The Oil Drum
DISCUSSIONS ABOUT ENERGY AND OUR FUTURE

After Fukushima: a new dash for gas? Really?

Posted by Jerome a Paris on March 23, 2011 - 11:58am

The final outcome and cost of the nuclear accident at Fukushima are yet to be determined but the obituary of the nuclear industry has already been written, and one competing source of power has already been declared the absolute winner by the Serious People: natural gas.

> To fill the gap, renewables are likely to receive a boost. But there will also be a need for a reliable power generation that works even when the sun does not shine and the wind does not blow. Gas-fired power plants are quick and cheap to build, and natural gas is plentiful in the US. It could also be abundant in Europe and China if American production techniques can be imported. (FT)

> Despite a push to increase power generated from renewable sources such as solar and wind power, the wind doesn't blow all the time even in Northern Europe, and the sun is notoriously elusive. Renewables aren't cheap either, in part because they need other methods of power generation to back them up because they generate intermittently. Despite improved technologies, coal is still a relatively dirty fuel, while switching to oil in a $100-a-barrel world doesn't seem appealing either. But there is a fuel that's plentiful, and becoming more so, emits significantly less carbon dioxide per kilowatt-hour generated than coal, and where power stations can be built and online in a relatively short time: natural gas.(WSJ)

The theme is eerily similar: renewables are nice, but unSerious (not "reliable," too expensive) so we need to rely on the big boys. Coal is a bit too dirty to be pushed openly, so gas is it. Cheap, abundant, clean and quick to be ramped up. Case closed.

Or is it? Let's take all of these arguments in turn.

Added to my Wind Power series
The usual disclosure: my job is to advise projects in the wind sector on their financing plans

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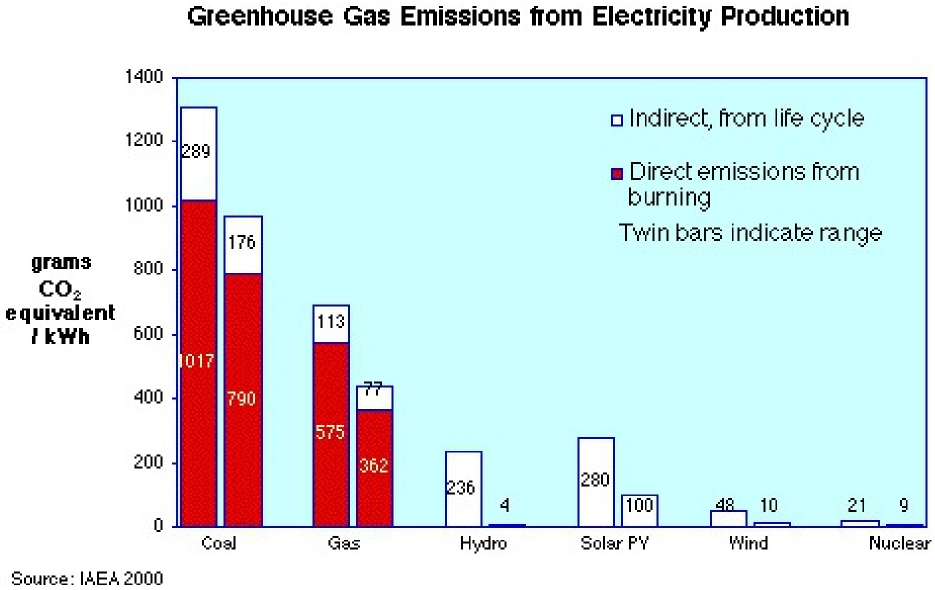
Gas is "clean?"
This one is actually simple: gas is clean only when compared to coal.

Burning gas means fewer particles and other nasty by-products than what you get from burning coal. Producing and transporting gas is also generally less dirty than producing and transporting coal. And burning gas means emissions of carbon dioxide which are roughly half that of coal for the same production of electricity.



Source: Externe project

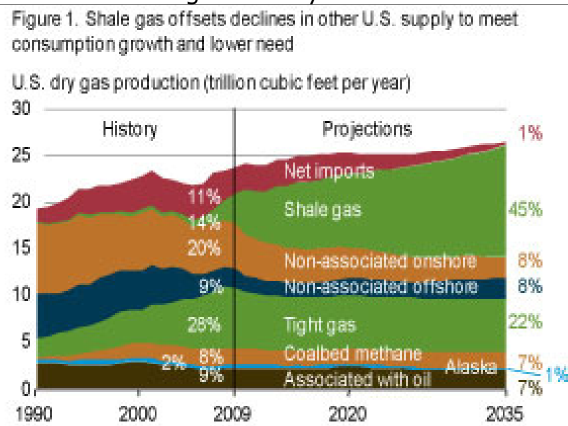
But it still produces a lot of carbon emissions - a lot more than other alternatives - and natural gas itself is methane, which is a much more potent hothouse gas than carbon dioxide, so any losses during production and transport need to be added there with a high contributing factor.

Gas is "abundant?"

This is a perception which has taken hold in the past 2 years, as demand in the US fell (due to the crisis) while production actually increased, thanks to new developments and the emergence of **shale gas** as a significant contributor to the country's production. This in turn has significantly lowered US imports of LNG, releasing these volumes for Europe and Asia and creating an impression of glut over there as well.

The articles above flag this new source of gas, and suggest that similar developments could happen in Europe, where shale gas deposits do exist and could provide a *domestic* source of gas. But this overlooks a number of things:

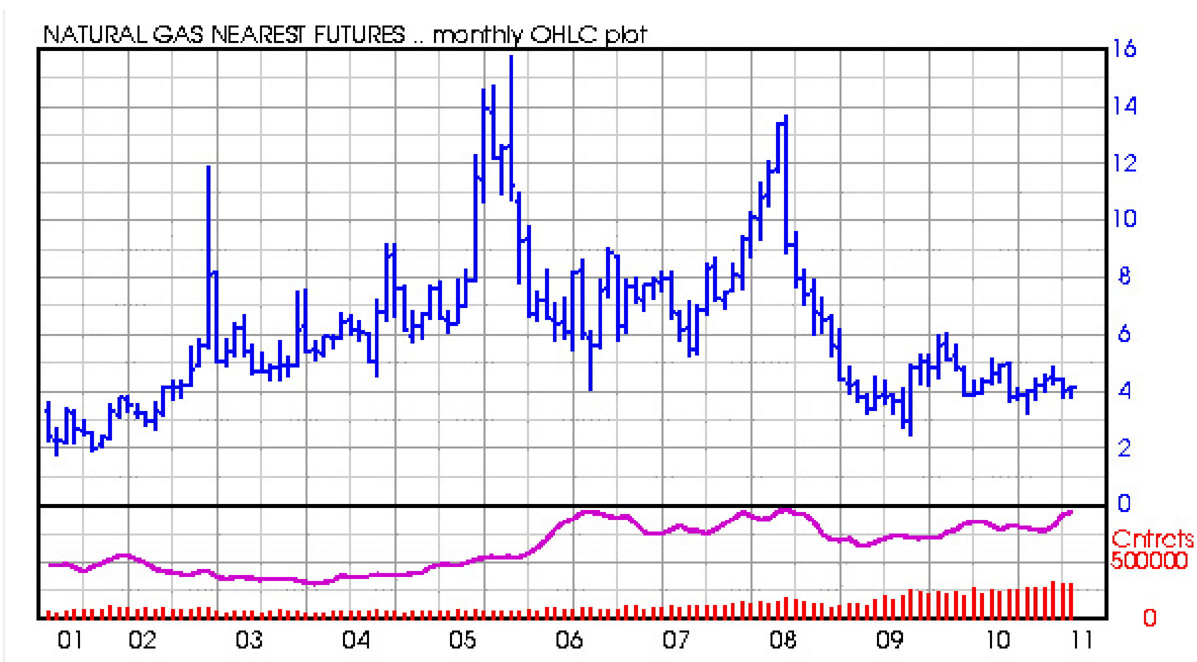
- ***shale gas is generally more expensive to produce*** than current prices suggest. This FT article notes that shale gas costs are probably double current gas prices, and Arthur Berman here at the Oil Drum has some extensive writing (see the most recent one) on this;
- ***shale gas creates serious environmental problems*** as it uses production techniques ("fracking") which, while well known to the industry, create issues of water use (large volumes) and water pollution which are much more sensitive in the inhabited areas where shale gas tends to be found than in more traditional out-of-the-way areas of gas production;
- most importantly, ***shale gas volumes are not that significant in the long run***, even in the US. A lot has been made out of the most recent prospective study by the US DoE, which sees shale gas providing almost half of US gas within 25 years, but as the graph below shows, this mostly compensates the decline in traditional production and does not even allow the country to eliminate its need for imports from Canada. (And of course, this assumes a "business as usual" scenario, with no significant switch from nuclear towards gas-fired electricity generation beyond current trends):



While shale gas has indeed changed the dynamics of the gas markets, and has allowed a new source of gas to contribute to the overall supply, the fact remains that 50% of world reserves are controlled by Russia and Iran, and most of the rest from the same countries which control the oil supply, so "abundance," in addition to being a temporary situation, is still a concept largely subject to political risk. This is seen as a small risk today (because of that short term "abundance") but go back just 4-5 years to see how our leadership can quickly become hysterical about this...

Gas is "cheap?"

Current gas prices are lowish:

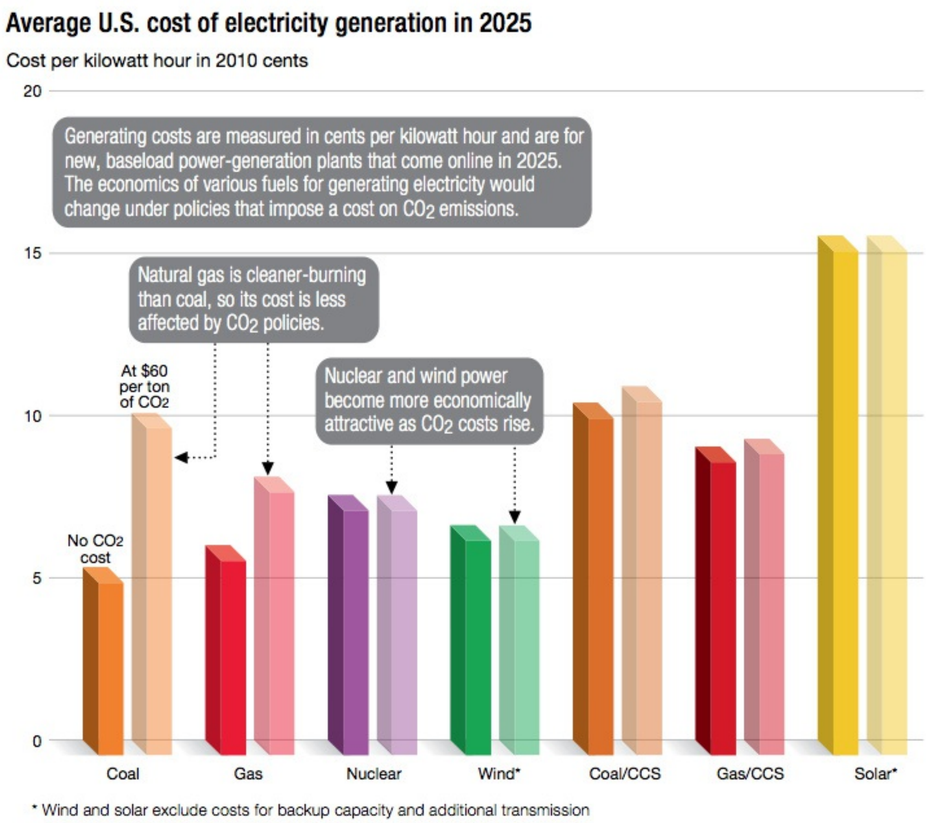


Source: FreeCharts.com

If anything, that graph demonstrates that natural gas prices are highly volatile. So electricity prices for gas-fired plants are highly dependent on what assumptions one makes about future prices - for the next 25 years! Most price scenarios, and in particular the most widely quoted one from the IEA (see here) tend to see slow increases over time, with no volatility and no expectation of geopolitical or geophysical disruption.

Additionally, as I've noted before in various articles (see here for instance), gas-fired electricity is currently advantaged cost-wise by the political choice made in the past 2 decades that power sector investment should be made by the private sector rather than the public sector - that means that the discount rate, i.e. the cost of money, for investment in the sector is higher today than it has ever been. Gas-fired plants are the cheapest to build per MW, and most of the cost of electricity in their case comes from the cost of fuel - so using a higher discount rate increases the overall cost per kWh less than for other technologies, thus giving gas a very real relative advantage. Again, this is a *political* choice and absolutely not an objective fact.

Despite all this, estimates of the long term cost of gas-fired power do not show any meaningful advantage for gas:



Source: ExxonMobil's "Energy Outlook: A view to 2030"

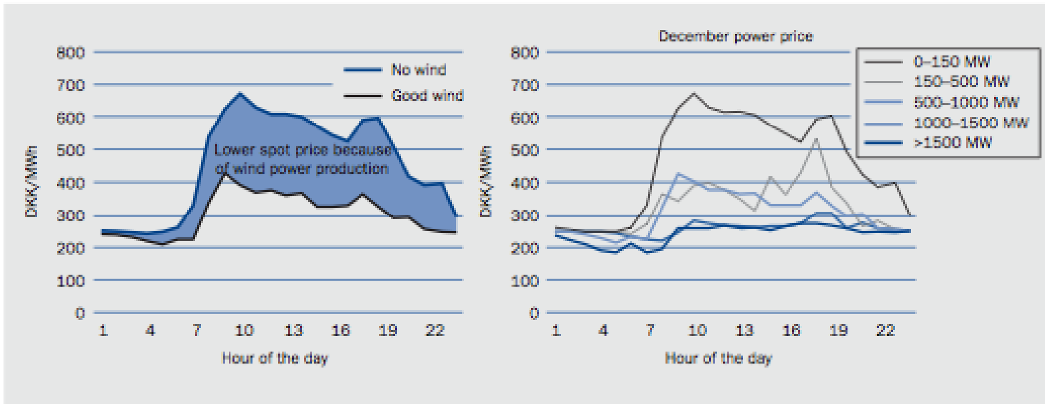
Which takes us to the arguments that we'll do gas because the alternatives, i.e. wind or solar, besides being more expensive, are simply not reliable or scale-able enough.

Renewables are too expensive?

As the graph above shows, onshore wind is fully cost competitive, in the long run, with other traditional sources (coal, gas, nuclear), even when one accepts a whole set of highly loaded assumptions (no payment of externalities by the various sectors beyond a largely symbolic price for carbon, continued expectation that the private-sector cost of capital is the relevant metric, no price for security of supply).

But as I've noted repeatedly (for instance in The cost of wind, the price of wind, the value of wind, or in Wind's latest problem: it ... makes power too cheap or in Wind Lowers Prices: New Scientist), wind, as a zero-marginal cost of production source, has an additional effect on market prices, bringing them down for consumers.

FIGURE 0.12: **The impact of wind power on the spot power price in the west Denmark power system in December 2005**



Note: The calculation only shows how the production contribution from wind power influences power prices when the wind is blowing. The analysis cannot be used to answer the question 'What would the power price have been if wind power was not part of the energy system?' Source: Risø DTU

Source: Economics of wind (pdf) by the European Wind Energy Association

So, either we are in a market situation, and that dampening effect on prices (the "merit-order effect") should be taken into account when evaluating the cost of wind, and not just the gross cost of wind. If we start moving away from marginal pricing mechanisms, the fact that the cost of capital has such an impact on the cost of wind kWhs should be brought into the picture, and public financing of power plants (at a lower discount rate) could be considered: this would allow one to incorporate wind into the system on the basis of its long term contribution (little capacity, but a predictable number of kWh at a fixed cost over a very long time) and take advantage of its capital-heavy cost structure. Allowing public funding would not change the cost of gas-fired plants much, but would significantly lower that of wind (as it would for nukes), and that is arguably in the public interest. Whether this is a good use of public funding is an open question, and a very political one, but saying that we should use "pure" markets is also, implicitly, a political choice, by denying the value that the lower costs of public funding bring to the calculation of the cost of a vital public good (one which is in any case a heavily regulated one for purely technical reasons, as it cannot be stored).

Renewables are not reliable?

The next argument is (as noted in the footnote of ExxonMobil's graph) that renewable energy sources are intermittent and unreliable as providers of firm production capacity. The intermittency of wind and solar is very real and obvious (although they should not be overstated - both offshore wind and solar production patterns happen to follow intra-day variations of demand quite closely; with offshore wind's capacity factor around 50% or more in the North Sea, intermittency is not an issue most of the time), but it is also something that (i) current systems know how to deal with at almost no cost, (ii) could become a problem only at very high penetrations, and (iii) will remain a problem only if our grid stays as it is and does not adapt over the next few decades as renewables increase their share of generation.

As **DoDo** noted in the The 3-part view of power generation, the intermittency of renewables is largely predictable, and thus no harder to deal with than the daily variations of demand - which current systems deal with, as it were, on a daily basis...thus the argument that the "cost of backup" for wind or solar is largely insignificant (adding, at most, a few % to the cost of wind) up to significant penetrations into the system (current studies, and the ongoing reality in Denmark, Ireland or Germany, suggest that more than 20% of power could be supplied by renewables without significant need for new investment in the grid or backup systems).

DoDo pointed here to an interesting table:

	Wind	Solar	Natural Gas	Hydro (dams)	Coal	Nuclear	Hydro (river)	Tide/wave
Characteristics*	S/-	S/-	P/+	P/+	BC/+	B/+	B/+	S/+ (tide)
Wind		o	++	+	-	--	--	--
Solar	o		++	+	-	--	--	--
Natural Gas	++	++		++	++	++	++	++
Hydro (dams)	+	+	++		++	++	+	+
Coal	-	-	++	++		-	-	-
Nuclear	--	--	++	++	-		-	--
Hydro (river)	--	--	++	+	-	-		-
Tide/wave	--	--	++	+	-	--	-	

Source: the Oil Drum

That table indicates the compatibility of different technologies with each other. Basically, gas and hydro are compatible with everything else, and can be used for peak load or balancing; most other technologies are less flexible and thus largely incompatible with each other. What this means is that wind or solar are no harder to incorporate in a power generation system than nukes or coal, provided that you have sufficient flexible capacity in the form of hydro or gas. While this does suggest a long future for gas in the power sector (as a provider of peaking plants and daily balancing capacity) where hydro is not available, it certainly does not mean that baseload needs to be done by gas. A side note on that table is that wind and solar seem less incompatible with each other than with traditional baseload sources, meaning that a combination of wind and solar would probably be somewhat easier to balance than a pure-wind or pure-solar input into the grid.

And what the Japanese crisis demonstrates as well is that large power plants have "intermittency" problems of their own: when they are offline, which does not require events as rare as 9.0 earthquakes (a technical problem on a power line can have the same consequence), the system may not have enough spare capacity to deal with their sudden large-scale disappearance, or have to deal with blackouts. Dispersed generation sources like renewables do not present this risk.

Renewables are too small?

The last argument is that renewables are simply not up to the task because they are too small to matter. But this is silly. That renewables are small does not mean that it will remain this way. There are no practical obstacles to building up capacity - and it has indeed happened when policies made it possible. Denmark went to 20% of its generation from wind in less than a decade in the '90s, using what was then less mature technology; Germany has gone from less than 10% of its capacity to close to 40% being renewables in less than 10 years...

The reality is that gas-fired power is the default solution for a number of bad reasons: it's a price-maker and thus a smaller financial risk, it's more profitable for private sector investors than for public sector utilities, and it's backed by large and powerful incumbent industrial companies. But inertia is not a policy.