The Oil Drum
DISCUSSIONS ABOUT ENERGY AND OUR FUTURE

The Economic and Political Consequences of the Last 10 Years of Renewable Energy Development

Posted by Jerome a Paris on September 5, 2013 - 9:22am

I've been privileged to be an editor of TOD over the past several years, and am glad to have been invited to do a final post as the site moves to an archive status.

When I started writing about energy on the blogs in 2003/2004, I was writing mostly about Russia, gas pipelines and gas geopolitics. There were so many conspiracy theories abounding on topics like the Turkmenistan-Afghanistan-Pakistan pipeline or (a bit later) Russia vs Ukraine pipeline conflicts that I felt the need to put out a different version, given that I knew the inside story on many of these issues - and that got me invited to contribute these to TOD as well. In the meantime, my job (which was, and - full disclosure - remains, to finance energy projects) slowed moved from oil&gas work to power sector transactions and, increasingly, to renewable sector deals, and I started writing about the wind business, in my mind from the perspective of a banker wanting to make sure that these projects could be paid back over periods of 15 or 20 years.

While my work is now almost exclusively focused on offshore wind in Northern Europe, I still do not consider myself a 'wind shill'... but it does give me a different perspective on the debates currently going on about energy policy in various places, and on the changes to the power sector caused (among others, by renewables) that are underpinning such debates, and I thought it would be a useful complement, together with **Big Gav**'s overview of the clean energy sector, to the other articles more traditionally focused on the oil&gas side of things.

I'll focus on Germany, where the transformation has been most advanced (and even has brought a new word to us: the *Energiewende*), and where the consequences of high renewable penetration are most visible.

A lot of rather unusual things have been happening in the Germany power sector lately, from negative prices, to utilities closing down brand new power plants and, naturally, a ferocious debate as to whether to cut support for renewable energy (as has already been done in Spain).

I've long described renewable energy producers as a price takers (i.e., they don't influence market prices in the short term and have to "take" market prices as set by other factors, unless shielded by specific regulatory regimes), but we are getting to the point, in a number of places, and in Germany in particular, where the penetration of renewable energy is such that it has a real macroeconomic impact on the prices of electricity, both at the wholesale and the retail levels, and thus on the way power markets run, and on the politics surrounding them. There's the additional factor that apparent spending on renewables is targeted by governments at a time of austerity in Europe, egged on by hardly disinterested utilities.

It is worth going through what's been happening in some detail.

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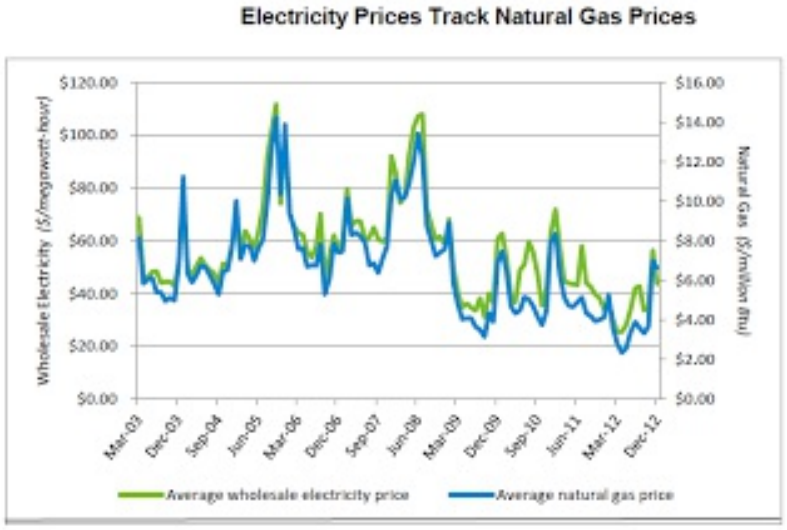
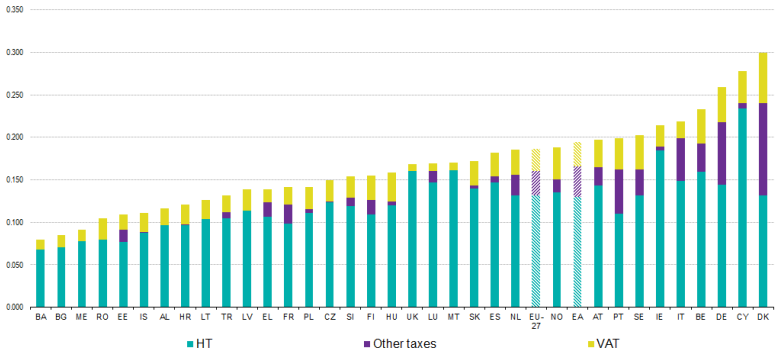
In the good old days, wholesale prices of power followed the price of natural gas, as gas-fired plants are the producer of the marginal kWh most of the time. This is still the case in the USA, and it looks like this:



Source: [neutroneconomy]

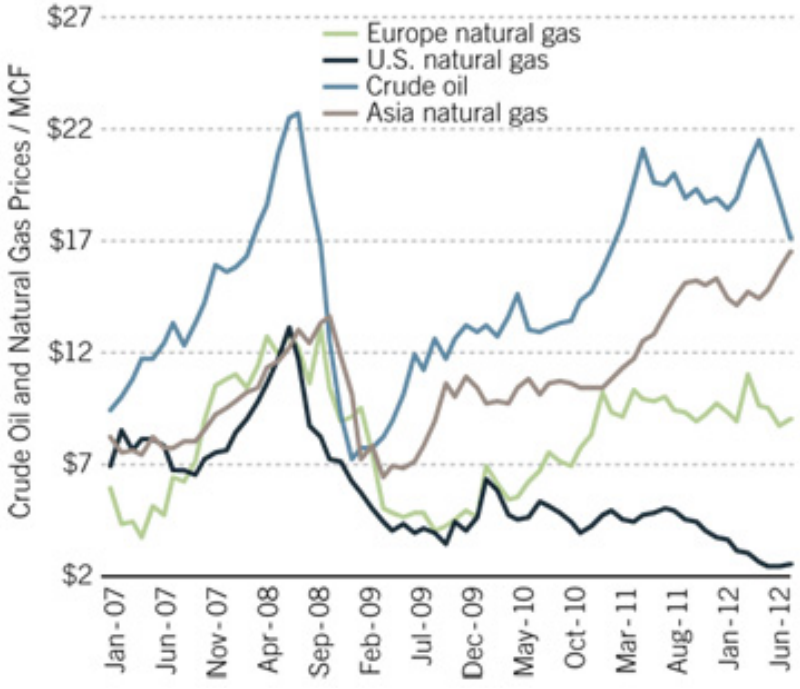
Retail prices tend to follow the average wholesale cost, plus a slice for distribution costs and taxes which can vary quite wildly from country to country:



Source: [eurostat]

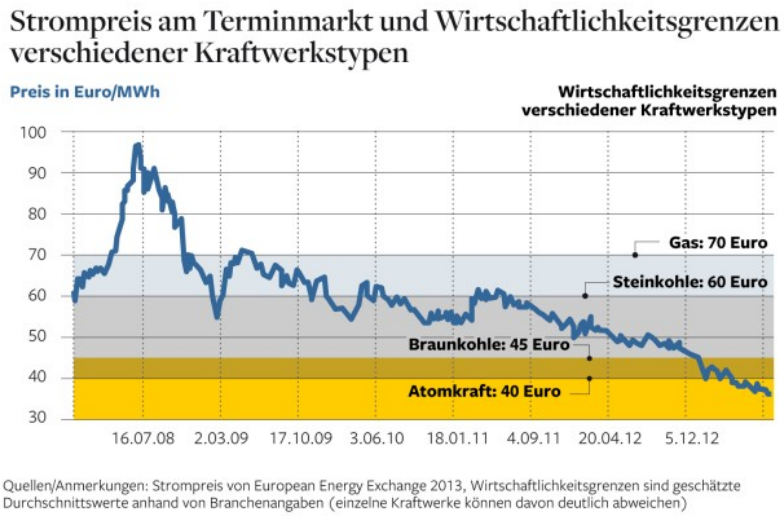
But we've seen prices diverging across markets over the past two years, as shown in the following graphs:

- gas prices diverging sharply across continents (notably as a result of the gas shale developments in the US and increased demand for gas in Japan following the Fukushima disaster, while European prices remain largely indexed to oil):



Source: Fidelity

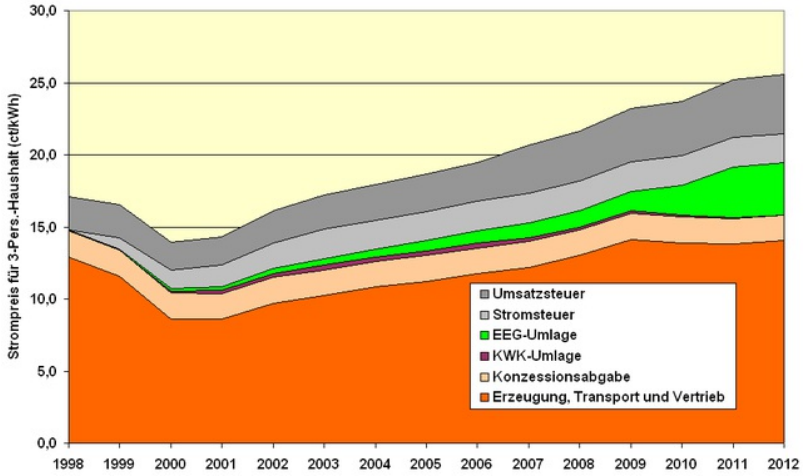
- wholesale power prices diverging from gas prices:



Source: Die Welt, via gwpf

Note: the lines above represent long term break-even prices for, from the bottom, nuclear power plants, coal-fired plants and gas-fired plants

- retail prices moving in the opposite direction to wholesale prices, and increasing:



Source: wikipedia (DE)

German wholesale prices have been trending down over the past several years, despite the closure of close to half of the nuclear plants of the country, and despite the persistently high natural gas prices on the continent, while retail prices have been going up, including due to contributions to pay for guaranteed fixed prices to renewable energy producers (the "EEG" component in yellow in the last graph).

The fall in wholesale prices means that most traditional power plants are not economical at current levels, as the second graph above shows.

There are some temporary factors to the current situation. One is the general economic woes of the eurozone, which are pushing demand downwards and thus prices as well. The other is the temporary higher use of coal-fired power plants, which itself comes from a combination of short term factors:

- cheap imports from the USA (where coal use has been displaced for a while by cheap gas in power generation) made coal more profitable than gas, and
- regulatory incentives mean coal plants have (under the (the Large Combustion Plants EU directive) a limited number of hours to run and operators have every reason to use these up quickly, and especially if the plants are profitable, or less unprofitable than gas ones (UK coal plants have the additional incentive that a carbon tax will be imposed on them from April 2013).

These factors have made it possible to claim that Germany was increasing pollution and carbon emissions because of wrongheaded policies (depending on your stance: closing nuclear plants or pushing renewables), but this looks like a temporary arbitrage between coal and gas.

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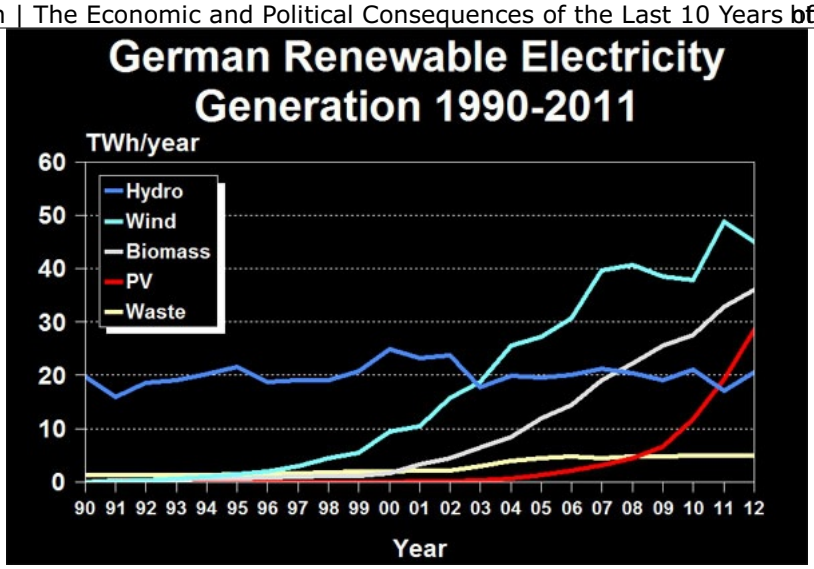
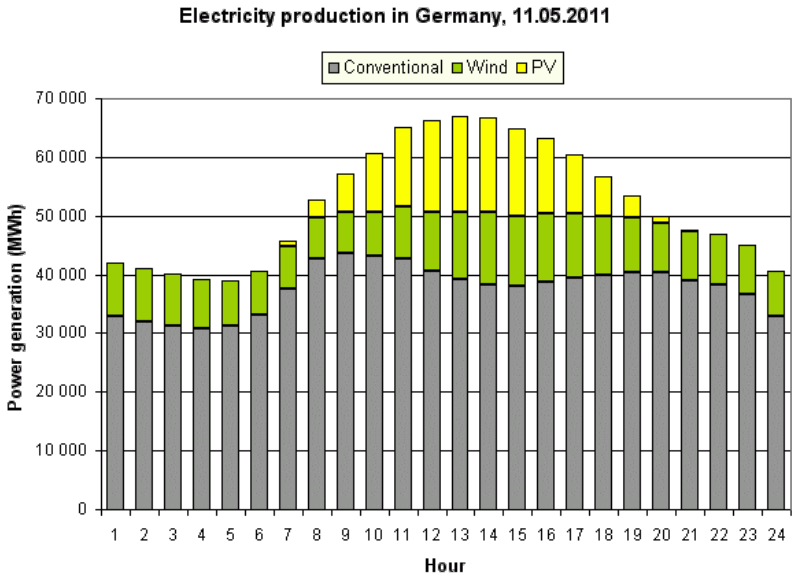
The real long term story is that the power spot markets are being completely upended by the increasing penetration of renewable energy. In Germany, new renewables represent around 50% of the overall installed capacity, and already provide close to 20% of all power generation (split in 2012 in 3 almost equal parts between wind (7%), biomass (6%) and solar (5%)), up from almost nothing 15 years ago, and on many days now they provide 50% or more of total output:

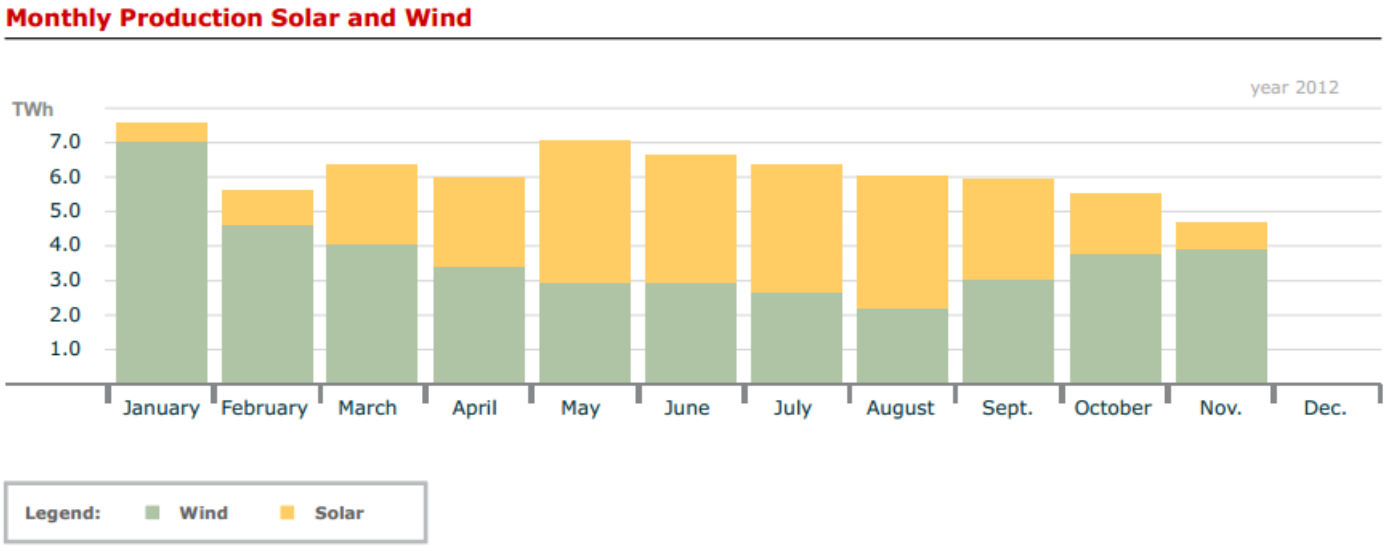


Source: Paul Gipe

This reduces demand for mid-load producers and peakers over more and more periods throughout the year. As the graphs below shows, on good days in the warm season the PV capacity almost eliminates altogether the need for intermediate load; in winter, wind takes over (in aggregate, although not with as regular a daily profile):



Source: DoDo on European Tribune



Source:carboncounter

This was the slice of demand served by coal-fired and gas-fired plants and they are simply not being used as much as they used to, and certainly not as much as their owners expected.

And prices are being squeezed down not just for these producers, but for everybody else as well, in particular during the peak day time hours which used to be the most profitable for all power plants (because baseload plants also receive the more expensive peak hour prices even if they did not bid at such prices). This means that existing capacity is less and less profitable - not just the peakers or intermediate plants, but also the nuclear and other baseload workhorses of the system. Thus the few highly publicized plant closures, and the ongoing utility complaints about lost revenues. Moreover there currently is no business case to invest in any kind of power plant (other than renewables under specific revenue regimes), which utilities use to argue against renewable support.

But here's the thing: preventing new renewables will not eliminate the current existing capacity, which means that the economics of the sector will not recover even if no new renewables were built... The wholesale market as it was designed 20 years ago (de facto based on gas-fired plants of various efficiency targeted at different points of the merit order curve setting up the marginal price) is irreversibly broken. The system is now dominated by plants with very low marginal cost of production (but high upfront investment), which means that spot prices are systematically too low for everybody - you can't invest in plants with high upfront investments (like nukes), and you can't invest in plants with high marginal running costs (gas-fired plants) unless you are betting on persistently low gas prices into the future. That may explain the push for shale gas in Europe, but who believes that shale gas will bring low prices? Even in the US prices are trending up again (and forward prices even more so).

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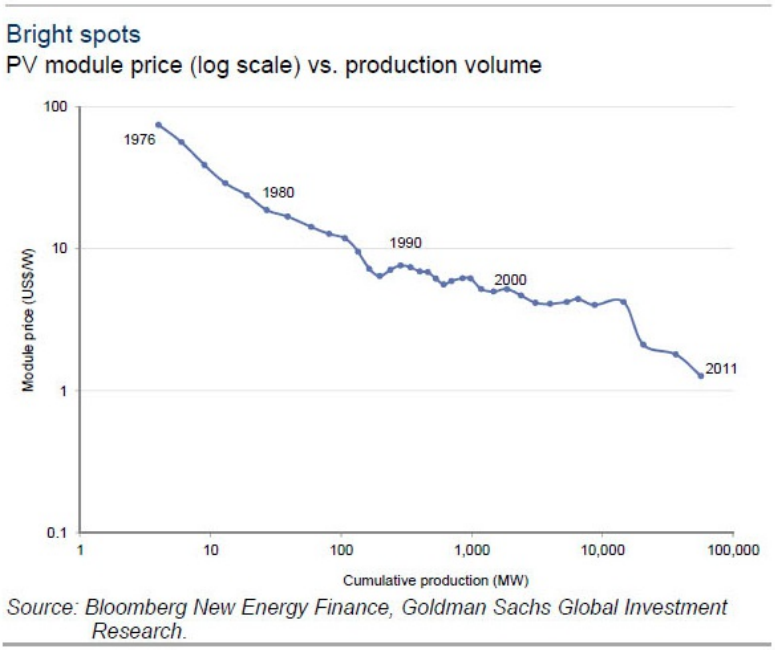
In the meantime, retail prices have kept on increasing, and the fact that the contribution of the support regime (in Germany, the "EEG-Umlage") to retail prices has become visible has made it a target of lobbyists and thus a political topic, despite the fact that retail prices increases have been caused, to a large extent (and in particular until 2009) by increases in gas prices.

This leads us to an hidden truth: **a large fraction of the massive increase in renewable energy production is not paid for by consumers, but by incumbent producers** who see their revenues decline as the price they earn per MWh goes down. Utilities, which see their margins on the retail side increase, but have very little renewable energy production capacity of their own are caught between two conflicting trends, with their upstream business losing profitability, but their downstream business earning more. IPPS are suffering, but have less voice. Unsurprisingly, utilities are focusing public attention only on the first part, and are naturally blaming renewables - not hesitating to point fingers at their support regimes as the cause of rising power prices, in the hope that these regimes will be weakened. They claim they are victims of unfair competition from "heavily subsidized" sources which have priority over them and can dump power with no worry for consequences into the network. They use a mix of real arguments and weaker ones to push against renewables:

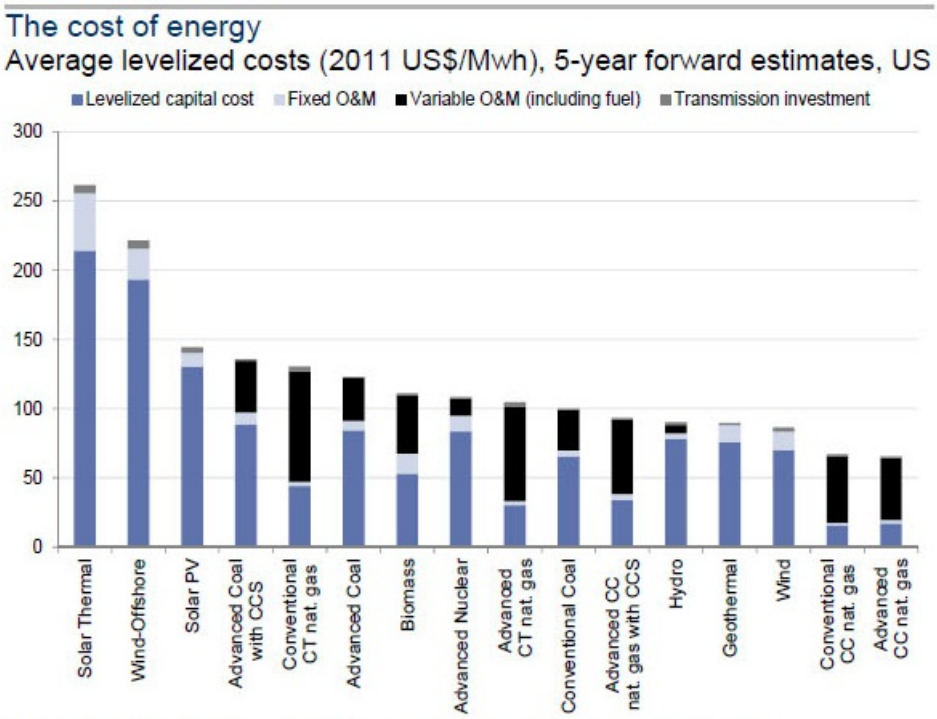


source: Goldman Sachs, via Zero Hedge

- one of the true arguments is that the cost of supporting solar PV has become larger than expected and faster than expected. Just 5 years ago, a number of countries had tariffs in the 500-600 EUR/MWh range, and regulators were surprised by the volumes that managed to be installed - and capture the advantageous prices levels. when they dropped the price support for new projects, they were again surprised by how fast the industry was able to match the lower prices through new technology (and a brutal price war). The result has been an amazing drop in the price of solar panels (-80% in just a few years, as shown above), bringing them close to grid parity, and a rather large (multiple GWs in Germany, Italy, Spain) stock of solar PV capacity which is entitled to very high tariffs for many years, at a visible cost to consumers;
- in some places, the regulatory regime allowed producers to capture the best of both worlds - the higher of the fixed tariff or the market price (whether wholesale or retail), thus preventing the network, and the public, from benefitting from the "cap" that a real fixed tariff would have provided;
- in Spain, retail power prices were kept artificially low for political reasons), and the the gross cost of the fixed tariffs was not absorbed into the general cost base of the network and instead explicitly imposed on utilities, which used that as an obvious argument against renewables (even though a good part of the price increases were linked to increased gas prices before the merit order effect acted on wholesale prices); the government's U-turn on tariffs, which imposed negative tariff changes on already operational projects, alienated the utilities further (as they had, contrary to what happened in Germany, become significant operators of renewable capacity and lost money in the process) and created a precedent that also scared off lenders and investors and put the sector in disrepute;
- in Germany, the renewable energy surcharge applies only to retail consumers, and large sections of industrial users (but not all) are exempted. That means that the gross costs is borne by a smaller fraction of the overall consumers, and that some industries are complaining that they are being treated unfairly. Meanwhile, those benefitting from the situation (the bug consumers who benefit from lower wholesale prices and do not pay the surcharge) are staying silent so as to avoid attracting attention (they failed - this quirk is likely to be corrected soon);

But what is not true is that wind has contributed in any meaningful way to retail price increases (most of Germany's wind capacity was installed before 2008 and the EEG component is all but invisible at that date), and not has offshore wind (which is indeed more expensive, but very little of which has been built to date). When you look at average costs, one sees that onshore wind is largely competitive on wholesale markets (and yes, that does take into account grid access and balancing costs - there is enough experience with large wind penetration in various networks to know that it can be done and that it has no meaningful impact on costs), that solar is already competitive against retail prices in many markets (the famous "grid parity"), and that other

technologies are somewhere in-between. Offshore wind is still more expensive, but is expected to come down in price by the time it will reach significant capacity:



Note: CC=Combined cycle, CT = Combustion turbine, CCS = Carbon sequestration and control
Source: EIA.

source: Goldman Sachs, via Zero Hedge

Note that these average costs of production, always include very political assumptions about the cost of money, and the future price of gas, to apply to such projects. The discount rate (at the time of investment) is the main driver of the cost of wind or nuclear whereas the cost of gas-fired power is only an estimate, based an assumptions about the cost of gas in the next 20 years. And that also means that the price of power from a wind farm or a nuclear plant is largely fixed and known once the plant is built, while the cost of power from a gas-fired plant in the future is essentially unknown. The cost of money is a fundamentally political decision (derived from investors' estimates of macro risks like inflation, of regulatory risks applying to the sector, and technology risk); the consensus on future gas price estimates is also influenced by many factors, including long term projections by public bodies like the IEA, the US EIA or private firms with their various agendas.

As an aside, the more renewables you have in the system, the less it is possible to take out the regulatory support regime, because spot prices tend to go towards zero - which makes investment in renewables (or in any other kind of power generation assets, for that matter) impossible. So "grid parity" is an illusory target, in a sense, because it is a moving target. Technologies with high variable costs (all fossil-fuel plants) cannot compete at any price when there is enough zero-marginal cost capacity in the system, and technologies with high upfront investment costs need comfort about price levels over a long period as they need such prices on a constant basis to amortize the initial investment. This is why the UK government is working on a "contract for differences" (essentially the same thing as a fixed tariff) for new nuclear plants.

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Altogether, the reality is that the consumers and the utilities is paying for a few expensive years of early solar PV technology (to the tune of a few cents per kWh, ie a few hundred euros per year and per household), and now the utilities are bearing almost in full the further impact on the system: they are no longer making (much) money on their current fleet - not on gas-fired plants, barely on their coal-fired plants, and they don't have much renewable energy capacity. They are stuck with a capital stock (including recent plants), which is increasingly uneconomic in today's markets, caught between high fuel prices and lower power prices. And that is the result of strategies over the past 10-15 years that willfully ignored policies to promote renewables pursued

pretty consistently across Europe, and the likely impact they would have on power prices (the infamous "merit order effect" - which I discussed in detail at least 5 years ago, and which was already the topic of academic papers before that).

So it's not like they had no warning and no notice... In a sense, utilities have been consistent: one of their past arguments was that renewables would never reach critical mass and thus were not a serious solution to reduce carbon emissions. And they surely did not take recent investment decisions (mainly to build base-load or mid-load gas-fired plants) with the scenario of heavy renewable penetration in mind, otherwise they would not have been so surprised by the current situation...

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Utilities do make a legitimate point when they underline that the system still needs their capacity (because renewables are not available on demand, and do not provide the flexibility required in the very short term), and that this needs to be paid for (and, at some point in the future, existing capacity will need to be replaced, and they need to be able to make a business case for that, which is not possible today).

In the previous regime, where power prices were determined by gas prices, it was possible to pay for the flexibility in the form of price spikes that gave the right signal for mid-load and peaker gas-fired (or oil-fired, or hydro) plants to be used, and their frequency of use was relatively predictable over a year, allowing for a sound business model to be implemented. Now, with plenty of renewables, the price signal is completely different. There are many more periods of very low prices when renewables flood the system (and this is particularly the case in places with lots of solar, as it is available during the day, ie when demand is stronger and thus prices used to be higher). This has two consequences: gas-fired plants get much less use than in the past (and less than their business plans expected), and baseload plants like nukes or big coal-fired plants get lower prices during periods when they were cashing in more money. The latter earn less money (but still run); the former now run a lot less than expected , which has income implications but also consequences for gas consumption and storage - patterns of use become very different, moving from the usual "once a day" pattern (a few hour at peak demand times), to short bursts several times a day (as renewables drop out), or very long periods of use over multiple days when renewables are not available at all.

Given that the penetration of renewables will continue to change every year, it has become really hard to identify the business model to use for flexible plants - and even harder to know what it will be in 1, 5 or 10 years from now. These flexible plants will be needed, at least to some extent, and they need to be paid for, and that cannot really happen with today's regulatory regime (and as noted above, stopping support regimes for renewables won't change that now: the existing stock of wind and solar is already big enough in several countries to keep the current market arrangements broken). One solution, thankfully being considered in several markets, and which already exists in places like California, is to put in place a capacity market, where plants make themselves available for rapid changes in output, without actually producing anything most of the time, and get paid for that availability: ie a market for MW in addition to the market for MWh.

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The politics of this transition are messy. You can have articles saying (without any real argument) that "Too much green energy is bad for Britain at the very same time that you have record cold weather, with critical weakness in the gas supply infrastructure and wind actually coming to the rescue... (in the UK last March).

People are presenting capacity markets as another subsidy to renewables, whereas system security has always required a significant margin of unused capacity for safety: power demand varies from 1 to 2 or one to 3 every day, peaks can be more or less intense depending on weather, and even large plants can go offline on a scheduled or unscheduled basis. That safety margin was simply paid for in a different way, either by imposing capacity buffers on utilities, or through spot price peaks that were high enough to pay in a few hours for the peaker plants which are otherwise idle most of the time. There's naturally a lot of talk that policies to develop renewable have failed, being costly (only partly true, as shown above, and increasingly less so as time goes by), ineffective at reducing carbon emissions (not true, each MWh of renewable energy has, by and large, replaced a MWh generated previously by fossil fuel plants) and damaging to the system (obviously not the case). But the cat is out of the bag: **once renewable energy reaches a critical mass, its impact on power systems is pretty much irreversible** and no amount of lobbying by utilities is going to get them their previous business model back: wind turbines and solar panels are there and they will keep on cranking out zero-marginal-cost MWh for a very,

very long time...

So utilities would be well advised to focus their lobbying on fixes to the system that actually solve problems (like capacity markets, or maybe new rules on grid access for "must-run plants), and to not cut the tree on which they are sitting (killing the support regime for offshore wind, the only sector in renewables which is "utility-scale" and where they have been able to take a leading share, and the only sector of the power sector where they can actually make money these days...)(*I note here again, for full disclosure, that I work in the offshore wind sector and appreciate that this may sound rather self-interested*).

The politics of power prices are rather volatile, and people have little sympathy for the big utilities, which are typically seen as profiteers anyway, so the focus on the high retail prices could end up damaging them more than it impacts renewable energy producers. Energy is a rather complex topic, not really suited for soundbites, and it is easy to confuse people or say outright lies without getting caught right away. But, by and large, Germans still support the Energiewende - both the move away from nuclear and the support for renewable energy - and are willing to pay for it. And for areas like Bremerhaven, all the manufacturing activity linked to wind and offshore wind is rather welcome.

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In summary:

- Renewable energy is reaching the scale where it has an impact on the overall system; the effects are irreversible, and highly damaging to incumbents;
- The net cost to get there has been relatively low, and largely paid for by utilities, which have constantly underestimated the ongoing changes, even as they were both (wrongly) dismissing them and (relatively ineffectively) fighting them;
- there are legitimate worries about the way to maintain the fleet of flexible plants that was required in the past and will continue to be needed in the new paradigm, but can no longer pay its way under current market arrangements; the solution is not to fight renewables (it won't make the existing fleet go away) but to ensure that the right services (MW on demand) are properly remunerated;
- the shale gas revolution will have a limited impact in this context (it had almost none in Europe, other than via some cheap coal exports from the US for a short period), and does not change the economics of gas-fired plants to the point that they can be competitive in a system dominated by renewable energy production capacity;
- more generally, the future for gas suppliers is bleaker than for gas turbine manufacturers - there will be a need for a lot of gas-fired plants but they won't be burning a lot of gas (they will be selling MW rather than MWh);
- overall, a future with high renewable penetration is not only possible but increasingly likely, and it's a good thing.

Part of the wind power series.

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