

21 John Adam Street, London WC2N 6JG

020 7930 3636

admin@ref.org.uk

http://www.ref.org.uk

WIND POWER AND SPOT PRICES: GERMAN AND DANISH EXPERIENCE 2006-2008

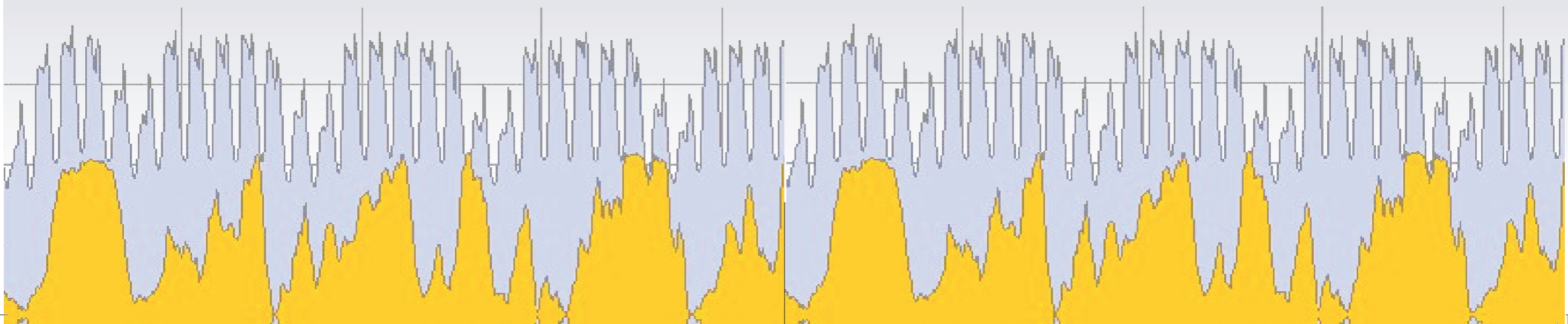
*A Statistical Study for the
Renewable Energy Foundation*

by Paul-Frederik Bach

Wind power and electricity demand for West Denmark for January 2008.

□ Demand

■ Wind



Wind Power and the Electricity Spot Market: Implications for UK Policy and Investment

Introduction

1. The impact of large wind power programmes on the electricity spot price market is a critical consideration for investors, market incumbents, policy makers, and the consumer, yet surprisingly little research has been done to date in this area.
2. The Renewable Energy Foundation (REF), a UK registered research and education charity, has commissioned one of the first publicly available independent and rigorous studies of this matter in the key markets of Denmark and Germany, where wind power is already a significant presence. This document is a brief introduction to the main text, and some of its major implications.¹

Study Outline and Findings

3. The study is based on a collection of data for 2006-2008, focusing on periods of particular interest such as zero prices, price spikes, and periods of calm weather when wind output is low.
4. There has been a widely accepted assumption that Denmark has successfully integrated more than 20% of its electrical energy from wind power, and that others can replicate this success with ease and at reasonable cost. Some have assumed that wind power, which has no fuel cost, has a beneficial effect through reduced spot market prices.²
5. The present work shows that these assumptions are questionable, and need to be re-examined.
6. We find that despite the relatively large geographical area, there is very little smoothing of the output of wind power in Denmark and the E.ON Netz control area of Germany, and that the outputs of both countries are consequently strongly correlated, sometimes being close to zero for days or even weeks.
7. This lack of smoothing means that while wind has little effect on average spot prices, bringing little or no benefit to the consumer, **wind power significantly increases spot price volatility, with very high prices observed at times of low wind (when conventional generators are required to take up the slack), and very low or even negative prices at times of high wind** (see Fig 1).

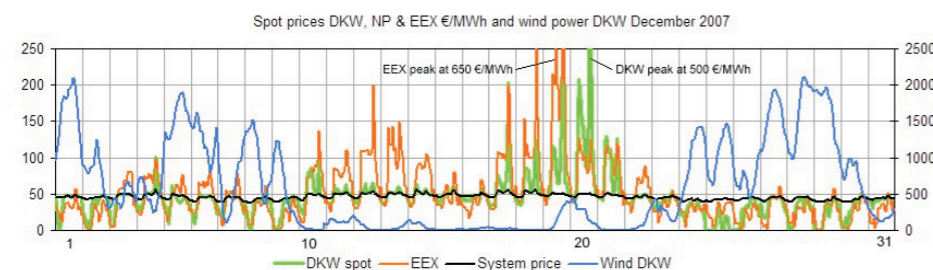


Fig 1 - Wind power and spot prices (DKE) and spot prices (EEX) - December 2007

8. Spot price volatility has significant economic implications for investors in the rest of the system; an unstable market is a high risk prospect.
9. The study also finds that, **the Danish and German spot markets are now strongly correlated** (see Fig 2). That is to say, **Denmark and Germany now behave like one electricity market**, and balance their grids as a single entity.
10. We therefore conclude that **it is misleading to suggest that Denmark has integrated some 20% of MWhs from wind**.
11. It is more accurate to say that **a new entity, "Germany-and-Denmark", has absorbed around 7% wind power**, and this has in large part been possible only because of trading relations with Norway and its hydropower fleet.
12. **Thus as an unintended consequence of their electricity policies Denmark and Germany are partially integrated economically**.

¹ The opinions expressed here are those of the Renewable Energy Foundation, and represent the Foundation's interpretation of the significance of the study.

² Camilla Cavendish, "We must turn up the green heat of technology", The Times (12 Dec. 2008): http://www.timesonline.co.uk/tol/comment/columnists/camilla_cavendish/article5327422.ece

What does this mean for the UK?

13. Far from being safely behind the Danish "frontier of experimentation", as previously supposed, the United Kingdom is now advancing into unknown territory.
14. Current UK policies almost certainly require upwards of 30% of electrical energy from wind power (as opposed to 1.5% at present).
15. Although further interconnectors are in progress, the UK is not strongly linked with continental Europe, and even if all current plans proceed, the UK will be weakly connected in proportion to its market size.
16. Consequently, if high levels of wind are to be built in the UK this can only occur with the provision of:
 - Major, and probably costly, internal grid balancing services, including, for example, demand management, electricity storage, and flexible, rapid response, generation.
 - The timely provision of many further inter-connectors to mainland Europe and Norway, to facilitate electricity trading.
17. Unless the United Kingdom can maintain independence by providing its own internal system balancing services, **prices over the new inter-connectors will most likely be unfavourable to the British economy**.
18. In the absence of a solution, the proposed UK wind fleet will either not be built or will be forced to curtail output.
19. This has implications of cost to the consumer (if curtailment is compensated), or costs to the generator if it is uncompensated. The attainment of environmental targets would also be threatened.
20. Additionally, a growing understanding of the capacity credit of wind shows that the UK system must always have sufficient reliable generating plant to meet peak load (plus a safety margin). Because of its uncontrollable variability wind can make little or no contribution to this "firm" generating fleet.
21. As a result of EU legislation the UK is faced with plant closures of ca. 30 GW, equal to around 50% of peak load, over the next decade. Thus, there needs to be investment in firm, clean, and flexible low-carbon plant.
22. In this context it is a matter of major concern that wind power may, together with other factors, create **significant price volatility on such a scale that it undermines confidence in the electricity market, and thus acts as a disincentive to investment in urgently needed new reliable low-carbon conventional plant**.

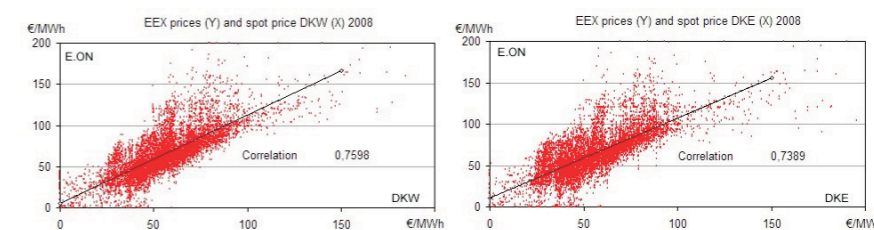


Fig 2 - EEX prices versus Danish spot prices 2008

Conclusion

23. Immediate attention must be given to stabilising the market in the presence of large scale wind power, to ensure that an affordable and clean system results.
24. It is doubtful whether the necessary balancing services will be forthcoming without government direction of the electricity sector, and perhaps ownership of those services.
25. **Government intrusion into the electricity market is not clearly desirable at all points, and should be exposed to intense public debate to ensure an optimal outcome, for the consumer and the electricity supply industry.**

John Constable
 Director of Policy and Research
 12 May 2009

About the Study Author

The work has been conducted for REF by Mr Paul-Frederik Bach, one of Denmark's most experienced and distinguished power system engineers. As Planning Director at Eltra, the Transmission System Operator in West Denmark, he was in charge of affiliation to the Nordic spot market for electricity, Nord Pool, in 1999, and until retirement in 2005 his main responsibility was the integration of wind power. He is now active as a consultant with an interest in the safe and efficient integration of wind power, particularly prevention of disturbances by advanced system control measures.

About Renewable Energy Foundation

The Renewable Energy Foundation is a registered research and education charity encouraging the development of renewable energy and energy conservation whilst emphasizing that such development must be governed by the fundamental principles of sustainability.

REF is supported by private donation and has no political affiliation or corporate membership. In pursuit of its principal goals REF highlights the need for an overall energy policy that is balanced, ecologically sensitive, and effective.