion euros (or, 26.5 billion dollars), accounting for a hefty 6.5 percent of *all* EU imports of Chinese

[6] Keith Bradsher, "To Conquer Wind Power, China Writes the Rules," *New York Times*, 14 December 2010.
[7] European Commission, "EU initiates anti-dumping investigation on solar panel imports from China," MEMO/12/674, Brussels, 6 September 2012.
[8] European Commission, "EU initiates anti-subsidy investigation on solar panel imports from China," MEMO/12/844, Brussels, 8 November 2012.
[9] European Commission, "EU initiates anti-dumping investigation on solar glass from China," MEMO/13/153, Brussels, 28 February 2013.
[10] SolarWorld, along with fellow German solar company Coenergy, had already filed a similar anti-dumping complaint in August 2009 with the European Commission who opted not to pursue an investigation at that time. "Not so sunny: trade war looms in solar space," *Reuters*, 7 September 2009; Lewis (2012).
[11] European Commission, "EU initiates anti-dumping investigation on solar glass from China," MEMO/13/153, Brussels, 28 February 2013.

goods.[12] Given that the case amounts to history's biggest anti-dumping investigation by value, even when adjusted for inflation, it should come as no surprise that the economic stakes are very high and that the case stirs heavy political reactions.

In what was clearly a retaliative move, the Chinese government announced in early November 2012 that it had opened anti-dumping and anti-subsidy probes on solar-grade polysilicon, an important component of solar cells, imported from the EU. The investigations were opened after complaints by Chinese polysilicon producers who contended that EU companies had received German government subsidies and favorable loans from the European Investment Bank.[13] Earlier, in July 2012, the Chinese Ministry of Commerce had already launched similar investigations against US and South Korean exports of polysilicon to China. That move was also interpreted by many observers as a retaliation for America's anti-dumping and anti-subsidy investigations and preliminary tariffs against Chinese PV solar exporters.

Adding to the growing pile of trade disputes over renewable energy, on 5 November 2012, China filed a complaint with the World Trade Organization (WTO) against the EU, and specifically (but not only) against Greece and Italy, alleging that certain feed-in tariff programs are inconsistent with WTO rules, because they include local content requirements, violating the WTO's national treatment principle. It is alleged that the European schemes are inconsistent with WTO rules because the payment of the feed-in tariff to renewable energy producers is linked to requirements that they use locally produced components. China's complaint resembles the WTO case that the EU itself brought against a similar scheme in the Canadian province of Ontario, so far quite successfully.[14]

China's solar industry has over the past few decades rapidly emerged as the most dynamic and fastest-growing in the world. It is largely export-oriented and has built up huge overcapacity. Even though the Chinese solar sector derives considerable advantages from low labor and raw material costs, it has increasingly suffered from massive losses due to the dramatically declining prices and waning demand. Yet, unlike their ailing European counterparts, which are faced with drastic consolidation, many Chinese solar companies have been artificially kept into business thanks to large state-led bailouts.[15] Competition in the solar sector is fierce, and profits have dropped sharply at a time when the green subsidies are being cut back in several EU member states. The global price of solar panels dropped by 40 percent in the period between 2006 and 2011.[16]

Judging by some of the sensational newspaper headlines, China and the EU are on a collision course regarding solar power. The escalation of mutual trade investigations, complaints and the prospect of countervailing measures is cited as evidence of the fact that the interests of

[12] Keith Bradsher, "Europe Investigates Chinese Solar Panels," *New York Times*, 6 September 2012. European Commission, MEMO/12/674.
[13] "Investigation targets EU polysilicon," *China Daily*, 2 November 2011.
[14] The WTO recently ruled that Ontario's FIT program violates international trade rules, though Ontario has already appealed the decision (cf. supra).
[15] Ehren Goossens, "China Solar Giants Likely to Get State Bailouts: Experts," *Bloomberg*, 12 November 2012.
[16] http://ictsd.org/i/trade-and-sustainable-development-agenda/149225/.

both sides are fundamentally at odds. As in the wind power case, a closer look at the story, however, reveals quite a different picture.

While big European solar-panel manufacturers, 25 of which are united in the ProSun alliance, are strongly in favor of imposing EU trade-defense instruments against China, there are also other voices. Parts of the European solar industry representing a different segment of the value chain, such as the Alliance for Affordable Solar Energy (AFASE), are firmly against such punitive tariffs, arguing that they would drive up the end-user costs of solar power, thereby making them less attractive for consumers. In the US, a similar coalition had emerged earlier, the Coalition for Affordable Solar Energy (CASE).

In April 2013, AFASE submitted a letter to the European Commission signed by more than 1.000 EU companies to warn against the potential negative impacts of any protectionist measures.[17] On its website, where it speaks out against any protectionist measures in the European solar industry, AFASE argues that the solar industry is based on a complex global supply chain:

> For example, Chinese solar companies import a significant portion of their manufacturing and testing equipment as well as individual components from European suppliers and many types of raw materials. After the panels have been produced, engineers and system integrators plan the solar systems for individual home owners or commercial clients and a network of local companies install them on the spot.[18]

In other words, this industry alliance calls to mind that the manufacturing stage is only one element in a much longer supply chain. There is a wide industry involved in the pre-production stage (i.e., mostly supply of raw materials) and there are huge economic rents to be reaped after the manufacturing stage. In fact, as AFASE argues:

> For every solar panel installed in Europe – even if produced in China – about 70 percent of the value-creation remains local. This means that the majority of jobs in the solar industry are generated in the country where the solar power plant is sold, installed, and serviced.[19]

On the Chinese side, there is a similar divide with regard to China's investigation of possible dumping of polysilicon by US, EU and South Korean companies. While several China-based producers of polysilicon – China Silicon Corporation, Dago New Energy Corporation, GCL-Poly Energy Holdings, and LDK Solar – felt that they suffered materially from the very low priced polysilicon imports, other companies (China's solar manufacturers) actually benefit from the low US and EU prices.[20]

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[17] "More than 1,000 firms demand end to EU-China solar PV trade war," *Guardian*, 9 April 2013.
[18] "AFASE advocates open markets and free trade," 13 June 2012. Available at: http://afase.org/en/media/afase-advocates-open-markets-and-free-trade.
[19] *Ibid.*
[20] Cheryl Kaften, "Trading Insults: China launches AD probes against USA and South Korea," *PV Magazine*, 23 July 2012.

4. Towards an international agreement?

4.1. Clean energy trade frictions as a global phenomenon

The emerging trade disputes between China and the EU in the areas of wind and solar energy are part of a global trend of growing clean energy trade frictions (see Table 2).

Table 2: Selected recent trade disputes in clean energy

Date	Initiator	Target	Subject	Description and outcomes
Oct. 15, 2010	US	China	Subsidies to wind turbine manufacturers	US probes subsidies to Chinese wind turbine manufacturers, consults with China. In June 2011 US announces that China has stopped its subsidies.
Aug. 11, 2011	EU	Canada	Ontario's Feed-in Tariff	WTO Panel upheld EU's complaints in December 2012. In February 2013 first Canada and then EU appealed to the Appellate Body.
Nov. 8, 2011	US	China	Solar cells imports	US opens AD & CVD investigations, set preliminary penalties in May 2012, and final AS and AD duties in December 2012.
Nov. 25, 2011	China	US	Clean energy subsidies	China opens probe into US support for clean energy. On May 24, 2012, China says renewable-energy subsidies in five US states violate free-trade rules.
Jan. 18, 2012	US	China, Vietnam	Wind turbine imports	US opens AD and CVD investigations of imports of utility scale wind towers. In December 2012, it set final AD and CVD penalties.
Mar. 13, 2012	US, Japan, EU	China	Rare earth export restrictions	EU, Japan and US request consultations with China on its rare earth export restrictions. In July 2012, a WTO panel was established.
July 20, 2012	China	US, South Korea	Solar-grade polysilicon	China launches AD & AS investigations into polysilicon made in the US and South Korea.
Sept. 6, 2012	EU	China	Solar panel imports	EU opens AD investigation into solar panels imported from China.
Nov. 2, 2012	China	EU	Solar-grade polysilicon	China opens AS & AD probe into polysilicon from EU. Investigation is merged with US/South Korea case (cf. supra).
Nov. 5, 2012	China	EU	Feed-in tariff in EU, Greece, Italy	China alleges that the FiT of certain EU member states include domestic content restrictions, and requests consultations.
Nov. 8, 2012	EU	China	Solar panel imports	EU now also opens AS probe into solar panel imports from China.
Nov. 23, 2012	India	China, Malaysia, Taiwan, US	Solar cells and module imports	India investigates dumping of solar cells and modules from named countries between Jan 1, 2011, and June 30, 2012.
Feb. 6, 2013	US	India	Solar Cells and Modules	US requests consultations with India on some domestic content requirements for solar cells and modules. Japan and Australia later join talks.
Feb. 28, 2013	EU	China	Solar glass imports	EU initiates AD probe on solar glass from China.

Source: Own compilation based on WTO website; websites of respective national ministries.
Abbreviations: AD = anti-dumping; AS = anti-subsidy; CVD = countervailing duty; FiT = feed-in tariff.

This list is but a selection of the growing trade conflicts whereby the wish to promote clean energy at home appears to increasingly collide with the rules and regulations of the international trade regime. One example of a more "classic" dispute, not depicted in the table, is the EU's row with its trade partners over the inclusion of the aviation sector in its Emission Trading System. Table 2 clearly illustrates that the clean energy race is viewed increasingly as a "zero-sum game" rather than a "positive sum game." In the US and the EU, there is growing paranoia about Chinese clean energy. Fears of China have translated into calls for "green protectionism," and new trade frictions. Anti-dumping investigations are met on the Chinese side with counter-investigations.

Especially with regard to solar energy, a series of trade disputes and retaliatory actions have arisen, creating a tit-for-tat pattern of investigations and counter-investigations. If these tensions do not abate, they risk to threaten the global trading system beyond the solar industry itself. This observation points to the need for a better international trade system to deal with issues related to climate change and clean energy. It is important to find a solution to ensure that developed and emerging powers are not locked into fierce trade wars over renewables.

4.2. The rationale and options for a negotiated solution

International cooperation is necessary to speed up the global diffusion of renewables, to level the playing field with other energy sources, and to smoothen tensions at a time of drastic restructuring of the global wind and solar energy markets. It is easy to forget that, only a few years ago, wind and solar power were installed primarily in rich countries that could afford generous subsidies. For example, in 2006, almost 85 percent of all grid-connected solar PV panels in the world were installed in just two countries: Germany and Japan. Today, the price of solar panels has plummeted and many European countries have cut their subsidies for solar. As a result, solar manufacturers are now increasingly looking toward other emerging markets to sell their product. Countries such as India, Brazil, China, South Africa and Saudi Arabia are developing policies that could turn them into the fastest-growing solar markets in the world.[21]

Another reason why it is important to engage emerging powers and high income countries into clean energy cooperation is that it is one of the few areas of climate change mitigation where developed and developing countries can find common ground. The global climate change negotiations are in complete political deadlock. The 2011 COP in Durban barely kept the international negotiation process alive, by extending Kyoto for a few more years. Durban made it clear that no post-Kyoto protocol will enter into force until 2020, so the Durban outcome does not reflect the urgency of the problem at hand. The political deadlock at the international level stands in stark contrast to the dynamic changes occurring on the ground where the clean energy race heats up. Helping to spread renewables to emerging countries could thus become one of the most important tracks in the fight against climate change.

[21] Edward Crooks, "Renewable Power: Developing Markets are a Ray of Sunshine," *Financial Times*, June 1, 2012.

So, what are possible negotiating pathways to end this obvious conflict between the international trade regime and domestic green industrial policies? One solution is to change the Subsidies and Countervailing Measures (SCM) Agreement, which contains the WTO's rules pertaining to subsidies. According to the SCM, domestic subsidies are permissible as long as they do not negatively harm the trade interests of other countries. The agreement contained a "safe harbor" clause which exempted certain environmental subsidies from being challenged, either unilaterally through trade remedies or multilaterally through WTO litigation. However, this environmental safe harbor expired in 2000 and has not been renewed. Some people therefore propose to renew the exemption of subsidies that serve environmental purposes by fostering the shift toward clean production alternatives (Wu and Salzman 2013).

Another route that is contemplated is the negotiation of a sector-specific agreement aimed at the reduction of tariff rates on environmental goods and possibly also addressing services and non-tariff barriers. The WTO permits the negotiation of stand-alone, sector-specific treaties to which countries can opt-in. An example often cited as a model is the Information Technology Agreement (ITA) which lowered tariffs on a series of information technology goods such as electronics and semiconductors. The idea is to negotiate a similar treaty for environmental goods, dubbed a Clean Technology Agreement (Wu and Salzman 2013),[22] an Environmental Goods and Services Agreement (EGSA), or a Sustainable Energy Trade Agreement (SETA). Within the WTO, there currently are negotiations under the Doha round to establish an EGSA. These talks were initiated by the US and the EU "to eliminate tariff and non-tariff barriers to environmental technologies and services."[23] The initial proposal aimed to eliminate tariffs entirely by 2013 for 43 climate-friendly technologies identified by the World Bank (2007). However, little headway has been made so far.

5. Conclusions

This paper was concerned with analyzing EU-China trade relations with regard to wind energy and solar PV. Given the fact that the analysis presented here is only a very rough, first cut at the issue, any conclusion drawn from it is necessarily preliminary. With this disclaimer in mind, several lessons nevertheless emerge.

First, China's ascent as a powerhouse in the global wind and solar industries has been nothing short of astonishing. This dramatic shift was helped in large part by support mechanisms that conflict with international trade rules. However, western governments have long tolerated these subsidies as their domestic industries did not complain about these practices (e.g.,

[22] See also: Matthew J. Slaughter, "How to Avoid a Wind and Solar Trade War," *Wall Street Journal*, March 13, 2012.

[23] Office of the United States Trade Representative, "USTR Schwab to Announce New Climate Initiatives for WTO, Including a New Environmental Goods and Services Agreement (EGSA)," November 30, 2007. Available at: http://www.ustr.gov/about-us/press-office/press-releases/archives/2007/november/ustr-schwab-announce-new-climate-initiat.

Spanish wind turbine manufacturer Gamesa's attitude with regard to wind power subsidies in China or the fact that the complaint in the US was eventually filed by a worker's union, not by the industry itself).

Second, bilateral clean energy trade frictions are often more complex than the dominant image of a zero-sum game between nations would lead one to suspect. It is necessary to decompose such bilateral conflicts sector by sector and along the global value chain. Consider the US anti-dumping measures against imports of Chinese solar panels. This creates winners and losers, both on the US and on the Chinese side. China's retaliation with regard to polysilicon makes the bilateral picture even more conflicts as it creates another set of winners and losers.

Third, government subsidies are by no means solely a Chinese practice, nor are clean energy trade frictions restricted to the Sino-European relationship. Everywhere around the world, governments are trying to spur green industrial innovation, and some of these policies and support mechanisms are clashing head on with the rules and regulations of the international trade regime. The outcome in some cases (e.g., the fact that the EU and Japan are likely to win their case against Ontario's FiT) sometimes spurs others to take on similar actions. Trade measures are frequently met with retaliatory moves, adding to fears of a global clean energy trade war. Given the global nature of these trends, a global solution seems appropriate.

Fourth, two of the most innovative ideas to spur a global negotiated solution are the proposals for an "environmental safe harbor" exception in the WTO SCM agreement and for a "Clean Technology Agreement" of some sorts within the WTO. Both options are not mutually exclusive, and they have been part of the Doha negotiations for a number of years, however to little avail. More research is needed on the conditions under which such solutions can be politically feasible.

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