

DOCKETED

Docket Number:	15-IEPR-11
Project Title:	Climate Change
TN #:	205386
Document Title:	Gene Nelson, Ph.D. Comments: The Key Technology for GHG Reduction is Nuclear Power Generation - Part 6
Description:	N/A
Filer:	System
Organization:	Gene Nelson, Ph.D.
Submitter Role:	Public
Submission Date:	7/17/2015 12:08:11 PM
Docketed Date:	7/17/2015

Comment Received From: Gene Nelson, Ph.D.

Submitted On: 7/17/2015

Docket Number: 15-IEPR-11

The Key Technology for GHG Reduction is Nuclear Power Generation - Part 6

Here is a 02 July 2015 Forbes article by energy policy expert Jim Conca, Ph.D. Please note the very high average cost of 18.24 cents per kWh of industrial electricity in Germany, with its upwards trend which is tied to Germany's planned phase out of nuclear power. Note also this quote from the Pacific Gas and Electric website regarding their new "Green option." <http://www.pge.com/en/about/environment/pge/greenoption/faq/index.page> [New Green Option (Community Solar) FAQ]

Why does this cost so much?

At this time, renewable energy costs more to generate. However, it's important to note that since the customer is credited with the generation costs that PG&E avoids, the customer's net participation price is expected to diminish over time.

In contrast, PG&E's cost to generate nuclear power at Diablo Canyon is about 4 cents/kWh, including decommissioning costs. The Diablo Canyon Power Plant (DCPP) annually generates about 18,000,000,000,000 Watt-hours (18,000 GWh) with high 24/7 reliability and zero emissions. PG&E can use this emissions-free power at night to "recharge" the large Helms Pumped Storage Facility. During the day, Helms can then release that emissions-free power from DCPP.

Additional submitted attachment is included below.

Forbes<http://onforb.es/1GQ4Lz7>**James Conca** Contributor*I write about nuclear, energy and the environment*

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ENERGY 7/02/2015 @ 7:00AM | 89 views

Germany's Energy Transition Breaks The Energiewende Paradox

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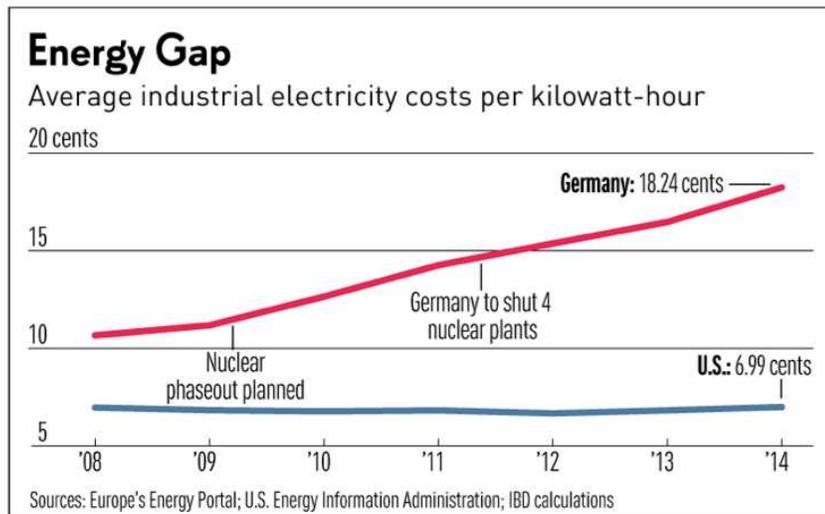
2014 saw Germany's carbon emissions fall for the first time since the big 2009-2013 emissions increase that occurred concurrently with their record renewable energy installation and nuclear phase-out, breaking the so-called [Energiewende Paradox](#).

Germany's electricity costs are still one of the highest in the world, and their electricity production is still made primarily from coal, with a significant amount of nuclear, wind, biomass, solar, natural gas and hydro, in that order. Renewables grew exponentially from 2005 to 2012, but have slowed in the last few years even though costs continue to rise (see Figure and Tables below).

Some think that Germany's energy transition has turned a successful corner and that the only reason electricity prices haven't dropped is that there isn't enough competition in the markets ([CleanTechnica](#)). Translation – *suppliers are keeping prices artificially high and ripping off ordinary consumers*.

But Germany is phasing out nuclear in the next several years, even though nuclear provides about 18% of their production and is still their largest low-carbon source by far. What they replace it with will determine what direction their energy transition will take.

Will it be replaced by renewables or coal?



Electricity costs are still one of the highest in the world. Electricity production in Germany is made primarily from coal, with a significant amount of nuclear, wind, biomass, solar, natural gas and hydro, in that order. Renewables grew exponentially from 2005 to 2012, but have slowed in the last few years. Germany is phasing out nuclear in the next several years which provides about 18% of their production, the largest low-carbon source by far. Will it be replaced by renewables or coal? Source: Craig Percy

The problem is when nuclear goes, it will go almost overnight. So the replacement capacity has to be installed before that happens. It's not easy or quick to install that much capacity, and you can't install that much capacity ahead of time and just let it lie unused.

While Germany is the [eighth largest coal producer](#) in the world, it still [imports significant amounts of coal](#) from the United States. **It's hard to see how Germany can avoid increasing its coal use dramatically after it phases out nuclear power. The U.S. coal industry is certainly hoping this happens as a way to help offset the decreasing coal use within the United States.**

So the strategy will be tricky, and that strategy will probably include a combination of continuing to increase conservation and efficiency, ramping up coal for the interim years while more renewables get installed, and increasing power imports from other countries in the European Union, particularly France.

But Germany already imports over half of its energy.

Germany's plan is to have 35% of their power come from renewables by 2030, up from the 25% today. But with 18% presently coming from nuclear, they will actually need to double renewables without ramping up fossil fuels dramatically or increasing their imports to extreme levels.

On the other hand, they could perform a delicate dance with France to achieve the image of success, by clouding the differences between consumption and generation.

Recently, France passed a law saying they will [reduce nuclear from 75% to 50%](#) by 2025 and increase their use of renewables to 40% by 2030. They can take more power from Germany during time periods when German renewables are producing excess energy, and then send nuclear power to Germany when German renewables are not producing enough.

That way France will appear to have a lower proportion of nuclear, and a higher proportion of renewables, without changing its generation significantly. And Germany gets clean nuclear power to help achieve its CO₂ reduction goals.

But this won't work for too long. Germany's plan calls for renewables to produce 80% of their power by 2050 and to lower carbon emissions by 80% relative to 1990 ([BlogActive](#)). So they really would have to replace nuclear with renewables, and eventually [cut coal itself dramatically](#), if they are to have any chance of achieving this final goal.

I hope they make it.

Germany Electricity Production 2014 (513.9 TWh)

<i>Source</i>	<i>TWh</i>	<i>%Total</i>
<i>Coal (brown + hard)</i>	237.2	46.2%
<i>Nuclear</i>	91.8	17.9%
<i>Wind</i>	51.5	10.0%
<i>Biomass</i>	48.9	9.5%
<i>Solar</i>	32.8	6.4%
<i>Natural Gas</i>	31.4	6.1%
<i>Hydroelectric</i>	20.3	4.0%
<i>Net energy imports (% of use)</i>		61.0%
<i>GDP/unit energy use (PPP \$/koe)</i>		11.0

Germany Electricity Production 2000 (572.3 TWh)

<i>Source</i>	<i>TWh</i>	<i>%Total</i>
<i>Coal (brown + hard)</i>	304.2	53.2%
<i>Nuclear</i>	169.6	29.6%
<i>Wind</i>	9.5	1.7%

<i>Biomass</i>	4.7	0.1%
<i>Solar</i>	0.1	0%
<i>Natural Gas</i>	52.5	9.2%
<i>Hydroelectric</i>	21.7	3.8%
<i>Net energy imports (% of use)</i>		59.9%
<i>GDP/unit energy use (PPP \$/koe)</i>		6.3

Germany Electricity Production 1990 (547.6 TWh)

<i>Source</i>	<i>TWh</i>	<i>%Total</i>
<i>Coal (brown + hard)</i>	321.6	58.7%
<i>Nuclear</i>	152.4	27.8%
<i>Wind</i>	0.1	0%
<i>Biomass</i>	1.4	0%
<i>Solar</i>	0.0	0%
<i>Natural Gas</i>	40.5	7.4%
<i>Hydroelectric</i>	17.4	3.2%
<i>Net energy imports (% of use)</i>		47.0%
<i>GDP/unit energy use (PPP \$/koe)</i>		4.2

Data from [Trading Economics](#)

Net energy imports (% of energy use) are estimated as energy use less production, both measured in oil equivalents. A positive value indicates that the country is a net importer. Energy use refers to use of primary energy before transformation to other end-use fuels, which is equal to indigenous production plus imports and stock changes, minus exports and fuels supplied to ships and aircraft engaged in international transport. **Net energy imports in Germany was last measured at 59.88 in 2012, according to the World Bank, but can be extrapolated to 61.0% for 2014.**

GDP per unit of energy use (PPP dollar per kg of oil equivalent) is the PPP GDP per kilogram of oil equivalent of energy use. PPP GDP is gross domestic product converted to current international dollars using purchasing power parity rates. An international dollar has the same purchasing power over GDP as a U.S. dollar has in the United States.

Follow Jim on <https://twitter.com/JimConca> and see his and Dr. Wright's book at <http://www.amazon.com/gp/product/1419675885/sr=1-10/qid=1195953013/>

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GAN comment 07 02 15

As a consequence of the low capacity factor (CF) of both wind and solar, large amounts of fossil fuels are typically utilized to maintain electrical grid stability. Your article was very informative regarding the goal of U.S. coal companies to increase their exports to Germany if the current political goal of phasing out German nuclear power is successful. The trend of declining German nuclear power generation since 1990 is probably motivated by the political clout of fossil-fuel interests.