

I Love Wind!

Wind is good, anytime...anywhere! I like how they look and I like what they do.

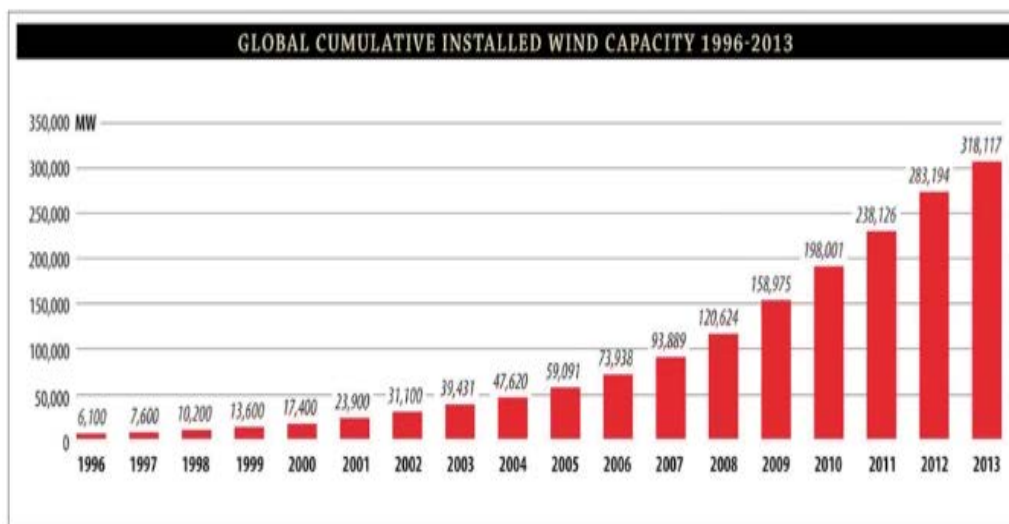
But, have you ever noticed that all the success claims relate to how much wind capacity has been installed, rather than how much power that has been generated.

To illustrate, here's some recent data on installed capacity:

Table 1. International rankings of wind power capacity

Annual Capacity (2013, MW)		Cumulative Capacity (end of 2013, MW)	
China	16,088	China	91,460
Germany	3,237	United States	61,110
India	1,987	Germany	34,468
United Kingdom	1,833	Spain	22,637
Canada	1,599	India	20,589
United States	1,087	United Kingdom	10,946
Brazil	948	Italy	8,448
Poland	894	France	8,128
Sweden	724	Canada	7,813
Romania	695	Denmark	4,747
<i>Rest of World</i>	7,045	<i>Rest of World</i>	51,031
TOTAL	36,137	TOTAL	321,377

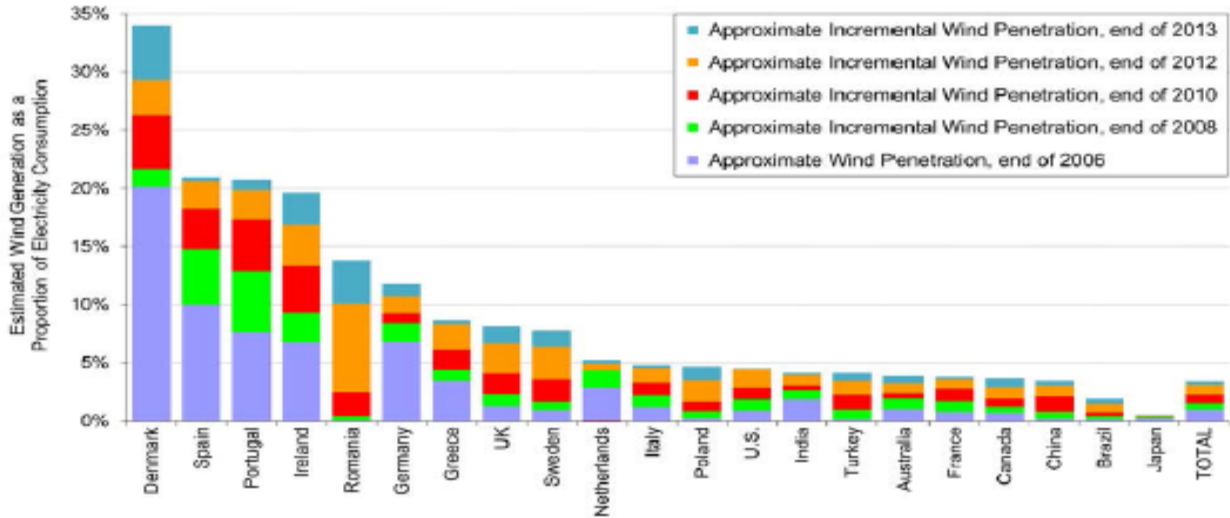
Source: Navigant; AWEA project database for U.S. capacity



Source: Global Wind Report – Annual Market Update 2014, GWEC

There is some information available on wind energy penetration into the overall electricity consumption. As can be seen from the chart shown below, the U.S., as a point of comparison indicates

that wind accounted for just under 5% of electricity consumption in 2013, an approximate 4x increase over 2006.



Source: Berkeley Lab estimates based on data from Navigant, EIA, and elsewhere

Figure 4. Approximate wind energy penetration in the countries with the greatest installed wind power capacity

In terms of Climate Change impact and specifically in terms of the CO₂ emissions profile, load factor is more interesting. Wikipedia provides some wind data by country, tabulated below.

Top windpower electricity producing countries in 2012 (TWh)

Country	Windpower Production	% of World Total	Nameplate GW	Nameplate TWh	Load Factor
United States	140.9	26.40%	60.0	526	26.8%
China	118.1	22.10%	75.3	660	17.9%
Spain	49.1	9.20%	22.8	200	24.6%
Germany	46.0	8.60%	31.3	274	16.8%
India	30.0	5.60%	18.4	161	18.6%
United Kingdom	19.6	3.70%	8.4	74	26.6%
France	14.9	2.80%	7.6	67	22.4%
Italy	13.4	2.00%	8.1	71	18.9%
Canada	11.8	2.20%	6.2	54	21.7%
Denmark	10.3	1.90%	4.2	36	28.3%
Rest of World	80.2	15.00%	40.9	358	22.4%
World Total	534.3	100.00%	283.1	2480	21.5%

The data suggests that load factors typically vary between 20% and 30%. No surprise here. Most of these wind projects tend to be driven by first cost and today these wind assets are backed-up by natural gas-fired, simple-cycle gas turbines to manage the intermittent wind resource. These types of simple cycle units are required by the EPA New Source Performance Standard to not exceed 1100 lb-CO₂/MWh.

The combined effect of 30% at zero lb-CO₂/MWh, plus 70% at 1100 lb-CO₂/MWh, would deliver 770 lb-CO₂/MWh in the best case, but some of these simple cycle units operating at part or varying load struggle to meet 1100 lb-CO₂/MWh and at a 20% load factor, that combination would yield a value closer to the combined cycle CO₂ threshold without abatement of 1000 lb-CO₂/MWh.