

Networking for renewables: meeting the EU's renewable energy targets

Today's fossil fuel and nuclear based energy system brings the resource to the power plant, but as the share of renewable energies increases, we will need to get used to the idea of taking the power plant to the resource. Much of the challenge of building a sustainable, geopolitically secure and cost effective energy system will fall on Europe's aged and nationally focused electricity networks. We now need a fresh, forward looking approach.

Challenging the status quo

In early November 2009, Rio de Janeiro, the designated host for the 2016 Summer Olympic Games, was plunged into darkness when bad weather pushed already over-extended electricity transmission grids to breaking point.

It's fair to say that the importance of electricity grids is often underestimated – just as cars or trains attract far more attention than roads and railways, so the energy debate tends to centre on coal power plants or wind turbines with less attention being paid to the challenge of actually getting the power to the consumer.

Europe's grids have historically been very national in focus: because transporting electricity is a costly and wasteful business, it has always made better sense to

locate power plants as close as possible to major consumer centres and respond flexibly to demand. Electricity – unlike coal, gas or oil – cannot be stored in any significant volume.

This national outlook is set to change, however, due to the increasingly widespread debate over the wisdom of maintaining our reliance on fossil fuels and nuclear. Because they relate to electricity grids, let's quickly go over the arguments for moving away from the current energy system to a higher reliance on renewable power sources.

First, the EU is one of the most energy dependent regions of the world, currently importing over 80% of its oil, close to 60% of its gas and approximately 97% of its uranium. As we've seen with the recent Russia-Ukraine-Belarus gas transit crises, this is a costly and unpredictable threat to Europe's energy security for which there is no quick answer. Natural gas demand is actually predicted to increase over the next decades (replacing coal and nuclear), just as EU or European suppliers (the Netherlands, the UK and even Norway) are fast running through their reserves.

Second, the price of oil reached 147 dollars a barrel in July 2008, an all time high which eclipsed even the 1973 and 1979 price shocks (gas prices, indexed to oil, also set price records). Unlike previous geopolitical price hikes (Yom Kippur and the Iranian revolution), this one was caused by supply failing to meet demand: when the effects of the sub prime crisis are over, prices will rise again.

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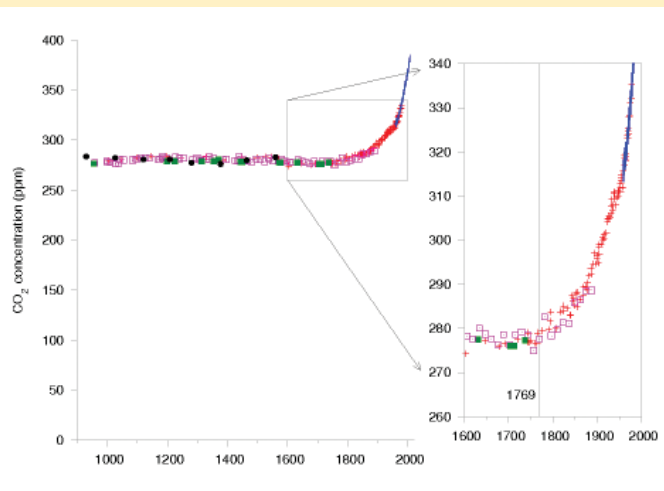
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"We produce thirty year predictions of oil prices without realizing that we cannot even predict those for next summer." Nassim Nicholas Taleb, *The Black Swan*

Third, safety: While fossil fuel and nuclear power plants have very high safety standards, accidents do happen. Chernobyl led to the permanent evacuation of over 300 000 people and completely halted nuclear development for 20 years. Meanwhile, no long term solution for nuclear waste has been found. It is hard to relate to 100,000 years of radioactivity when our written history only goes back 5000 years.

Finally, climate change. The accumulation of scientific evidence makes it difficult to deny man's fossil fuel driven responsibility for global warming:



Carbon concentrations in parts per million for the last 1100 years, measured from air trapped in ice cores (up to 1977) and directly in Hawaii (from 1958 onwards). Source *Sustainable Energy Without The Hot Air*, David Mackay

As Mackay in *Sustainable Energy Without The Hot Air* points out *"I think something might have happened between 1800 and 2000!"*. Could we not preserve our current fossil fuel based energy system while slashing CO₂ accumulation in the atmosphere? Possibly, but not with today's technology: Carbon Capture and Storage has yet to be proven at any commercial scale, capturing CO₂ "out of thin air" is still in the laboratory stage and

would be prohibitively expensive, while more straightforward energy efficiency measures (without net reduction targets) have historically been annulled by overall rises in energy consumption.

20 % Renewables by 2020: building the right networks for a sustainable Europe

Taken together, these arguments make the "renewable case" and have received the EU seal of approval with the binding RE Directive framework: Member States must together achieve an average of 20 % of renewables in Europe's energy mix by 2020.

This brings us back to unglamorous logistics and electricity grids. The current fossil fuel and nuclear powered energy system adds up to a fantastic amount of installed generating capacity: Even to replace 20 % of it with renewables is a considerable challenge, and we now know that we must aim at much higher shares in the future (at least 30 % if not more by 2030).

The issue of grids (broken down into large scale transmission and local distribution networks) is key because renewable energy power sources will not be located in the same place as today's generators: To achieve comparable outputs, wind turbines, solar panels (thermal and PV), wave power devices and other systems require roughly **300 times** more land space than the average gas or nuclear plant, so we obviously can't just switch one for the other. On the other hand, renewables are much more scalable and can make the most of unused spaces such as roofs and, increasingly walls. Try developing a cost effective household nuclear reactor!

This means that Europe's networks will have to link up with main consumer centres, large projects in isolated rural or maritime areas where land - or sea - prices are cheap, handling greatly increased local (house, town, city) production. In other words, cities will be able to supply part of their own demand, but will need to import significant amounts, for example when local weather conditions are insufficient.

Some renewables are intermittent: Wind turbines or solar plants don't deliver more than 30 % of their installed capacity (though coal, oil, gas or nuclear

plants do no better – about 1/3 of the raw resource being transformed into electricity). The solution is to create *multinational catchment areas*: if wind power off, for example, the Belgian coast has strong ups and downs, local differences are smoothed out when all North Sea country production figures are added together.

Therefore Europe needs the right technical and legal network upgrades to allow 1) balancing cross border electricity flows, 2) greatly increased local “feed ins” to town or city distribution networks and, 3) for all levels of renewable energies, guaranteed access to grids and common, easily understandable connection procedures. At the same time, we need to simplify the scale of the task by cutting down overall energy consumption and by working on dedicated measures to inform and gain support from policy makers and the public. Renewables and grids do have a tricky task dealing with “BANANAs” (Build Absolutely Nothing Anywhere Near Anybody ...).

Some non-technological suggestions for what needs to be done:

- Clear and transparent transposition of guaranteed grid access for renewables as outlined in the RE Directive into member states’ national action plans (NAPs, due in June 2010).

- RE expansion is frequently hampered by overly complicated *grid codes* (the technical and legal conditions that a power plant must meet to be connected to the grid). We need to support the push for a standard model that producers can easily understand and apply.

- More cross border interconnections to address production variability on a flexible daily basis and do away with electricity wastage. The model is there: During periods of excessive production, Denmark exports wind energy for storage in Norwegian hydro dams, then re-imports it as demand rises. Interconnections for *day ahead* and *intraday* exchanges are legally challenging, requiring delicate negotiations (and regulatory prodding) to address competition concerns among Transmission System Operators (TSOs). The newly formed ENTSO-E, which represents TSOs at EU level, is currently preparing a crucial first off 10 year network investment plan which will strongly determine RE growth and is at present still open to public comment.

- Strengthening the whistle blowers: the electricity sector is overseen by national regulators coordinated at EU level by CEER and ERGEG. Regulators, however, are often overly vulnerable to member state, TSO and electricity utility pressure. Directives in the 3rd Energy Package, if applied as planned, will address



54.4 % of the European Union’s energy consumption is imported. Of these 1010 million tons of oil equivalent (Mtoe), 86.5 % are oil and natural gas, and 35 % of the total imports come from Russia. Since 1990, fossil fuels imports into the EU have risen by 60 %. (DG Energy figures)

this by laying out tighter independence conditions and by empowering regulators to set hefty fines. Cooperation will be reinforced at EU level with the creation of ACER, a dedicated agency for regulatory cooperation (note that the Director of ACER has still to be nominated and the choice will heavily influence the agency's potency).

- Regulators must be mandated to move beyond simple low electricity costs for consumers and work harder to integrate renewables. Put simply, we need less “cheap cheap” and more “affordable and sustainable”!
- Properly separating generating and transmission affiliates (unbundling) boosts the growth of a common electricity market and facilitates intra-country flows of RE electricity. EU Commission findings clearly show that as long as vertically integrated companies dominate the sector, the tendency will be to shut out electricity exchanges and preserve existing markets. The 3rd Energy Package is rather weak on this point, France and Germany having pushed through the ITO compromise. This in practice allows ongoing power company control of electricity transmission, and makes the case for strengthening the regulators – through political support – even more poignant.
- When wind production in Germany pushes overall production above demand (and no export connections are available), turbines are shut down to avoid voltage overload and *base load* demand is provided by nuclear. Renewables will account for 30% of Germany's electricity production in 2020 – they must be progressively integrated into the base load.
- Money vs. planning: As the recently completed 550 km link between Norway and the Netherlands has proven, interconnections are a lucrative business. Financial support for TSOs or other investment groups is not a priority; streamlined licensing procedures to accelerate construction are.
- BANANA: Famously, a proposed wave energy “hub” off the coast of Cornwall was blocked by a surfers association over concerns that wave quality would suffer. This “battle of the breaks” (as it was inevitably dubbed by media) illustrated once again how much must be done to bring public opinion round to the importance of renewable energies and electricity networks. Local support is officially a TSO prerogative, yet results show that more needs to be

done to promote best practices (such as the Danish model of involving local communities in wind farm investment). ENTSO-E is open to suggestions.

- Perhaps most importantly, there must be a closer cooperation among renewable energy and electricity grid promoters in general. The energy efficiency sector is an excellent example: LED light bulbs, smart meters, simple devices (such as voltage frequency detectors) to shift household appliance consumption to *off peak* periods (and how about financially rewarding electricity distributors for making energy savings?) will all reduce overall consumption and bring the renewable transition that much closer.

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