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ABSTRACT

This paper analyzes the impact of the increase in wind turbine demand from 2005 to 2009 on U.S. production and trade. The results of this analysis indicate that wind turbine imports rose substantially, but not as fast as U.S. production. Rising demand for wind turbines led to both a significant expansion of domestic production capacity and an increase in imports through 2008. The financial crisis and recession, however, depressed both domestic production and wind turbine imports in 2009. Overall, imports peaked as a share of the market in 2006 and U.S. production in 2008 and 2009 was significantly higher than in 2005, indicating a growing role for domestic producers. The number of foreign and domestic wind turbine original equipment manufacturers (OEMs) producing nacelles or blades at one or more locations in the United States increased from one in 2005 to nine by the end of 2009, with six more OEMs planning to begin U.S. production. Other companies increased investment in U.S. wind turbine blade and tower production. If planned manufacturing plants come online in the next few years, U.S. capacity will continue to expand.

[1] This paper represents solely the views of the author and is not meant to represent the views of the U.S. International Trade Commission or any of its commissioners. The invaluable assistance of Michael Anderson, Dennis Fravel, Peg Hausman, Deborah McNay, and Monica Reed is gratefully acknowledged. Please direct all correspondence to Andrew David, Office of Industries, U.S. International Trade Commission, 500 E Street, SW, Washington, DC 20436, telephone: 202-205-3368, fax: 202-205-2018, email: andrew.david@usitc.gov.

Introduction

The Obama administration has prioritized expansion of renewable energy as a way to reduce greenhouse gas emissions and revitalize the economy. Central to this strategy is investment in wind energy, which is already adding thousands of megawatts (MW) each year to the U.S. electric grid. Yet there is debate about the economic impact of wind energy investment and the extent to which the U.S. industry will benefit from the growth in wind turbine installations. This paper thus analyzes the impact of the increase in wind turbine demand from 2005 to 2009 on U.S. production and trade.

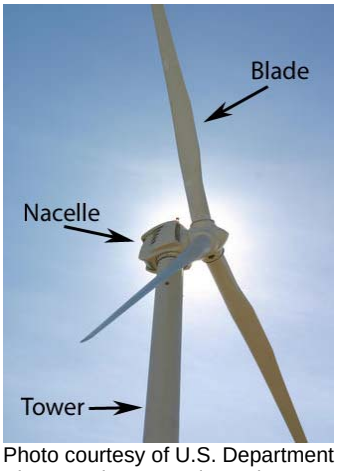
The results of this analysis indicate that U.S. wind turbine imports rose substantially, but not as fast as domestic production.[1] Rising demand for wind turbines led to both a significant expansion of domestic production capacity and an increase in imports through 2008. The financial crisis and recession, however, depressed both domestic production and wind turbine imports in 2009. Overall, imports peaked as a share of the market in 2006 and U.S. production in 2008 and 2009 was significantly higher than in 2005, indicating a growing role for domestic producers. If planned U.S. manufacturing plants come online in the next few years, U.S. production capacity will continue to expand.

This paper focuses on the manufacturing and trade of utility-scale (>100 kilowatts) wind turbines from 2005 to 2009.[2] It analyzes import and export trends, the extent to which U.S. production is growing, U.S. production as a share of the wind turbine equipment market in the United States, and employment and wages in the industry. The primary focus of this paper is on the main components of a wind turbine: the nacelle, blades, and tower (box 1). There will also be a short discussion of the value of gearbox and generator imports.

[1] For the purposes of this paper, "domestic production" refers to wind turbine manufacturing/assembly and does not refer to wind energy generation from wind farms. The terms U.S. production and domestic production include production at all plants in the United States regardless of whether they are owned by U.S.-based or foreign-based companies.

[2] Small wind turbines are produced by different companies for a different market.

BOX 1 Wind turbine components



Blade: Most wind turbines have three blades. Blades are generally 30 to 50 meters (100 to 165 feet) long, with the most common sizes around 40 meters (130 feet).

Gearbox: Many turbines have a gearbox that increases the rotational speed of the shaft. Some turbines use direct drive generators that do not require a gearbox.

Generator: Wind turbines typically have an AC generator (housed in the nacelle) that converts the mechanical energy from the wind turbine's rotation into electrical energy.

Nacelle: The nacelle houses the main components of the wind turbine, such as the controller, gearbox, generator, and shafts.

Tower: Towers are usually tubular steel structures around 80 meters (260 feet) high. They consist of several sections of varying heights.

Photo courtesy of U.S. Department of Energy (DOE)/National Renewable Energy Lab (NREL).
Photographer: Lee Fingersh.

Sources: This text box from U.S. International Trade Commission (USITC), *Industry and Trade Summary: Wind Turbines*, June 2009, 2.

Background

Global wind turbine installations are rapidly rising, due to the maturation of wind technology and the proliferation of government policies that support the development of wind energy.[3] Global wind turbine installations increased from 11,531 megawatts (MW) per year in 2005 to 37,466 MW per year in 2009, and cumulative installed capacity reached 157,899 MW at the end of 2009.[4] The wind turbine market is diversifying geographically as well. In the 1990s and early 2000s, it generally centered on Europe, but in 2009 installations in Asia and North America exceeded installations in Europe. In 2009, installations in Asia were 14,639 MW; in North America, 10,872 MW; and in Europe, 10,526 MW.[5]

[3] Unless otherwise noted, data on annual wind turbine installations cited in this report are net capacity: megawatts of wind capacity added, minus megawatts of wind capacity from turbines that are decommissioned. However, the capacity decommissioned each year in the United States and other countries is generally small.

[4] Global Wind Energy Council (GWEC), *Global Wind 2008 Report*, April 2009, 10; GWEC, "Global Wind Power Boom Continues," February 3, 2010.

[5] GWEC, "Global Wind Power Boom Continues," February 3, 2010.

The traditionally large size of the European market is one of the key reasons for the strong position of Europe-based original equipment manufacturers[6] (OEMs) in the wind turbine manufacturing industry.[7] In 2009, at least two Europe-based OEMs were among the top three suppliers of wind turbines in eight of the ten largest markets. Vestas (based in Denmark) and Enercon (Germany) supplied wind turbines to the largest number of markets. U.S.-based General Electric Co. (GE) was the world's second largest supplier in 2009, primarily due to its strong presence in the U.S. market (an estimated 84 percent of turbines supplied by GE were to the U.S. market). However, GE and many European OEMs lost global market share in 2009 as a result of the rapid growth of the Chinese market and the dominant positioning of China-based manufacturers in that market. Two of the five leading wind turbine suppliers in 2009 were China-based OEMs and five of the fifteen leading suppliers were based in China. These OEMs have had limited sales outside of China and their increase in market share to this point is almost exclusively the result of the growth in the domestic market, which accounted for an estimated 99.8% of turbines supplied by the five largest Chinese OEMs.[8] This may change in the next few years since many Chinese OEMs are actively seeking to enter foreign markets.[9]

U.S. wind turbine installations increased every year from 2005 to 2009, and the United States was the largest wind turbine market in the world in terms of annual wind turbine installations from 2005 to 2008 (figure 1). (In 2009, China surpassed the U.S. in annual installations.) Annual U.S. wind turbine installations increased from 2,420 MW in 2005 to 9,922 MW in 2009, and total cumulative wind installations surpassed 35,000 MW by the end of 2009.[10] However, record 2009 installations mask

[6] OEMs are companies that manufacture wind turbines and sell the turbines under their name (e.g., Acciona, Clipper, GE, Siemens, and Vestas). Wind project developers generally contract with OEMs for the delivery of the entire turbine, including the nacelle, blades, and tower. Most OEMs assemble the nacelle in-house, while blades, towers, and other components are produced either by the OEM or to the OEM's specifications by a supplier. This paper focuses on wind turbine manufacturing and does not discuss companies such as AMSC that develop and license wind turbine designs but do not manufacture nacelles in-house.

[7] For more on the factors that led to the development of the wind industry in Europe, see Lewis and Wiser, "Fostering a Renewable Energy Technology Industry," November 2005.

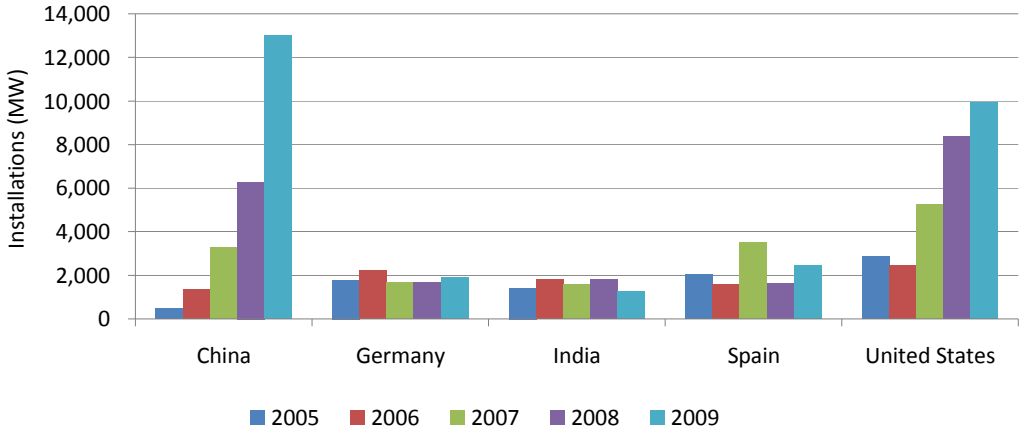
[8] Data on wind turbines supplied from BTM Consult, *International Wind Energy Development Update 2009*, March 2010, 28, 31, 33, 93, 113.

[9] Siegel, "Armed with Cash," June 2010, 80–83; *Reuters*, "Chinese Eye Domination of Wind Turbine Market," May 26, 2010; industry official, interview by Commission staff, Dallas, TX, May 24, 2010; industry official, interview by Commission staff, Dallas, TX, May 25, 2010.

[10] AWEA, *Annual Wind Industry Report: Year Ending 2008*, 2009, 4; AWEA, *Year End 2009 Market Report*, January 2010, 1–2.

significant instability in the market. The financial crisis and recession contributed to a slowdown in project development starting in the fall of 2008. As a result, there were high installations in the first quarter of 2009 as projects started in the previous year reached completion and high installations in the fourth quarter after provisions in the American Recovery and Reinvestment Act of 2009 (Stimulus Bill) were finalized.[11] There continue to be challenges in the market in 2010 and U.S. installations are projected to decrease: IHS Emerging Energy Research forecasts 2010 installations of 6,300 to 7,100 MW and BTM Consult forecasts installations of 8,000 MW.[12]

FIGURE 1 Annual wind turbine installations 2005–09, top five countries in 2009 installations



Source: Global Wind Energy Council (GWEC), *Global Wind 2008 Report*, April 2009; GWEC, "Global Wind Power Boom Continues," February 3, 2010.

Expanding Nacelle, Blade, and Tower Manufacturing in the United States

The growth in wind turbine installations and a period of stability in government policy led to significant investment in U.S. manufacturing by both U.S. and foreign companies from 2005 to 2008, along with a rapid increase in domestic production. In 2009, however, there were fewer announced investments in new manufacturing facilities. Furthermore, while production in 2009 across the key

[11] In 2009 first-quarter installations were 3,006 MW, second-quarter installations were 1,218 MW, third-quarter installations were 1,656 MW, and fourth-quarter installations were 4,041 MW. AWEA, *Year End 2009 Market Report*, 5, 9, 11, 13. For a general discussion of factors affecting wind turbine demand, see U.S. International Trade Commission (USITC), *Industry and Trade Summary: Wind Turbines*, June 2009, 25–30. For an overview of renewable energy provisions in the Stimulus Bill, see American Council on Renewable Energy, "Overview, Renewable Energy Provisions," n.d. For more on the impact of the Stimulus Bill, the U.S. market, and policy drivers in 2010, see, for example, Hall, "A Double Edged Sword: Examining Section 1603," February 2010, 18–22; Kaplan, "U.S. Wind Growth Flat," 2009; Magee, "American Reinvestment and Recovery Act," 2009; Sala de Vedruna, "New Wind Capacity," 2010.

[12] BTM Consult, *International Wind Energy Development Update 2009*, 48; IHS Emerging Energy Research, "IHS Study: After Record-Breaking 2009," May 26, 2010.

segments of the value chain discussed here (nacelles, blades, and towers) was still significantly higher in 2009 than in 2005, some U.S. producers reduced their workforces and production levels to be in line with reduced market demand due to the financial crisis, a decline in wind turbine orders, and the cancellation or deferral of existing orders.

Rising U.S. Production by OEMs

OEM production capacity in the United States rapidly increased from 2005 to 2009 as companies opened new manufacturing facilities. In 2005 GE was the only OEM with production in the United States, but by 2009 there were nine OEMs producing nacelles, blades, and/or towers in the United States, with six more OEMs planning to open their first U.S. plant. However, as noted earlier, starting in the fall of 2008 OEMs in the U.S. market were significantly affected by the financial crisis and the recession. The downturn's impact varied by manufacturer, but in general it affected OEMs in the following ways:

- Starting in the fall of 2008, most OEMs suffered from a lack of new U.S. orders due to the inability of project developers to find financing for wind projects.[13]
- Some (but not all) OEMs had significant wind turbine orders cancelled or deferred.[14]
- The timing of 2009 installations was unusual, with many installations in the first quarter, as projects far along in the construction process moved forward, and many in the fourth quarter as well, after rules for the Stimulus Bill's provisions were finalized. Installations in the second and third quarters were much fewer.[15]
- Some companies increased production in expectation of higher and/or more stable demand in 2009 and were left with excess production capacity and inventory, including turbines that were produced for cancelled or deferred orders and had to be put back onto the market.[16] On the other hand, some new entrants found it easier to build their supply chain for components due to less tightness in the overall supply chain.[17]
- Some companies had more installations in 2009 than in 2008, but had less production or fewer shipments in 2009, as some of the turbines installed in 2009 were likely shipped in 2008. For example, U.S. installations of GE wind turbines increased from 2,438 wind turbines (3,657 MW) in 2008 to 2,663 wind turbines (3,995 MW) in 2009 (a 9 percent growth rate).[18] However, GE's global deliveries

[13] From November 2009 to March 2010, there were only three publicly announced wind turbine orders. Magee, "American Reinvestment and Recovery Act," 2009.

[14] Clipper Windpower, "Operational and Trading Update," 2010; Norfleet, "Acciona Expects to Rebound Soon after Layoffs," 2009; Vestas, *Annual Report 2009*, n.d., 22.

[15] AWEA, *Year End 2009 Market Report*, 5, 9, 11, 13; Hall, "A Double Edged Sword: Examining Section 1603," 2010, 18–22; Sala de Vedruna, "New Wind Capacity," 2010.

[16] Industry official, interview by Commission staff, Washington, DC, February 24, 2010; Vestas, *Annual Report 2009*, 18; Lillian, "European Turbine Manufacturers Hot for U.S.," 21.

[17] Lillian, 20.

[18] AWEA, *Annual Wind Industry Report: Year Ending 2008*, 10; Belyeu, "Status of the U.S. Wind Power Market," May 25, 2010.

of wind turbines, which are likely closely linked to trends in the U.S. market, decreased from 3,240 turbines in 2008 to 2,633 turbines in 2009 (a 19 percent drop).[19] U.S. installations of Clipper wind turbines increased from 2008 to 2009, but U.S. production decreased from 722 MW to 260 MW.[20] Vestas wind turbine installations in the United States increased from 1,120 MW in 2008 to 1,488 MW in 2009, but wind turbine deliveries to the United States decreased from 1,345 MW to 749 MW during the same two years.[21] In total, Emerging Energy Research reported that 1.5 gigawatts (GW) of wind turbines were delivered in 2008 but installed in 2009.[22]

These market conditions led some OEMs to reduce production levels to be in line with orders, layoff workers, and/or slow the construction of new manufacturing plants.[23] The downturn also affected suppliers of key components such as blades and towers, as will be discussed below. However, far more OEMs were producing in 2009 than in 2005, production was significantly higher than in 2005, most planned manufacturing plants moved forward, and several more OEMs announced or began significant planning for new manufacturing plants in 2009 and early 2010.[24] The United States is likely to continue to be one of the largest global markets in the next few years and many OEMs want to be well positioned in this market. As a result, challenging market conditions in 2009 do not appear to have halted the trend toward increased U.S. production by OEMs.

U.S.-based OEMs, which accounted for 46 percent of U.S. wind turbine installations in 2009, have a significant domestic presence in nacelle production.[25] U.S.-based OEMs generally do not produce blades or towers in-house. GE has three U.S. plants that assemble nacelles and is the largest U.S. producer

[19] While this is global deliveries for GE, it likely reflects trends in the U.S. market, since more than 80 percent of MW supplied by GE in 2008 and 2009 were to the United States. BTM Consult, *International Wind Energy Development Update 2008*, 24, 109; BTM Consult, *International Wind Energy Development Update 2009*, 28, 113; General Electric Co., "Conference Call Transcript for Q4 2009," 2010, 16; General Electric Co., "Conference Call Transcript for Q4 2008," 2009, 12.

[20] Clipper Windpower, *2009 Annual Report*, 2010, 38; Clipper Windpower, *Annual Report and Financial Statements*, May 2009, 3; AWEA, *Annual Wind Industry Report: Year Ending 2008*, 10; Belyeu, "Status of the U.S. Wind Power Market," May 25, 2010.

[21] The Danish company Vestas produced blades in the United States in 2009, but not nacelles. Vestas, *Annual Report 2009*, 26; AWEA, *Annual Wind Industry Report: Year Ending 2008*, 10; Belyeu, "Status of the U.S. Wind Power Market," May 25, 2010.

[22] Kaplan, "U.S. Wind Growth Flat."

[23] Compiled from press releases and media reports. For example, see Norfleet, "Acciona Expects to Rebound Soon after Layoffs," 2009; Franzman, "Update: Clipper Windpower Confirms Layoff at Cedar Rapids Plant," 2009; Mellott, "Gamesa Layoffs a Surprise," 2009; *Windpower Monthly*, "Nordex Delays U.S. Factory Debut," 2009.

[24] There were nine OEMs producing nacelles, blades, and/or towers in the United States in 2009 compared with only one in 2005. The one OEM with U.S. nacelle production, GE, accounted for 1,433 MW in installations in 2005. In 2009, companies with U.S. production accounted for 5,410 MW in installations. Most of the nacelles for these installations were likely produced in the United States. Only one OEM officially put its planned manufacturing plant on hold, though there is at least one other plant whose status is uncertain. Most planned plants moved forward, although often at a slower pace than initially anticipated. Information on OEMs producing in the United States and production data are compiled from press releases, media reports, and company documents and Web sites; data on wind turbine installations by U.S. manufacturers are USITC calculations based on AWEA data.

[25] USITC calculation based on Belyeu, "Status of the U.S. Wind Power Market," May 25, 2010.

of nacelles (table 1).[26] U.S.-based Clipper Windpower began production of nacelles in 2006 and was the 13th largest global wind turbine supplier in 2009.[27] Northern Power Systems, a leading U.S.-based producer of small wind turbines, developed a utility-scale turbine that it plans to launch in 2010.[28]

Investment in the U.S. market by foreign-based OEMs significantly increased during this time period, and there are currently seven foreign OEMs with a combined ten operational plants producing blades, nacelles, and towers. Five additional foreign-based OEMs are planning to manufacture in the United States and a total of eight more plants are planned by foreign-based OEMs.[29] OEMs are localizing production in the United States in order to take advantage of the growing market, reduce transportation costs, minimize the risks associated with currency fluctuations, ease logistical challenges associated with exporting large nacelles and components, and avoid import duties.[30] Up to this point foreign-based OEMs have opened a similar number of nacelle and blade plants, with only one OEM currently operating a tower plant. However, subsequent investments are more heavily weighted toward nacelle plants, with seven nacelle plants and only two blade plants planned. The companies investing in U.S. production include both companies with limited U.S. market presence and companies with a large presence in the U.S. market, like Siemens and Vestas (which accounted for a combined 27 percent of the U.S. market in 2009).[31]

[26] GE also has plants in Germany, Norway, China, Canada and the United States and is planning to start assembling nacelles in Brazil. GE Energy Web site, http://www.gepower.com; Bloomberg New Energy Finance database (accessed March 22, 2010).

[27] BTM Consult, *International Wind Energy Development Update 2009*, 28.

[28] Other companies, such as Continental Wind Power, have announced plans to begin U.S. production of utility-scale wind turbines, but this discussion is focused on companies with prior U.S. or global production of small or large wind turbines. Pettinger, "Continental Wind Energy Targets Medium Market," 2009; Northern Power Systems Web site, http://www.northernpower.com (accessed September 15, 2009).

[29] Compiled from press releases, media reports, company documents and Web sites, AWEA publications, and White House Web site (for the American Reinvestment and Recovery Act of 2009 [ARRA] Advanced Energy Manufacturing Tax Credit [MTC] list of awardees), http://www.whitehouse.gov/the-press-office/fact-sheet-23-billion-new-clean-energy-manufacturing-tax-credits.

[30] Industry official, interview by Commission staff, October 30, 2008; industry official, telephone interview by Commission staff, December 10, 2008.

[31] Belyeu, "Status of the U.S. Wind Power Market," May 25, 2010.

TABLE 1 OEM production capabilities, current and planned, June 2010

OEM	2009 MW Installed	U.S. Production			
		Nacelles	*Blades*	*Towers*	*Components*
U.S.-based OEMs					
Clipper Windpower[a]	605	X			
General Electric Co. (GE)	3,995	3X			2X
Northern Power Systems[b]	–	P			
Non-U.S.-based OEMs (headquarters)					
A-Power (China)[c]	–	P			
Acciona Windpower (Spain)	204	X			
Alstom (France)	–	P			
DeWind (Korea)[d]	6	X			
Fuhrländer (Germany)[e]	3	P			
Gamesa (Spain)	600	X	X		
Mitsubishi Heavy Industries (Japan)	751	P			
Nordex (Germany)	63	P	P		
Nordic Windpower (United Kingdom)	–	X			
Siemens (Germany)[f]	1,162	P	X		X
Suzlon (India)	702		X		
Vestas Wind Systems (Denmark)	1,488	X	X/P	X	

X = Existing manufacturing facility

P = Planned manufacturing facility

3 = Number of manufacturing plants (if more than one)

Source: Manufacturing plant information compiled from press releases, media reports, company documents and Web sites, AWEA publications, and White House Web site (for the American Reinvestment and Recovery Act of 2009 [ARRA], Advanced Energy Manufacturing Tax Credit [MTC] list of awardees). Installation data from Belyeu, "Status of the U.S. Wind Power Market," May 25, 2010.

Notes: Only includes OEMs with prior installations of small or utility scale wind turbines. There are other U.S.-based companies (e.g., Continental Wind Power) that have announced plans to begin commercial production of utility-scale turbines for the first time. Component plants include only facilities that are separate from blade, tower, and nacelle plants. MW installed includes only utility-scale installations in the United States. Emergya Wind Technologies planned to produce nacelles and blades in Arkansas, but these plans were put on hold in late 2009.

[a]In December 2009, United Technologies Corporation agreed to purchase a 49.5 percent stake in Clipper.

[b]Nacelles for Northern Power Systems turbines will be produced by Merrill Technologies Group in Michigan.

[c]A-Power Energy Generation Systems, U.S. Renewable Energy Group, and American Nevada Co. announced plans in March 2010 to build a wind turbine manufacturing plant in southern Nevada, though a specific site has not yet been selected. While limited details are available, previous statements indicated that A-Power intended specifically to build a nacelle manufacturing plant in the United States.

[d]In August 2009, U.S.-based Composite Technology Corporation (CTC) announced that it reached an agreement to sell DeWind to Daewoo Shipbuilding & Marine Engineering Company (DSME). DeWind nacelle production is contracted to TECO Westinghouse Motor Company in Texas.

[e]While the status of Fuhrländer's plant is uncertain, Fuhrländer was an American Reinvestment and Recovery Act (ARRA) Advanced Energy Manufacturing Tax Credit (MTC) awardee and planning for the plant appears to be moving forward.

[f]Siemens subsidiary Winergy produces components in the United States.

Expanding Blade and Tower Manufacturing by Suppliers to OEMs

Blade suppliers made significant investments in wind turbine blade manufacturing from 2005 to 2008, but were negatively impacted by the downturn in wind turbine demand starting in the fall of 2008.[32] Currently, three U.S.-based suppliers (Knight and Carver, Molded Fiberglass, and TPI Composites) and Denmark-based supplier LM Glasfiber, which is the largest independent blade supplier globally, produce blades at a combined total of seven locations in the United States (table 2). Energy Composites announced plans in 2009 to open a manufacturing plant in Wisconsin, and Michigan manufacturer Energetx Composites reached a licensing agreement with Spanish company Aeroblade and was an American Reinvestment and Recovery Act (ARRA) Advanced Energy Manufacturing Tax Credit (MTC) awardee in January 2010 (box 2).[33] These plants are in addition to the four current OEM blade manufacturing plants and two facilities planned by OEMs.

BOX 2 Advanced Energy Manufacturing Tax Credit (MTC)

The American Reinvestment and Recovery Act (ARRA) or Stimulus Bill authorized up to $2.3 billion for an Advanced Energy Manufacturing Tax Credit (MTC). This is a 30 percent tax credit for investments in new or existing facilities for the production of advanced energy technologies, such as renewable energy, energy storage, energy transmission, energy conservation, and electric vehicles. MTC awardees were announced in January 2010.

Sources: DOE Web site, http://www.energy.gov/recovery/48C.htm; White House, "Fact Sheet: $2.3 Billion in New Clean Energy Manufacturing Tax Credits," January 8, 2010.

The production of blades in the United States was negatively affected by the financial crisis and recession. The downturn also likely contributed to a slowing in the pace of announced new investments in manufacturing plants. Including OEMs, only one new U.S. manufacturing plant was announced in 2009, compared to five new manufacturing plants announced in 2007 and three in 2008.[34] At least six of the eight companies producing blades in the United States, including OEMs, either laid off workers, furloughed workers, or temporarily halted production at some point after the onset of the financial crisis,

[32] Compiled from press releases, media reports, AWEA publications, and company Web sites.

[33] TPI Composites was also an awardee for a new manufacturing plant, though a site has not yet been announced. Bauer, "Blades for Industrial-size Wind Turbines," 2010; White House Web site (for the list of ARRA MTC awardees).

[34] Compiled from press releases, media reports and AWEA publications.

though some suppliers subsequently returned to prior staffing levels and some applied for the ARRA MTC in order to help increase production levels.[35]

TABLE 2 U.S. blade production facilities, current and planned, excluding OEMs, February 2010

Company	U.S. Production
U.S.-based Manufacturers	
Energetx Composites	P
Energy Composites Corp	P
Knight and Carver	2X
Molded Fiberglass	2X
TPI Composites	X
Non-U.S.-based OEMs (headquarters)	
LM Glasfiber (Denmark)	2X

X = Existing manufacturing facility
P = Planned manufacturing facility
2 = Number of manufacturing plants (if more than one)

Source: Compiled from press releases, media reports, company documents and Web sites, AWEA publications, and the White House Web site (for the ARRA MTC list of awardees).

Notes: TPI Composites received an ARRA MTC award to build a new blade manufacturing plant, though the plant is not listed here because TPI has not yet announced a production location. Energetx signed a wind turbine blade licensing agreement with Spanish company Aeroblade and was announced as an MTC awardee in January 2010.

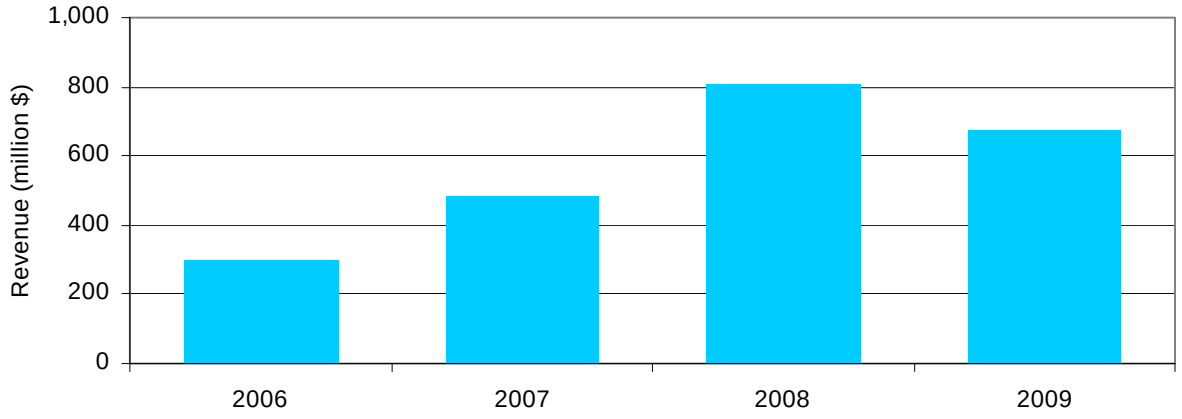
Tower manufacturing in the United States also expanded significantly during this time period, with companies announcing new manufacturing plants, entering the industry for the first time, and increasing revenue and production.[36] The number of tower plants in the United States increased from six in 2004 to 20 in 2009.[37] A number of additional investments in tower manufacturing facilities are planned, with over $70 million of the ARRA MTC funds awarded to companies to manufacture towers.[38] Most tower manufacturers in the United States are U.S.-based companies. Only one OEM, Vestas, currently has a tower manufacturing facility in the United States. This is not surprising, given that OEMs tend to produce a lower percentage of wind turbine towers in-house than blades.[39]

The same trends that affected wind turbine blade producers affected tower producers, with some companies facing reduced orders, cutting production levels, and laying off workers due to the financial

[35] Compiled from press releases, media reports, and the White House web site (for the list of ARRA MTC awardees).
[36] For list of current and planned manufacturing plants, as of June 2009, see USITC, *Industry and Trade Summary: Wind Turbines*, 2009, 13.
[37] AWEA, Blue Green Alliance, and United Steelworkers, *Winds of Change*, June 2010, 14.
[38] See the White House Web site (for the ARRA MTC list of awardees).
[39] For more on the percent of components that OEMs produce in-house, see USITC, *Industry and Trade Summary: Wind Turbines*, 2009, 10–12.

crisis and recession.[40] Revenue from sales of towers by four U.S.-based producers—with nine American, one Canadian, and one Mexican production plant among the four—increased from an estimated $302 million in 2006 to $809 million in 2008, then decreased to $679 million in 2009 (figure 2). Yet despite this 16 percent drop in revenue from 2008 to 2009, 2009 revenues were still 125 percent higher than in 2006. In addition, revenue did not decrease for all companies. Revenue declined at two companies, stayed roughly even at the third company, and increased at the fourth company.[41]

FIGURE 2 Estimated revenue from tower production of four U.S.-based publicly traded tower manufacturers, 2006–09



Source: Compiled from company statements and annual reports.

Notes: See footnote 42 in text.

Increasing U.S. and Foreign Investment

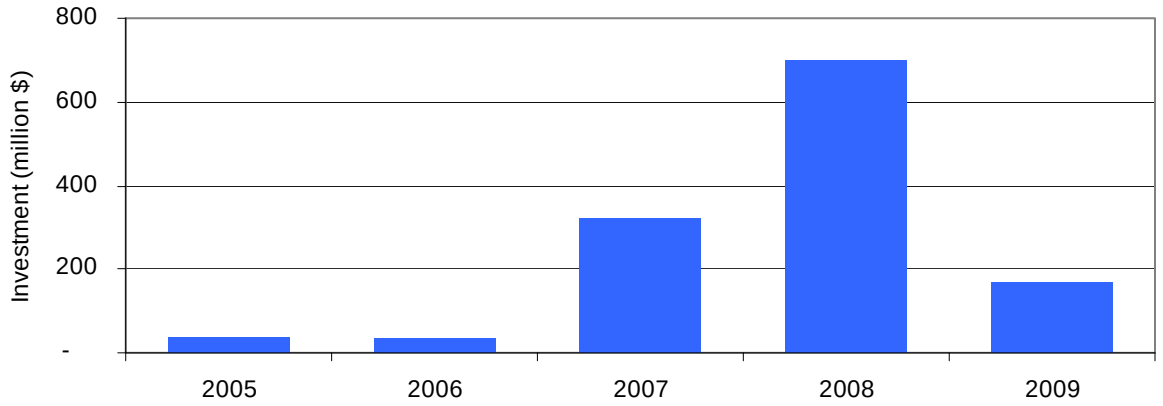
Annual announced foreign investment in new U.S. nacelle, blade, and tower manufacturing facilities rose from about $39 million in 2005 to $700 million in 2008 (an increase of almost 1,700 percent), then decreased to about $170 million in 2009 due, at least in part, to the financial crisis and recession (figure 3). Total announced foreign investment in new manufacturing plants over these five

[40] Compiled from press releases, media reports, and company documents and Web sites.

[41] Revenues of Ameron International, DMI (part of Otter Tail Corporation), Tower Tech (Broadwind), and Trinity Structural Towers (Trinity Industries). In all, these tower manufacturers have nine combined U.S. factories, one factory in Canada, and one factory in Mexico. Since separate data are not available, figures include revenue from production at the facilities in Canada and Mexico. These companies likely represent a significant share of U.S. tower production in 2009, though precise data are not available. Data are taken from company statements and annual reports, but in some cases are the result of ITC calculations based on data included in these documents. The Ameron fiscal year ends on November 30, but fiscal-year data were used to represent the calendar year.

years was about $1.3 billion.[42] Investment by domestic companies was also significant but is more difficult to quantify, since many of these investments may involve retooling or expanding existing plants rather than opening new ones. U.S. companies manufacture nacelles at four plants and blades at five plants, with at least one more nacelle manufacturing location and two more blade plants planned. In addition, U.S. companies account for most tower manufacturing in the United States.

FIGURE 3 Annual announced foreign investment in new U.S. nacelle, blade, and tower manufacturing plants, 2005–08



Source: Compiled from press releases, media reports, FDIMarkets investment database (accessed November 3, 2008), and Bloomberg New Energy Finance database (accessed March 12, 2010).

Note: See footnote 43 in text.

U.S. Import Trends

U.S. wind turbine imports substantially increased after 2005, peaking in 2008 and declining slightly in 2009. U.S. imports of wind-powered generating sets—the provision in the Harmonized Tariff Schedule of the United States (HTS) that includes nacelles and, if they are imported with the nacelle, other components (box 3)—increased from $482.5 million in 2005 to $2.5 billion in 2008, then decreased to $2.3 billion in 2009 (figure 4).[43] Denmark was the leading source of imports in 2009, accounting for

[42] Compiled from press releases, media reports, FDIMarkets investment database (accessed November 3, 2008), and Bloomberg New Energy Finance database (accessed March 12, 2010). Investment is listed under the year in which the plant was announced. In one case the amount of the manufacturing investment was not available. In this case, the amount invested by another company in a similar size manufacturing plant was used to approximate the investment amount. For joint ventures, half of the total investment is included.

[43] Wind-powered generating sets include the nacelle and, if imported with the nacelle, components such as blades and hubs. Blades, towers, and other components are included in separate provisions when they are not imported with the nacelle.

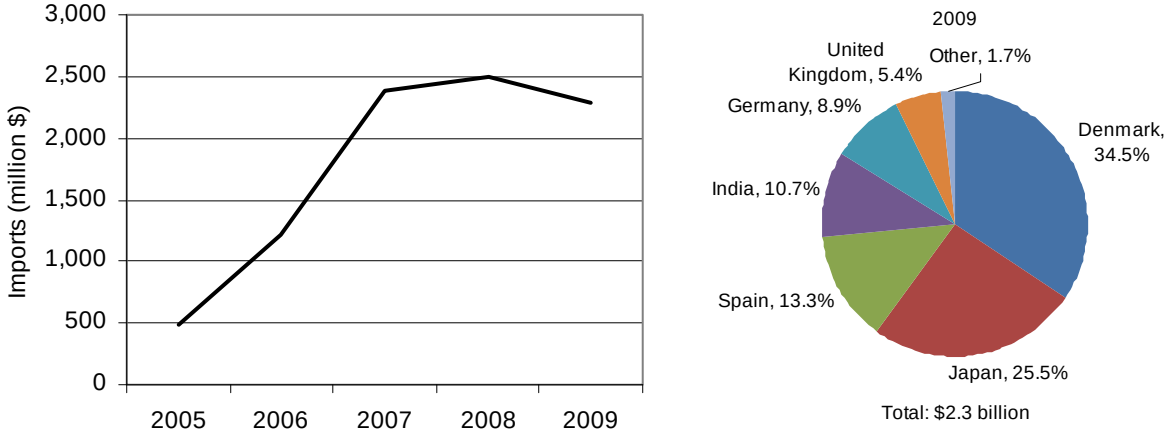
34.5 percent of imports. Japan accounted for 25.5 percent, Spain 13.3 percent, India 10.7 percent, and Germany 8.9 percent.[44] Each of these countries is home to a significant wind manufacturing industry.

BOX 3 HTS nomenclature for wind turbines

Wind turbine nacelles are currently included in 8502.31.0000, wind-powered generating sets, in the Harmonized Tariff Schedule of the United States (HTS). This provision also includes components, such as blades, hubs, and towers, when imported with the nacelle. This HTS provision includes both small and utility-scale wind turbines, but small wind turbines generally represent a low percentage of wind turbine trade. When imported separately, blades and other components, such as hubs, are included in HTS 8412.90.9080, parts of other engines and motors, and HTS 8503.00.9545, parts of generators. Towers are included in HTS 7308.20.0000, towers and lattice masts.

The term "wind-powered generating sets" will be used to refer to trade specifically in HTS 8502.31.0000, while "wind turbine" will be used to refer to installations, production, and trade in more generic terms or in reference to combined trade of generating sets, blades, and towers.

FIGURE 4 U.S. imports of wind-powered generating sets (HTS 8502.31.0000)

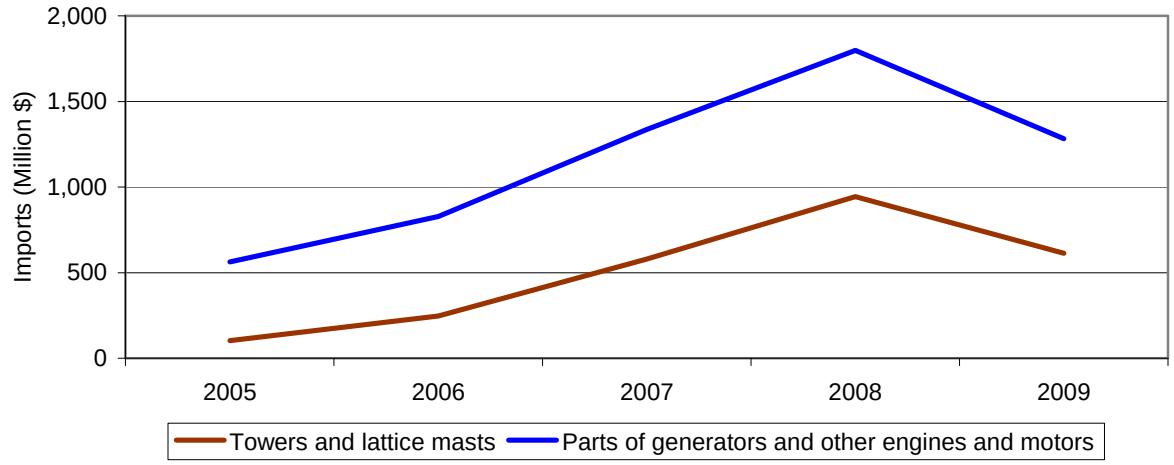


Source: Compiled from official statistics of the U.S. Department of Commerce.

Similarly, U.S. imports in the HTS provisions that include towers and blades increased from 2005 to 2008, then declined in 2009 (figure 5).[45] Imports of other parts of generators and other engines and motors, which includes wind turbine blades and other components such as hubs, increased from $562.7 million in 2005 to $1.8 billion in 2008, then declined to $1.3 billion in 2009. The top five sources of these imports in 2009 were Brazil (21.2 percent of imports), Mexico (17.5 percent), Germany (14.1 percent), India (8.6 percent), and Denmark (8.1 percent).[46]

[44] Compiled from official statistics of the U.S. Department of Commerce.
[45] Blades and other components such as hubs, when imported separately from the nacelle, are included in HTS 8412.90.9080 (parts of other engines and motors) and HTS 8503.00.9545 (parts of generators).
[46] Compiled from official statistics of the U.S. Department of Commerce.

FIGURE 5 U.S. imports of parts of generators and other engines and motors (HTS 8503.00.9545 and 8412.90.9080) and towers and lattice masts (HTS 7308.20.0000), 2005–09



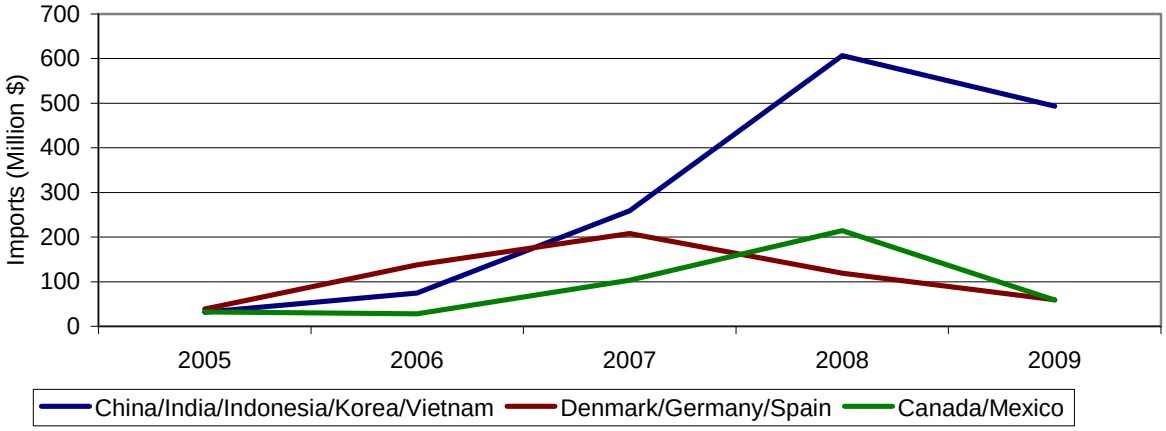
Source: Compiled from official statistics of the U.S. Department of Commerce.

Imports of towers and lattice masts, the HTS provision that includes wind turbine towers, increased from $102.7 million in 2005 to $944.4 million in 2008, then declined to $612.2 million in 2009.[47] Since 2007 there has been a shift in the sourcing of tower imports from Europe to Asia, with the share of imports from five Asian countries (China, India, Indonesia, Korea, and Vietnam) increasing from 31 percent to 81 percent of imports (figure 6). Imports from Canada and Mexico increased from 2006 to 2008, but declined in 2009 when imports from Canada fell from $152.4 million in 2008 to $15.7 million in 2009 and imports from Mexico from $62.2 million to 43.0 million.[48]

[47] Towers are included in HTS 7308.20.0000, towers and lattice masts.

[48] The reason for this decline in imports from Canada and Mexico is not clear, but it may not be indicative of a long-term trend. In the first four months of 2010, imports of towers and lattice masts from Canada totaled $31 million and from Mexico $40 million. Tower production in both countries is expanding, with Korean companies in particular investing in new plants in Canada and Mexico (though the extent to which the new plants in Canada will export to the United States is not clear). Trade data compiled from official statistics of the U.S. Department of Commerce; information on new tower plants compiled from press releases and media reports.

FIGURE 6 U.S. imports of towers and lattice masts (HTS 7308.20.0000), 2005–09, top 10 countries



Source: Compiled from official statistics of the U.S. Department of Commerce.

U.S. Production Growth Begins to Outpace Import Growth

The prior two sections indicate both rising production and rising imports of wind turbines, though both were depressed in 2009 by the financial crisis and the recession. The following section assesses the balance between imports and domestic production in the market by comparing imports to (1) the number of MW supplied to the U.S. market and (2) the value of the U.S. market. This analysis indicates that imports peaked as a share of the market in 2006 and subsequently declined to around 2005 levels. Domestic production significantly increased after 2006, capturing a greater share of the growing U.S. market (box 4).

BOX 4 Domestic production

For the purposes of this paper, the terms U.S. production and domestic production include production at all plants in the United States regardless of whether they are owned by U.S.-based or foreign-based companies.

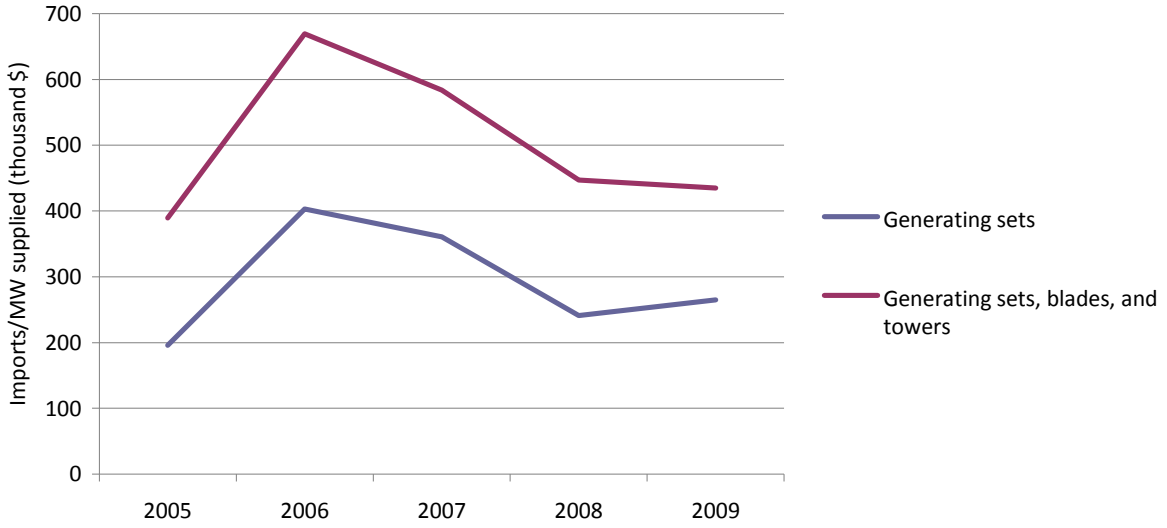
Imports per MW Supplied to the U.S. Market

U.S. imports of wind-powered generating sets and combined imports of wind-powered generating sets, blades, and towers per MW of wind turbines supplied to the U.S. market peaked in 2006 and subsequently declined significantly.[49] The estimated import value of wind-powered generating sets per

[49] BTM Consult collects data on the number of turbines supplied by manufacturers to the U.S. market. This may differ from the number of turbines installed because of a possible lag between when the turbine is shipped and when it is installed at a wind farm. Turbines supplied is the better metric for market size for this analysis since it is more closely correlated with imports. This is particularly true for 2008 and 2009 since, as noted earlier, 1.5 GW were shipped in 2008 but not installed until 2009.

MW supplied rose from $196,000 in 2005 to $403,000 in 2006, then declined to $265,000 in 2009 (figure 7).[50] Similarly, the value per MW supplied of combined imports of wind-powered generating sets, blades, and towers increased from an estimated $390,000 per MW in 2005 to $670,000 in 2006 before declining to $435,000 in 2009. Since the market expanded substantially from 2005 to 2009 and the value of imports per MW supplied (of generating sets, blades, and towers) was only slightly higher than in 2005, this indicates a significant increase in domestic production.

FIGURE 7 Imports of wind-powered generating sets, alone and in combination with estimated imports of towers and blades, per MW of wind turbines supplied, 2005–09



Sources: USITC calculations based on import data compiled from official statistics of the U.S. Department of Commerce and data on wind turbines supplied from BTM Consult.

Note: This figure does not control for changes in wind turbine prices from 2005 to 2009. Import data are based on the full value of imports of wind-powered generating sets (HTS 8502.31.0000) and towers and lattice masts (HTS 7308.20.0000) and two-thirds of the value of imports of parts of generators and other engines and motors (HTS 8503.00.9545 and 8412.90.9080).

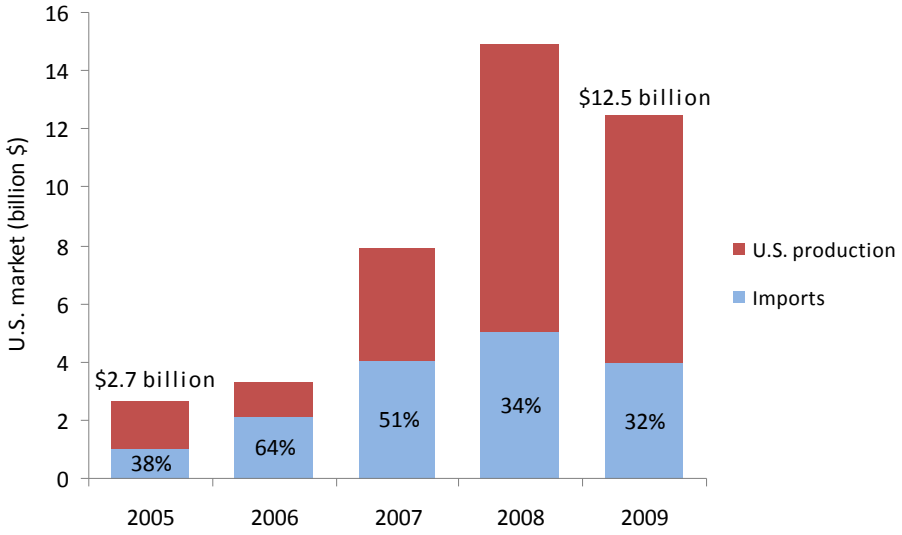
Imports as a Share of the Value of the Market

Accounting for the increase in the value of wind turbines over time by calculating imports as a share of the U.S. market (box 5), combined imports of wind-powered generating sets, blades, and towers

[50] This does not control for the change in wind turbine values over time. Calculated by dividing the estimated import value of wind-powered generating sets, blades, and towers by the number of MW supplied. The value of imports is based on the full value of imports of wind-powered generating sets (HTS 8502.31.0000) and towers and lattice masts (HTS 7308.20.0000) and two-thirds of the value of imports of parts of generators and other engines and motors (HTS 8503.00.9545 and 8412.90.9080). Import values are the customs values. Data on wind turbines supplied from BTM Consult, *International Wind Energy Development Update 2008*, 109; BTM Consult, *International Wind Energy Development Update 2009*, 113; industry official, e-mail message to Commission staff, September 18, 2009; trade data compiled from official statistics of the U.S. Department of Commerce.

increased from 38 percent of the market in 2005 to 64 percent of the market in 2006, but declined to 34 percent of the market in 2008 and 32 percent in 2009 (figure 8).[51] These numbers are based on estimates of the value of the wind turbine market and may not be an exact percentage of domestic content, but they do serve as an indicator of the trend in imports as a share of the market. In addition, these data indicate that while domestic production as a share of the market was only slightly higher in 2005 than in 2009, the value of domestic production was significantly higher, since the value of the market increased more than 350 percent.

FIGURE 8 Imports of wind-powered generating sets, towers, and blades as a share of the U.S. market, 2005–09



Sources: Import data compiled from official statistics of the U.S. Department of Commerce; value of the U.S. market based on USITC calculations using data on MW supplied from BTM Consult.

Notes: Value of the market calculated based on wind turbines supplied. Total value of wind turbines supplied includes both imports and U.S. wind turbine production. The figure does not include exports. Import data are based on the full value of imports of wind-powered generating sets (HTS 8502.31.0000) and towers and lattice masts (HTS 7308.20.0000) and two-thirds of the value of imports of parts of generators and other engines and motors (HTS 8503.00.9545 and 8412.90.9080). Import data are the landed duty-paid values. See box 5 for a fuller discussion.

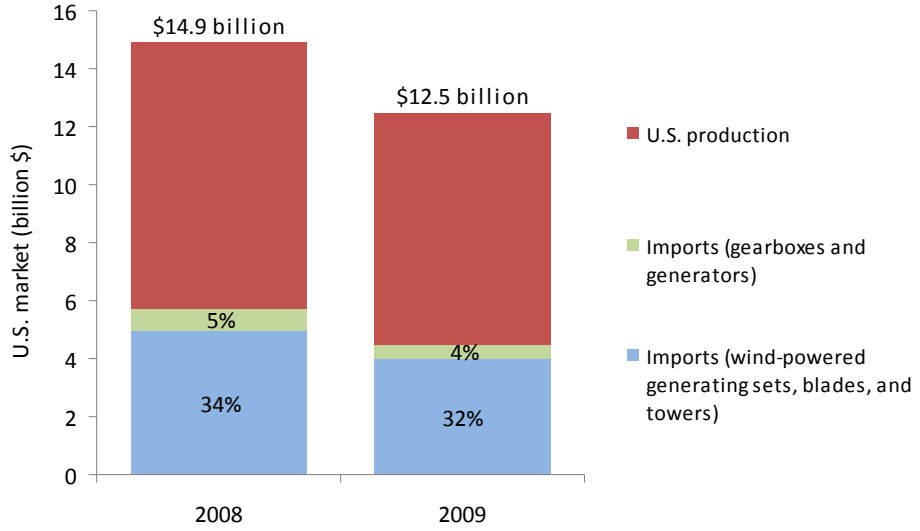
Including two key nacelle components, gearboxes and generators, indicates a slightly higher import share and a slightly lower share of U.S. production.[52] Imports of gearboxes and generators accounted for a combined 5 percent of the value of the U.S. wind turbine market in 2008 and 4 percent in

[51] Calculations based on supply data from BTM Consult, *International Wind Energy Development Update 2008*, 109; BTM Consult, *International Wind Energy Development Update 2009*, 113; industry official, e-mail message to Commission staff, September 18, 2009; trade data compiled from official statistics of the U.S. Department of Commerce. See box 5 for an explanation of the methodology.

[52] Wind turbine gearboxes and generators combined account for approximately 15 to 20 percent of the cost of a wind turbine. European Wind Energy Association, "Supply Chain: The Race to Meet Demand," January/February 2007, 33; Gamesa, "3rd Quarter Results 2008 and Outlook Beyond 2010," 2008, 33.

2009 (figure 9).[53] In total, imports of wind-powered generating sets, blades, towers, gearboxes, and generators accounted for approximately 38 percent of the market in 2008 and 36 percent in 2009.[54] Thus even with the inclusion of two main components of the nacelle in this analysis, indications are that there is significant wind turbine production in the United States.

FIGURE 9 Imports of wind-powered generating sets, towers, blades, gearboxes, and generators as a share of the U.S. market, 2008–09



Sources: Import data for wind-powered generating sets, blades, and towers compiled from official statistics of the U.S. Department of Commerce; imports of gearboxes and generators are ITC calculations; value of the U.S. market based on USITC calculations using data on MW of wind turbines supplied provided by BTM Consult.

Notes: Value of the market calculated based on wind turbines supplied. Total value of wind turbines supplied includes both imports and U.S. wind turbine production. The figure does not include exports. Import data are based on the full value of imports of wind-powered generating sets (HTS 8502.31.0000) and towers and lattice masts (HTS 7308.20.0000) and two-thirds of the value of imports of parts of generators and other engines and motors (HTS 8503.00.9545 and 8412.90.9080). Import data are the landed duty-paid values. Imports of gearboxes and generators are ITC calculations based on estimates of U.S. production and the unit value of gearboxes and generators. See box 5 for a fuller discussion.

[53] Imports of gearboxes and generators in 2008 and 2009 were calculated based on estimates of nacelles assembled in the United States using imported gearboxes in 2008 and 2009 and unit values of wind turbine gearboxes and generators. Data for earlier years were not included because of the challenges in estimating U.S. demand for gearboxes and generators. See box 5 for a fuller explanation.

[54] Numbers may not add due to rounding.

BOX 5 Method for estimating the market share of imports

This paper estimates imports of wind-powered generating sets, blades, and towers as a share of the market from 2005 to 2009. Estimating imports as a share of the market is complicated by the difficulty in estimating the size of the market and by Harmonized Tariff Schedule (HTS) provisions that are not exclusively wind products.

Market Size Calculation

For this analysis, market size is estimated by multiplying the number of MWs supplied by each OEM by the average price per MW of wind turbines for that OEM. This calculation used BTM Consult data on wind turbines supplied rather than turbines installed to ensure that the results are not skewed by cases in which turbines are not imported and installed in the same year (see appendix).

Price per MW was calculated by dividing the sales or revenues of the OEM by MW sold in a given year. Where possible, service and other types of revenue were excluded from the calculation so that revenue reflects only equipment sales. To the extent possible, these data are based on actual sales and revenues as reported by producers. In one case, revenue and sales were not reported in annual reports, so data were calculated based on the best available information (e.g., public statements, presentations on quarterly earnings, etc.). In several other cases no data were available, so the price per MW was the average price per MW of five producers with sales in the U.S. market—Clipper, Gamesa, GE, Suzlon, and Vestas. For years before Clipper began producing in the United States, average prices for the other four companies were used. In most cases, price data were for global sales, not specifically for sales in the U.S. market. For producers who are not U.S.-based, revenue was converted to U.S. dollars by averaging each year's daily exchange rates using data from the Federal Reserve.

U.S. wind turbine market size, 2005–09

		2005	2006	2007	2008	2009
U.S. Market Size	Estimated turbine price (thousand $/MW)	1,093	1,097	1,199	1,432	1,450
	U.S. market size (thousand $)	2,694,119	3,292,111	7,904,476	14,876,025	12,490,453

Source: Price calculations by USITC staff; market size calculated based on BTM Consult data on MW supplied.

Import Data and Use of HTS Provisions

The full value of the HTS provision for wind-powered generating sets was used in calculating the value of wind turbine imports since this provision is exclusive to wind. Some of the imports are small wind turbines, but this is generally a small percentage of imports.

USITC estimates of the percentage of HTS provisions that include towers and blades were used to determine the import share of wind turbines. The USITC estimates that from 2005 to 2009 towers accounted for the predominant share of imports in the provision for tower and lattice masts, so the full value of this provision was used. Blades can enter under one of two HTS provisions that are part of broad parts categories that can include components for a number of uses other than wind. Therefore, two-thirds of the value of imports in these provisions is used in calculating the market share of imports. The estimated import value of blades also includes certain other wind components such as hubs.

The import data used in this calculation are the landed duty-paid value. All other data in this paper is the customs value of imports. Landed duty-paid values are used here since it includes customs duties paid and cost, insurance, and freight and is likely the most reflective of the entire cost of an imported wind turbine.

Estimated imports of wind-powered generating sets, blades, and towers, 2005–09, thousand dollars

	2005	2006	2007	2008	2009
Imports	1,021,683	2,106,852	4,037,817	4,986,819	4,004,561

Source: Compiled from official statistics of the U.S. Department of Commerce.

Imports of Wind Turbine Gearboxes and Generators

Imports of gearboxes and generators in 2008 and 2009 were calculated based on estimates of nacelles assembled in the United States using imported gearboxes in 2008 and 2009 and unit values for wind turbine gearboxes and generators. Unit values are based on data on gearbox sales from Hansen Transmission and unit value of likely wind gearbox and generator imports from trade data. These are estimates of imports for new wind turbines and do not include replacement gearboxes and generators. Trade data were not used due to the difficulty in determining the share of the import category that is wind related.

Estimated imports of wind turbine gearboxes and generators, 2008–09, thousand dollars

	2008		2009	
	Unit Value/MW	Imports	Unit Value/MW	Imports
Gearboxes	123.2	389,000	116.2	244,000
Generators	52.6	323,000	49.6	214,000

Source: USITC calculation based on official statistics from the U.S. Department of Commerce and Hansen Transmissions, "Financial Year 2010 Results," May 17, 2010, 13.

Employment Growth and Wage Levels

The growth in the wind market has led to significant growth in wind-related employment. Employment in the wind industry, including manufacturing, construction, and service sector jobs, rapidly increased through late 2008, with total employment increasing from about 50,000 in 2007 to about 85,000 in 2008. About 20,000 of the 85,000 jobs were in manufacturing.[55] However, the financial crisis and the recession have had a negative impact on employment in the wind turbine manufacturing sector. In 2009, employment in the manufacturing sector declined by 1,500–2,000 jobs, though overall employment in the industry stayed at about 85,000 due to an increase in employment in construction and maintenance.[56]

Wages of production workers at wind industry manufacturing plants tend to be slightly above wages at similar plants. Based on 18 manufacturing plants for which information was publicly available, the average hourly wage of employees in wind industry manufacturing plants is generally between $13 and $20 (table 3). Comparing wages at these plants to national wages of production workers in the same industry, 61 percent of wind manufacturing plants pay above the national average wage for production occupations and 78 percent pay above the national median wage.[57] In addition, 61 percent pay above the average wage of all production workers, regardless of industry, in their state.[58]

[55] AWEA, *Annual Wind Industry Report: Year Ending 2008*, 17.

[56] Schmit, "Wind-energy Industry Lost Factory Jobs Despite Stimulus," January 26, 2010.

[57] Wages are reported at the 4-digit North American Industrial Classification System (NAICS) code level. The wage rate that is used is the rate for all production occupations within the NAICS code.

[58] Plant wage data compiled from press releases; media reports; Kelly, "Wind Energy Update," June 26, 2008; Mattera et al., *High Road or Low Road? Job Quality in the New Green Economy*, February 3, 2009, 15. National and state data on manufacturing wages are from Bureau of Labor Statistics (BLS), "May 2008 State Occupational Employment and Wage Estimates"; BLS, "May 2008 National Industry-Specific Occupational Employment and Wage Estimates."

TABLE 3 Estimated average hourly wages at 18 manufacturing plants compared to wages of production workers at the state and national level in 2008

	Number of wind plants in sample	Average wage range for wind plants (hourly)[a]	NAICS code[b]	National wages for production occupations, by NAICS[c]		Share of wind plants with wages above national wages, by NAICS[d]		Share of wind plants with wages above state average for production occupations[e] (percent)
				Average	Median	Above average wage (percent)	Above median wage (percent)	
Nacelle plants	6	$15 to $20	333611	$17.52	$16.49	33	67	100
Blade plants	7	$13 to $17	326199	$14.32	$13.09	57	71	29
Tower plants	5	$15 to $18	332312	$15.41	$14.47	100	100	60
All plants	18	$13 to $20				61	78	61

Sources: Plant wage data compiled from press releases; media reports; Kelly, "Wind Energy Update," June 26, 2008; and Mattera et al., *High Road or Low Road? Job Quality in the New Green Economy*, February 3, 2009, 15. National and state data on manufacturing wages are from Bureau of Labor Statistics (BLS), "May 2008 State Occupational Employment and Wage Estimates"'; BLS, "May 2008 National Industry-Specific Occupational Employment and Wage Estimates."

Note: Two of the nacelle plants also produce blades; these plants were only included in the nacelle category. The 18 plants are located in a total of nine states. Wage data are for plants for which information is publicly available.

[a]In several cases a wage range was given. In this case the median of the range was used as the average wage for that manufacturing plant. Most of the data are for new plants announced between 2006 and 2008, with most wage data from 2008. When possible, non-production workers are excluded from the sample. However, in several cases it was not clear whether production workers were included in the data.

[b]North American Industrial Classification System (NAICS) code.

[c]Wages are reported at 4-digit NAICS code level. The wage rate that is used is the rate for all production occupations within the NAICS code. 2008 data are used since this is when most of the manufacturing plants in the sample were announced.

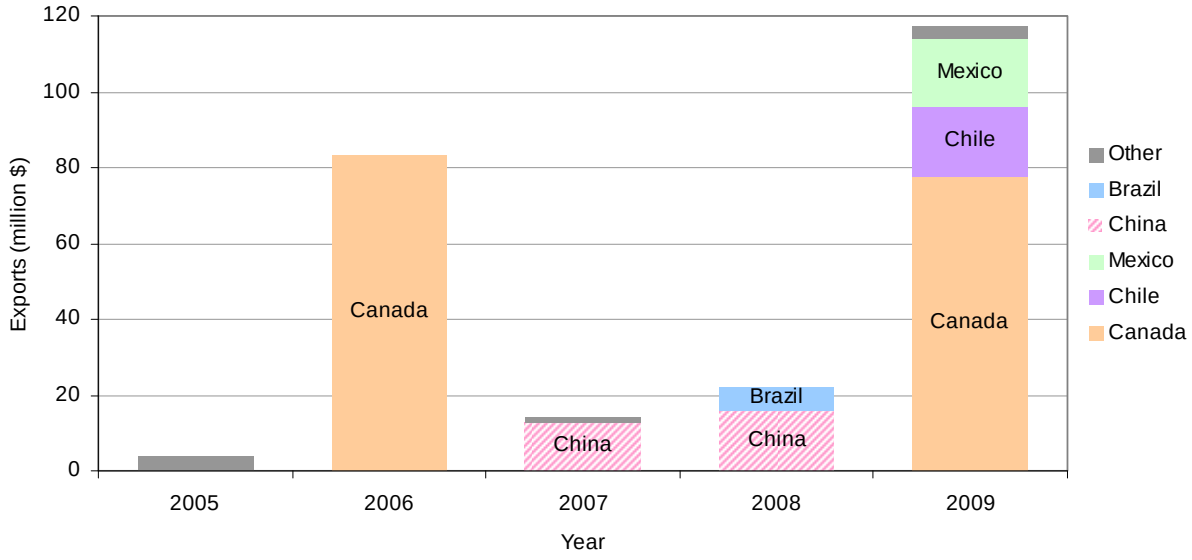
[d]Figures in the column on the left were calculated by dividing the number of wind plants where the average wage is above the national average for that NAICS code by the total number of plants. Those in the column on the right were calculated by dividing the number of wind plants where the average wage is above the national median for that NAICS code by the total number of plants.

[e]Calculated by dividing the number of wind plants where the average wage is above the average wage for all production workers in the state by the total number of plants. State-level data are not available by NAICS code.

U.S. Exports

The value of U.S. wind-powered generating set exports increased from $3.6 million in 2005 to $117.0 million in 2009 due to rising exports to Canada, Mexico, and South America (figure 10).[59] In 2009, Canada accounted for 66 percent of exports, Chile 16 percent, and Mexico 15 percent.[60] Overall, exports have been limited over the last five years due to the lack of U.S. production capacity, high demand within the U.S. market, and the fact that the largest U.S. producer, GE, has plants in many of the key foreign markets.[61]

FIGURE 10 U.S. exports of wind-powered generating sets, 2005–09



Source: Compiled from official statistics of the U.S. Department of Commerce.

Recent growth in U.S. production capacity and markets in Canada, Mexico, and South America indicate that there is the potential for further U.S. exports, but these exports might be limited by tariff and nontariff trade barriers and continued demand within the U.S. market. Installations in the Americas, excluding the United States, totaled 1,572 MW in 2009, and the market is expected to grow to 3,900 MW

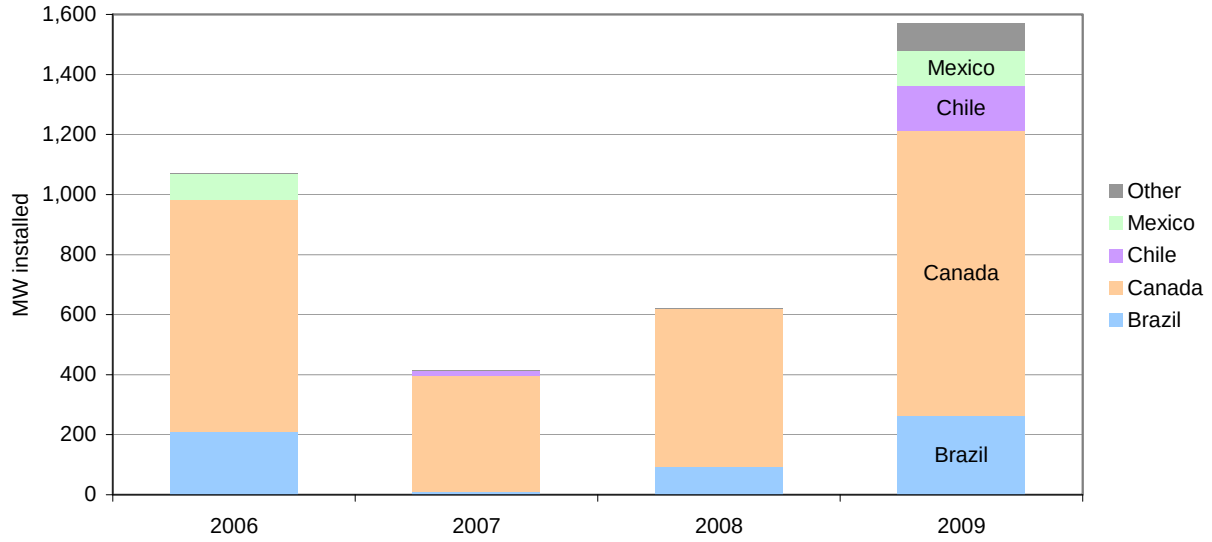
[59] Similar export data for blades and towers is not included since it is difficult to determine how much of these export provisions are wind related. There is anecdotal evidence of exports of towers (e.g., tower exports to Canada and Mexico) and blades (e.g., blade exports to Australia), but information on the overall value of trade is not available. Industry official, interview by Commission staff, Dallas, TX, May 23, 2010; Port of Longview, "Port of Longview Handles Blades for Export," August 14, 2008; Vestas, "First Train from Pueblo," May 31, 2010.

[60] Compiled from official statistics of the U.S. Department of Commerce.

[61] GE has plants in Germany, Norway, China, Canada and the United States and is planning to start assembling wind turbines in Brazil. GE Energy Web site, http://www.gepower.com; Bloomberg New Energy Finance database (accessed March 22, 2010).

by 2013 (figure 11).[62] Canada and Brazil were the third and sixth largest importers, respectively, of wind-powered generating sets.[63] Some foreign OEMs and blade manufacturers have established manufacturing plants in the United States with the intention of serving both the U.S. market and other markets in the Americas.[64] However, tariff and nontariff barriers, increasing local production in Brazil and Canada, and the resumption of the growth of the U.S. market may limit U.S. exports.[65] Finally, the projected growth of North American markets to 3,900 MW would still leave these markets much smaller than the U.S. market.

FIGURE 11 Annual wind installations in the Americas, excluding the United States, 2006–09



Source: Global Wind Energy Council (GWEC), *Global Wind 2008 Report*, April 2009; GWEC, "Global Wind Power Boom Continues," February 3, 2010.

[62] BTM Consult, *International Wind Energy Development Update 2009*, 48; GWEC, "Global Wind Power Boom Continues despite Economic Woes," 2010.

[63] Global Trade Information Service, Inc. (GTIS), World Trade Atlas database (accessed June 27, 2010).

[64] Industry official, telephone interview by Commission staff, December 10, 2008; press releases and media reports.

[65] For example, at least two Canadian provinces—Ontario and Quebec—have local-content requirements, and Brazil raised duties on wind turbines of up to 2.6 MW to 14 percent in 2009. Companies with current nacelle manufacturing plants in Canada include Pioneer Wind (as a result of its purchase of AAER assets) and GE. In January 2010 Samsung reached an agreement with the government of Ontario to invest in wind and solar projects and related solar and wind equipment manufacturing. DSME announced plans in February 2009 to build a blade and tower plant in Canada, joining several other companies already producing towers and at least one other company producing blades in Canada. Two companies, Enercon and IMPSA, currently have nacelle facilities in Brazil, and since August 2009 at least four more OEMs—Alstom, Fuhrländer, GE, and Suzlon—have announced plans to assemble nacelles in Brazil. Enercon and Tecsis currently produce blades in Brazil, and both blade and tower production are expected to expand. *Windpower Monthly*, "A Market Ready for the Next Big Step," October 2008, 5–6; Del Franco, "States and the Supply Chain: More than a Trivial Pursuit," February 2010, 27; Del Franco, "Ontario Wind Comes under Microscope," September 2009, 42–43; Lorinc, "Samsung Signs $6.6 Billion Deal to Build Wind and Solar Power in Ontario," January 21, 2010; *Recharge*, "Daewoo, Nova Scotia Sign Wind Turbine Joint Venture," March 8, 2010; Bloomberg New Energy Finance database (accessed March 22, 2010); Marmen Web site, http://www.marmen.qc.ca; Hitachi Web site, http://hitachi.sasktelwebhosting.com; Kirkegaard, Hanemann, and Weischer, "It Should Be a Breeze," December 2009, 20; Richards, House Commerce, Trade, and Consumer Protection Subcommittee written testimony, October 7, 2009, 6; Pioneer Power Solutions, "Pioneer Power Solutions Completes Asset Purchase from AAER Inc.," June 7, 2010.

Conclusion

U.S. production of wind turbines increased significantly from 2005 to 2008 and is likely to increase further as new production facilities come online in the next two years. Despite the appearance that imports, given the sharp increase from 2005 to 2008, now dominate the market, the opposite seems to be the case. The number of OEMs with at least one production plant in the United States increased from one in 2005 to nine in 2009. Another six have plants planned and there has been significant expansion in blade and tower manufacturing. The recession and the financial crisis were a challenge for the industry starting in the fall of 2008, but production remained at a much higher level than in 2005 and the construction and planning of additional manufacturing plants moved forward in 2009 and early 2010. Imports peaked at 64 percent of the market in 2006 and, though imports increased in value terms through 2008, they declined to 34 percent of the market in 2008 and 32 percent in 2009. It is difficult to predict whether U.S. imports will increase or decrease over the long term given the growing size of the U.S. market and the large number of new competitors seeking to enter the U.S. wind market. However, if planned manufacturing plants come online in the next few years, U.S. production capacity will continue to expand.

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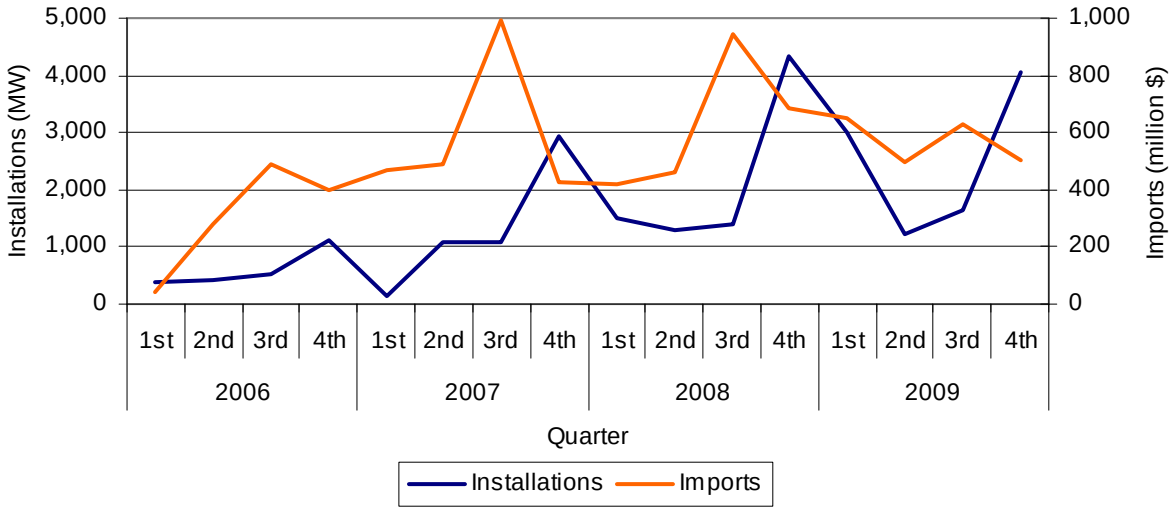
Appendix

Imports of wind-powered generating sets are generally related to installations, with imports preceding installations by a quarter (figure A.1). Imports typically peak in the third quarter and installations in the fourth quarter, though fourth-quarter 2008 imports and first-quarter 2009 installations and imports were higher than usual. The change in import and installation patterns at the end of 2008 and in early 2009 makes it difficult to compare import and installation data in these years.

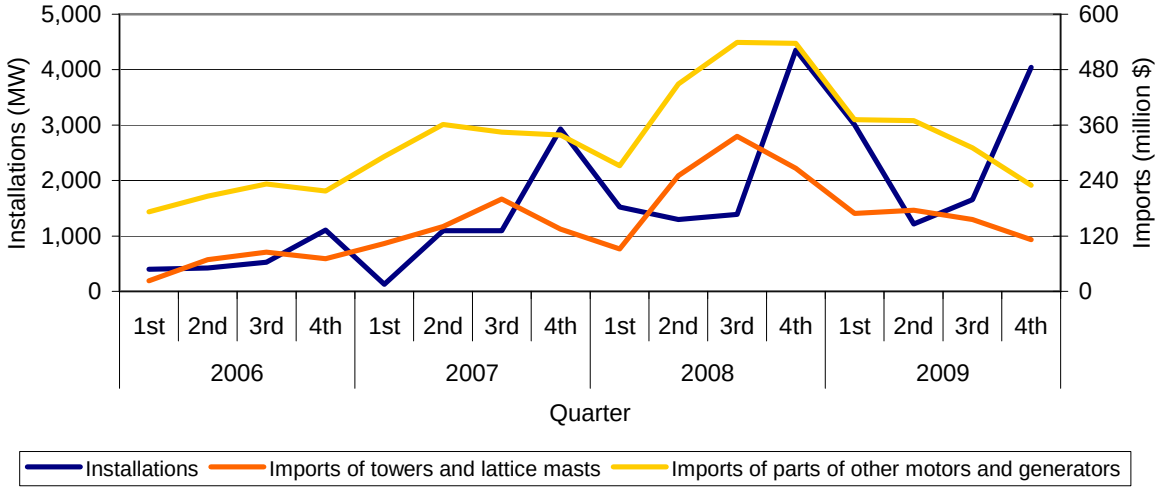
FIGURE A.1 Wind turbine installations and wind-powered generating set imports, by quarter, 2006–09



Source: Installation data from AWEA; trade data compiled from official statistics of the U.S. Department of Commerce.

Imports of towers and lattice masts tend to precede installations and peak in the third quarter (figure A.2). Imports of parts of generators and other engines and motors also generally precede installations, though this HTS provision likely has the lowest wind content. In 2009, however, imports of towers and parts of generators and other engines and motors were flat in the first two quarters and then trended downward in the third and fourth quarters.

FIGURE A.2 Wind turbine installations and imports of towers and lattice masts and parts of generators and other motors and engines, by quarter, 2006–09



Source: Installation data from AWEA; trade data compiled from official statistics of the U.S. Department of Commerce.