HEINRICH BÖLL STIFTUNG
NORTH AMERICA

Myths and Facts

The German Switch from Nuclear to Renewables

№ 263.

G.&V. St.

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Published by the Heinrich Böll Stiftung
Washington, D.C., March 2012
Second Edition: February 2014

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Editor: Arne Jungjohann, Rebecca Bertram
Design: Anna Milena Jurca, Anna Liesa Fero
Cover image: by crackdog under CC BY- 2.0 License. Original: flickr. Modified by Anna Milena Jurca.

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Myths and Facts

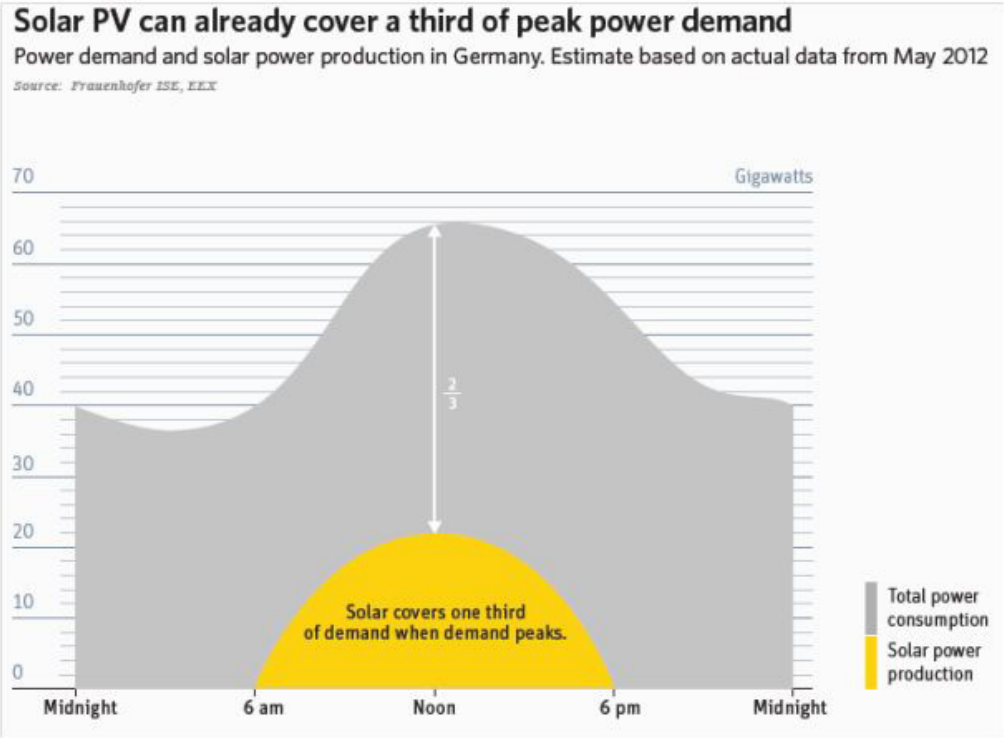
The German switch from nuclear to renewables

by Craig Morris

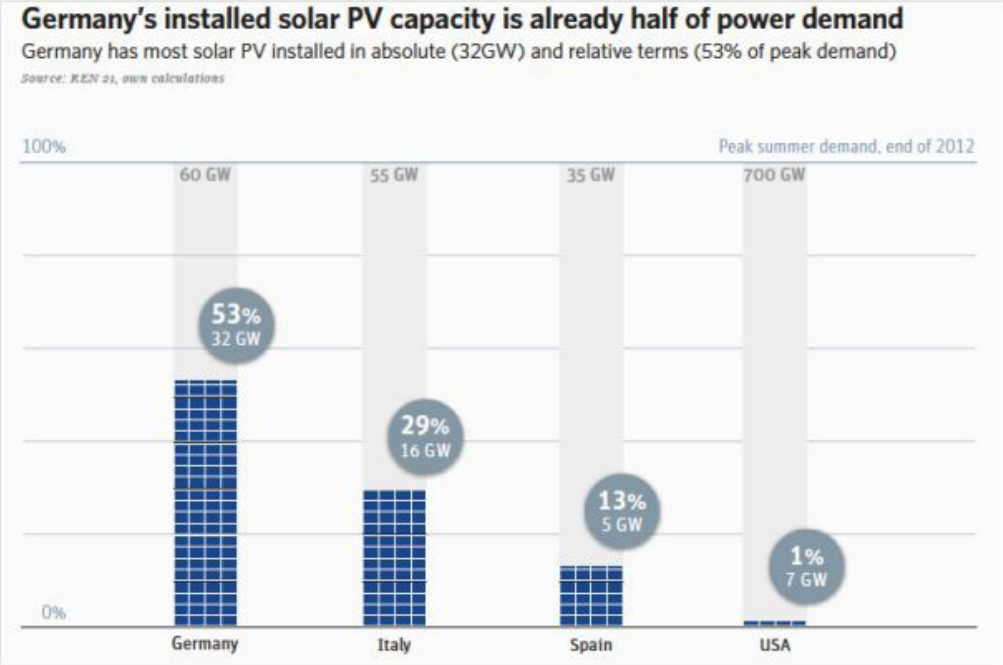
As a reaction to the nuclear disaster in Fukushima, Japan, starting on March 11, 2011, German Chancellor Angela Merkel's governing coalition shut down roughly 40 percent of the country's nuclear generating capacity in mid-March 2011 and roughly re-implemented the original nuclear phase-out set forth under Chancellor Schroeder's Social-Democrat/Green government. Nearly three years later, we can see what the temporary effects have been and what the long-term effects are likely to be.

But first, we need to understand the context. Germany has one of the largest shares of renewable power on its grid of any industrialized country. In the first half of 2011, Germany crossed the 20 percent threshold for renewable electricity in its power supply (the figure for the US is less than five percent excluding hydropower). Two years later, Germany covered 25 percent of its domestic power demand with renewables. At the end of 2013, around 35 gigawatts (GW) of photovoltaics had been installed. Solar power already regularly peaks at a third of power demand on sunny summer days (see chart below).

Germany has one of the largest shares of renewable power on its grid of any industrialized country



Compare that to the United States (PDF), which had a mere 1 percent of peak summer demand installed as solar at the end of 2012. For Americans to be at the level of German PV in terms of peak summer demand, roughly 80 times that level would need to be installed already.



Germany has been a net exporter of power for years and remained so in 2011.

Will Germany not have to simply import nuclear power from other countries?

Germany has been a net exporter of power for years and remained so in 2011. Power exports grew considerably in 2012, and in 2013 they reached a record high.

Greater imports of nuclear power from neighboring countries would not have been possible anyway. Nuclear plants generally run at full capacity, so they cannot be ramped up any further. In all likelihood, German power imports will be based more on conventional generation than on nuclear.

The main two buyers of German electricity in 2013 were the Netherlands and France. Germany's net exports made up five percent of the country's total power production, and the sustained high level of coal power production is a direct result of the growth in power exports. Around 2.5 percent of German electricity is coal power for export – and counting. Renewables have priority on the grid and would otherwise offset this coal power.

At the beginning of 2011, Germany had a dispatchable (i.e. not including solar and wind) power generating capacity of 93,100 megawatts, and roughly 8,000 of that was switched off after the Fukushima disaster in March 2011. According to the German Association of Energy and Water Industries (BDEW), Germany exported 90,000 megawatt-hours net per day on average in the six weeks leading up to the moratorium on nuclear in mid-March 2011, whereas starting on March 17, 2011,

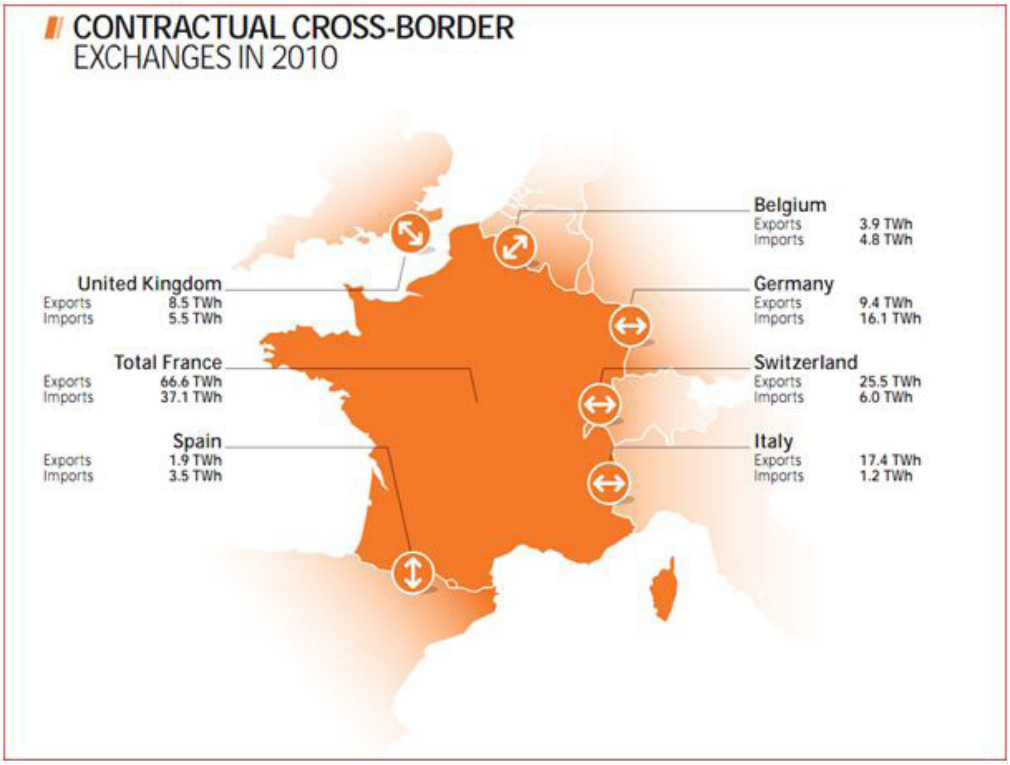
the country began importing an average of 50,000 megawatt-hours net per day. Nonetheless, Germany remained a net exporter of power in 2011.

To the east, power is imported from the Czech Republic and Poland, but not because of any electricity shortage in Germany. Rather, the German power market buys conventional electricity where it is cheapest. Countries like Poland and the Czech Republic are mainly concerned about wind and solar power surges from Germany offsetting their own production of fossil and nuclear power. There has been talk about uncontrolled power surges from renewables from Germany into Poland and the Czech Republic, but researchers have found that grid bottlenecks between Germany and its two neighbors to the East did not take place during a surge of wind or solar power.

To the west, and contrary to the numerous claims that France is a major power exporter to Germany, the opposite has been the case for several years now – as official French statistics themselves reveal (see chart 2 below). In other words, Europe's nuclear powerhouse – France – has been a net importer of power over the past few years from one of Europe's leaders in green power – Germany. This is what the situation looked like in 2010.

Europe's nuclear powerhouse – France – has been a net importer of power over the past few years from one of Europe's leaders in green power – Germany.

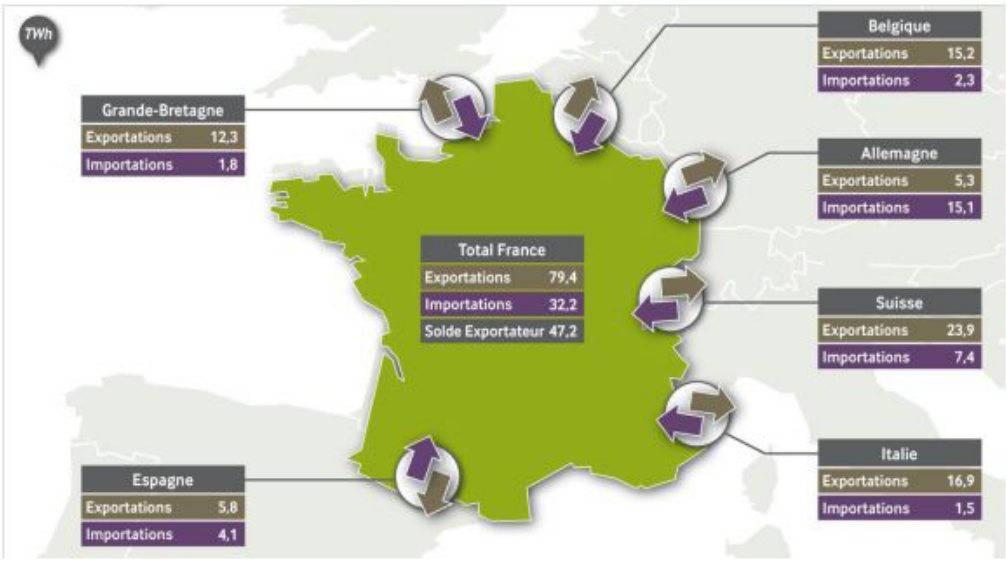
Chart 3: France is a net importer of electricity from Germany



Source: RTE Activity Report 2010

And this is what the situation looked like in 2013 (excuse the French):

Chart 4: France was an even larger net importer of electricity from Germany three years later



Source: RTE

Nuclear plants by design cannot ramp up and down quickly, making them completely incompatible with intermittent green power.

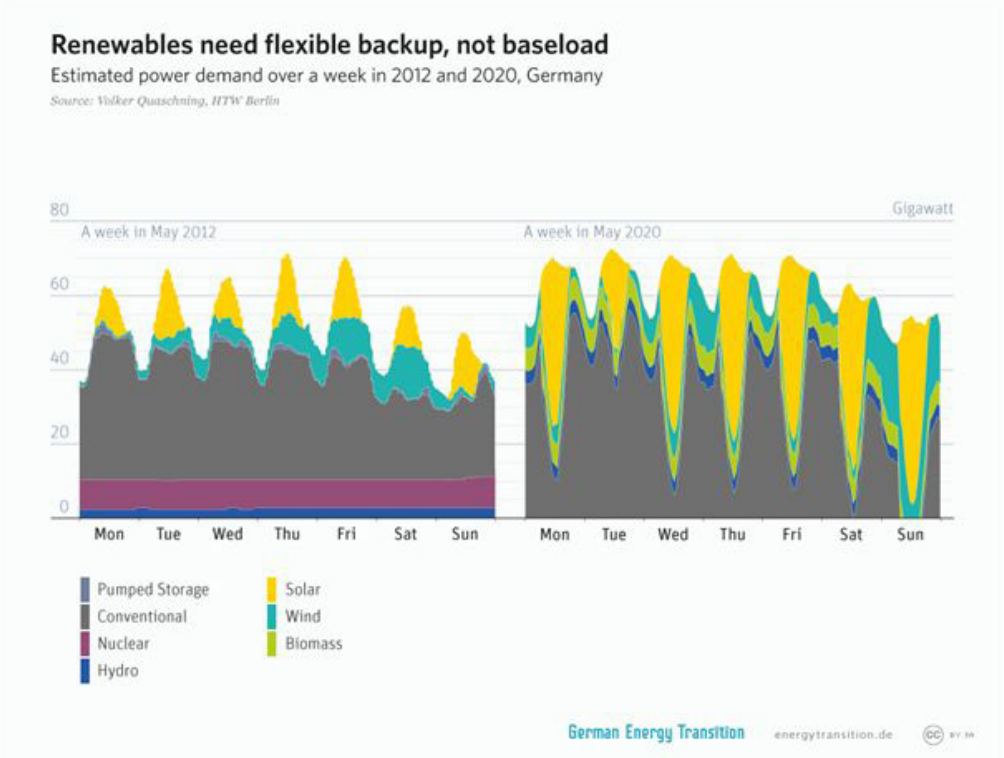
Isn't Germany planning to replace nuclear largely with natural gas, which only goes to show that renewables alone cannot replace nuclear?

Yes to the first part of that question, no to the second. But the focus is on the word "planning" here. The transition to natural gas is not taking place.

In addition to renewable power, natural gas is to be a main source of electricity to fill the gap left behind by decommissioned nuclear plants. While proponents of 100 percent renewables might cringe at the idea, the combination makes sense: nuclear plants by design cannot ramp up and down quickly, making them completely incompatible with intermittent green power. But gas turbines can be easily switched off for only hours at a time, run at partial capacity, and then quickly ramp up again.

The partial switch to natural gas would also lay the foundations for a feasible solution to the problem of storing excess power: power to gas, in which excess solar and wind power is used to make hydrogen. Germany also plans to refine more and more biogas into "biomethane," essentially biogas with properties nearly identical to natural gas. For an example, see this presentation of a hybrid plant. Stephan Lacey also discusses "virtual power plants" as one of five things that need to be done in the switch to renewables.

Chart 5: By the end of this decade, the need for baseload power will be greatly reduced in Germany because of fluctuating solar and wind



Germany actually has an action plan to reach 80 percent renewable power, and natural gas is a temporary part of that plan.

As natural gas becomes scarcer and more expensive, Germany could produce excess solar power in the summer, store it for the winter gap as gas, store excess wind power as gas for hours and days at a time, and use dispatchable cogeneration turbines running increasingly on biomethane as natural gas is phased out. No fancy gas storage tanks will be needed; Germany will just use the gas lines it already has.

In 2010, researchers from Germany's Fraunhofer estimated that the German gas network has a storage capacity equivalent to more than four months of German power consumption. German researchers have also estimated that 100 percent renewable power would only „require up to two weeks at a time to be bridged during the winter," far less than the four months already available. But that two-week gap can only be crossed if Germany gets rid of nuclear and resorts to natural gas as a bridge today.

In other words, Germany actually has an action plan to reach 80 percent renewable power, and natural gas is a temporary part of that plan. In addition, a number of studies have been published to show how Germany could go 100 percent renewable such as here, here, here (PDF in German), and here (PDF in German). And let's not forget the organization called 100% Erneuerbar – or the study called Energy Rich Japan that German and Japanese researchers did on how Japan could get all of its energy from renewables way back in 2003.

What about coal power – is Germany not going to switch to that?

Some German politicians, especially those close to the conventional energy sector, have proposed that new coal plants be built after Fukushima (Germany has tremendous brown coal reserves), but it is highly unlikely that any such plant will go up, and power firms have completely scrapped all plans for carbon capture and storage (a.k.a. "clean coal"). Central-station coal plants would also be just as inflexible – and hence incompatible with intermittent renewable power – as central nuclear plants are (see above). Given Germany's ambitious climate targets, the strong push for renewable energy, and constraints for CO2 storage, large investors such as Vattenfall don't see a future for new coal plants in Germany.

Offsetting carbon emissions is a side effect of renewable energy, not the main purpose. The main purpose is to provide us with energy.

The planning of a coal plant generally takes five or six years, so we cannot expect any coal plants as a result of the nuclear phaseout after Fukushima until around 2017. The power plants that opened after Fukushima were planned back around 2007, during the first phase of the EU's emissions trading platform, which unfortunately failed to provide adequate incentives for a shift from coal to natural gas.

Since 2011, plans for new coal plants are down. Firms are scrambling to step away from coal plant construction where possible. Indeed, the list of coal plant projects have gotten shorter by 2013; the country now has six fewer coal plants planned than it did at the beginning of 2011.

Won't switching off nuclear increase carbon emissions?

Yes, but that's not all. It will also cut German production of the most radioactive nuclear waste and reduce the risk of nuclear plant accidents during operation.

But if you are concerned about climate change and support the Kyoto protocol, you will be pleased to hear that Germany completely blew past its Kyoto target of 21 percent reduction by reaching 24.7 percent. Renewables have been indispensable in reaching that goal.

If you are worried about carbon emissions, no industrial country had a more ambitious target than Germany, lots of countries (like the US) did not sign on to the Kyoto Protocol at all, and almost all of those who did missed their targets.

Aren't renewables a relatively expensive way to lower carbon emissions?

If you want to compare apples and oranges, yes. It is often claimed, for instance, that insulation is a much cheaper way. But even if we insulate our homes better (which, incidentally, Germany also already does), we still have to decide how we are going to make electricity.

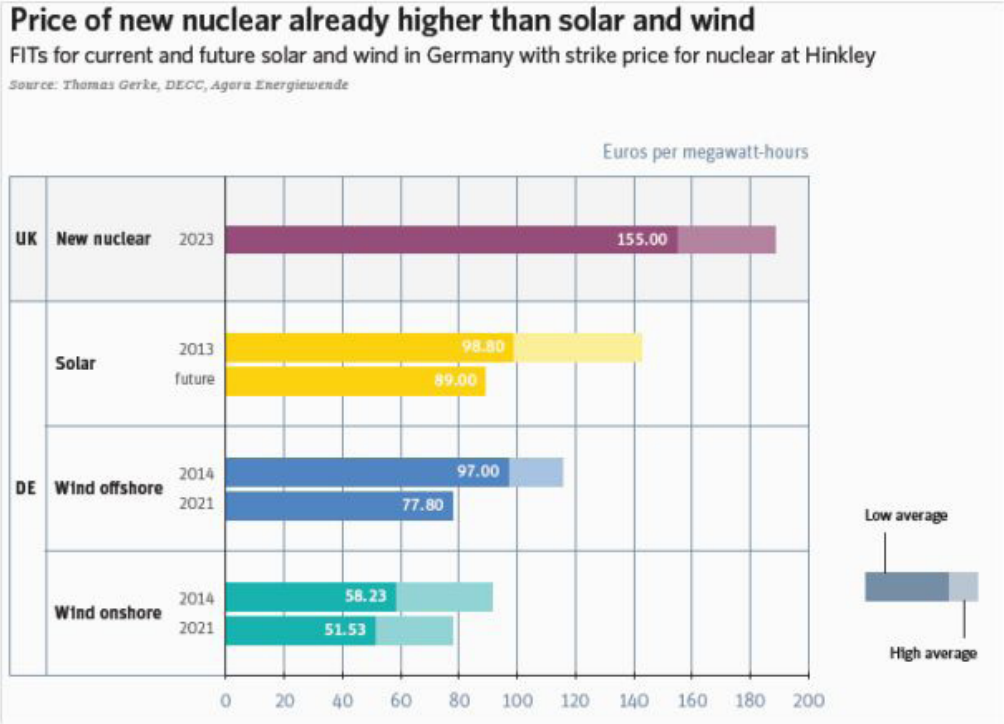
You see, offsetting carbon emissions is a side effect of renewable energy, not the main purpose. The main purpose is to provide us with energy.

Aren't renewables raising the cost of power in Germany, and isn't nuclear cheap?

A qualified yes to the first part, a qualified no to the second. Decades-old nuclear plants (built with heavy subsidies and governmental support) do indeed produce quite inexpensive power, but all estimates are that the cost of building a nuclear plant today without heavy subsidies would be prohibitive. The only plants currently under construction in the EU (in France and Finland) are both behind schedule and far over budget.

In 2013, we learned what the price of new nuclear power would be when the UK announced its „strike price" for the planned Hinkley project: around 0.19 euros per kilowatt-hour (around 24 US cents), several times more than German onshore wind currently costs and even around 50 percent more than the current feed-in tariff for solar power in Germany.

Chart 6: A comparison of the cost of new nuclear power in the UK (orange bar) and current & future feed-in tariffs for wind and solar in Germany. Based on an idea by Thomas Gerke



The only [nuclear] plants currently under construction in the EU are both behind schedule and far over budget.

In the US, Wall Street has turned its back on financing risky nuclear power. Only the massive subsidy of $8.33 billion in conditional federal loan guarantees keeps Southern Company's dream alive to build two additional reactors at Plant Vogtle in Georgia. Vogtle, however, has a history that should trouble taxpayers. The original two reactors at the Georgia site took almost 15 years to build, came in 1,200 percent over budget and resulted in the largest rate hike at the time in Georgia.

Even existing nuclear plants are coming under increasing price pressure, however. In 2013, five nuclear plants were closed in the US, mainly because of price, not security concerns.

But yes, green power has raised the retail rate in Germany. In 2014, the renewables surcharge rose by nearly 20 percent from 5.27 to 6.24 cents per kilowatt-hour – more than 20 percent of the retail rate. The rising retail rate has become a concern, but there is still overwhelming support for the energy transition, according to a survey conducted by consumer advocates.

And while the retail power rate in Germany is almost twice as great as in France, industrial power prices are close in both countries. Compare, for instance, the monthly, quarterly, and yearly power prices in the two countries on this exchange.

One reason for the discrepancy between retail and industry power prices is that around 1,800 of Germany's largest power-consuming companies are practically exempt from the surcharge to cover renewables – up from around 500 in 2005. And then there is the merit-order effect of renewables – green power is actually pushing down the cost of electricity on power exchanges by keeping relatively expensive reserve plants offline. It is estimated that solar alone reduced the price of power on the exchange by 10 percent in 2011. Wholesale prices were down for the fourth year in a row in 2013. Ironically, the greater the merit-order effect, the higher the surcharge for renewable power rises in Germany because of the way that surcharge is calculated – but now we are truly getting technical.

Since 2006, photovoltaics has become nearly 60 percent cheaper in Germany thanks to feed-in tariffs. Strangely enough, solar is now far less expensive in cloudy Germany than it is in the US.

The main thing to understand is that these costs were incurred when solar in particular was expensive. Since 2006, photovoltaics has become nearly 60 percent cheaper in Germany thanks to feed-in tariffs. Strangely enough, solar is now far less expensive in cloudy Germany than it is in the US. According to one estimate, an installed watt of PV cost less than one-half ($2.80) as much in Germany in the third quarter of 2011 as it did in the US ($5.20). Since that estimate was published, Americans in particular have been focusing on how Germany has reduced the „soft costs" of solar with a policy called feed-in tariffs.

If the US were to implement feed-in tariffs and begin ramping up renewables seriously, Americans could bring down the cost of solar to German levels and benefit from the work Germany has done in cutting the cost of renewable power. In other words, it would be even cheaper for the US to move toward solar power while reaping similar benefits as Germany: clean energy and new jobs.

Anything else we need to know about Germany's switch from nuclear to renewables?

Yes. Germany is replacing central-station plants that can only be run by large corporations with truly distributed renewable power. While Germany's Big Four utilities make up around three quarters of total power generation, they only own seven percent of green power. Roughly three quarters of renewable power investments have been made by individuals, communities, farmers, and small and midsize enterprises.

A small-town energy revolution is going on in Germany, where more than 100 rural communities are becoming 100% renewable. More people work today in Germany's renewable sector than in the country's nuclear and coal industry combined. These are not only new green jobs, but also blue-collar jobs in very traditional industrial areas, such as steel, glass and ceramics. Even worn down shipyard areas in northern Germany are revitalized thanks to the offshore wind industry. So one reason why Germans might not mind paying a little more for green power is that they largely pay that money back to their communities and themselves, not to corporations.

The US is slowly switching to renewables, but it is nearly completely shutting out the little guy, with only two percent of installed wind power capacity not owned by giant corporations. And when it comes to solar in the US, almost everything is utility-scale plants. The changes in Germany are driven by the little guy, whereas the renewable industry in the US is controlled by some of the world's biggest multinational companies. For more information, see our recent publication entitled „German energy freedom" (PDF).

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