

Does part load of conventional power plants increase CO2 emissions?

1. Wind power needs negligible backup generation capacity up to moderate levels of penetration and in well interconnected markets!

Several studies show that the dedicated reserves for wind depend on the level of wind penetration. Up to moderate levels of penetration (around 20%), “back-up” generating plants dedicated to wind power plants are generally not required, and would actually be a poor and unnecessarily costly use of power-generation resources¹.

Estimates for the increase in short-term reserve balancing capacities have a wide range: 1-15% of installed wind power capacity at 10% penetration (of gross demand) and 4-18% of installed wind power capacity at 20% penetration, and depend notably on the level of interconnection of a given market. The average share of wind in total gross demand in the EU in 2011 was 6.3%, by 2020 the value will reach 15.7% and just by 2025 the percentage will surpass 20% (up to 28.5% in 2030). By then the EU should have a well interconnected internal energy market very much diminishing the need for back-up.

The need for dedicated back-up plants for wind energy is quite negligible, and even more so in more and more interconnected markets.

2. Part load increases emissions but not absolute emissions!

A clear difference should be made between overall emissions reduction and emissions of a power plant per kWh. At part load, the CO2 emissions per unit might go up but this has only a very small impact on the overall emissions saved by wind power.

A wind-generated kWh displaces a kWh that would be generated by another source, usually one that burns a fossil fuel, because of the merit order effect². The CO2 free wind-generated kWh avoids the fuel consumption and emissions associated with that fossil-fuel kWh. Without wind, the required electricity would be generated by gas or coal or fuel oil, creating greater total emissions. It is estimated that wind power avoided 140 Mt of CO2 emissions in 2011. **Part-loading of conventional power plants will, at worst, offset 8% of this saving.** Overall CO2 avoided emissions from wind power remain therefore very significant.

Despite very small and short-term emission increases associated with ramping-up and down conventional power plants, wind considerably decreases emissions.

3. Technological developments of gas turbines enable efficient part loading without further research!

With the increasing penetration of variable renewables, gas turbine manufacturers, such as, Alstom, Siemens and GE have developed new gas turbine models with higher flexibility. The main features of the new gas turbines are: faster start-up, faster ramp-

¹ <http://www.ohiowind.org/PDFs/Wind%20Power%20Myths%20Debunked.pdf>

² Wind power has a low marginal cost (zero fuel costs) and therefore enters near the bottom of the supply curve in a power exchange and pushes out the technologies with the highest marginal costs, ie coal and gas.

up/down and good part-load performance (up to 20-30% load) while keeping emissions within set limits.

Technological developments allow the improvement of emissions efficiency at full and part-load.

A good example of such emission improvements is the GE FlexEfficiency50 gas turbine when compared with the current gas fleet in operation:

- Today's CCGT fleet has average CO₂ emissions at full load of around 340–350 g/kWh. According to Eurogas, the same fleet operated at 30-40% loads has average CO₂ emission of approximately 500 g/kWh meaning an increase of around 45% in CO₂ emissions.
- The GE FlexEfficiency50 plant operated at 100% load emits 320 CO₂g/kWh while operated at 30% load up to 390 g/kWh the equivalent of a 22% increase.
- NO_x on the other hand decreases its emissions by 20% from 50 to 40 mg/kWh if load goes down to 30%.

Instead of securing already scarce EU research funds for research in more efficient gas plants, the EU and Member States should continue to promote renewables in order for the market to develop the most flexible power plants, as well as push for applying the best available techniques to new gas power plants.