Abstracts

Renewables and the future of energy meteorology

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Foreword: Setting the UK low carbon scene
Prof Sir Brian Hoskins CBE FRS HonFRMetS, Imperial College London

Renewable energy generation is expected to play an increasingly important role as nations seek to reduce their carbon emissions over the coming decades. The UK has set itself a target of an 80% CO2 emissions reduction by 2050. This talk will outline the basis for this goal, highlighting the importance of almost completely decarbonising the electricity supply by 2030, and will discuss the necessity of accessing a range of renewable technologies in order to achieve the target.

Wind resource assessment and forecasting
Dr Clive Wilson, UK Met Office

Both onshore and offshore wind turbines are increasingly important in meeting the UK and European energy needs with ambitious targets to expand their contribution in the near future. As part of the 20% by 2020 renewable target, the EU expects that the production of energy from wind will multiply from 70TWh in 2005 to almost 500 TWh in 2020. Denmark hopes to generate half of its electricity from wind by 2020 and have 100% renewable energy by 2050. Meteorology has a large role in both identifying suitable sites for exploitation of wind resources to ensure sound investment decisions and in forecasting the winds at operational wind farms for likely energy yield and operations, maintenance and grid balance between alternative generation technologies. Traditional site assessment based on wind mast observations and long-term records of surface winds at meteorological station are now complemented with "virtual met mast" data from mesoscale atmospheric models, adapted to site-specific locations. Higher resolution and Computational Fluid Dynamics (CFD) models are often used to refine the detailed predictions. Long term expected resources are based on downscaling atmospheric reanalyses. Key challenges are to provide uncertainty estimates of the long term wind resource depending on the site complexity and the influence of inter-annual variability. Estimates of turbulence, shear, wind gusts and stability are also required. On-site offshore wind measurements are orders of magnitude more expensive so that remote sensing and models are expected to play a larger role. Wind and air density forecasts are needed from hours to weeks for operational generation. Improving the accuracy in locations with complex orography and land use is a big challenge. Ensemble forecasts are likely to play a greater role in future in short-term energy supply management.

Probabilistic forecasting for energy: minutes to seasons
Dr Pierre Pinson, Technical University of Denmark

Renewable energy production and demand are directly influenced by the weather, with leading renewable energy sources today being wind, solar and maybe wave energy. While extensive expertise on accounting for temperature forecasts at different temporal scales is getting common in energy load forecasting, there is still a long way to go when it comes to renewable energy generation. This is even more the case for probabilistic forecasting, for which substantial developments are required as a result of collaborations between meteorologists, climate scientists, mathematicians/statisticians and power systems engineers. Probabilistic forecasts actually are of utmost importance for the optimal management and trading of renewable energy generation, since almost all decisions to be made using forecasts are based on dynamic and asymmetric cost functions. The most common examples related to short/medium-range forecasts are that of the trading in electricity markets and that of optimal maintenance planning offshore.
In this talk, we will give an overview of the state of knowledge in probabilistic forecasting for energy while considering the balance to be given to meteorological and statistical aspects for issuing probabilistic forecasts suitable for decision-making needs. Particular emphasis will be given to introducing the various time scales of interest, from minutes to seasons (even decades): probabilistic forecasts may there be issued based on very different methodologies, based on different input, and communicated differently. The necessity of an increasing role of meteorologists and climate scientists in the development and validation of forecast methodologies for energy will be discussed and motivated by the speaker's own experience. Some of the reasons while it may still be difficult to impose probabilistic forecasts as a base product for decision-making in the energy sector will finally be mentioned.

**Perspective: meteorology and energy trading**  
Dan Guertin, EDF Trading

Weather plays a very important role in both electricity demand and electricity supply throughout much of Europe. In the winter, demand for electricity rises as temperatures fall due to increases in residential and commercial space heating requirements. Similarly, demand for electricity rises in the summertime as temperatures rise, resulting in increases in cooling requirements for residential and commercial entities alike. On the supply side, the impacts due to weather are usually more complex and more difficult to forecast since the weather systems that impact wind, cloud cover, and precipitation can be very small-scale (i.e. meso-scale) in nature. Thus, weather patterns play a crucial role in wind generation, hydroelectricity generation, and solar electricity generation throughout Europe. Additionally, most European countries differ in their installed capacities of each of these supply components, and these “renewables” are making up an ever-increasing percentage of the electricity supply-demand balance across Europe. In the coming years, global weather patterns and weather forecasting will play an even more important role in the European energy markets, especially as it pertains to electricity supply and, ultimately, energy prices.

**The challenges of integrating intermittent renewables**  
James Cox, Poyry Consulting

The European Renewables Directive of 2009 and subsequent National Renewable Energy Action Plans mean that at least 20% of energy should come from renewable sources such as wind and solar. This represents a radical shift in the electricity system, with a change from conventional thermal plant such as gas and coal which can be scheduled and are predictable, to a much more intermittent and unpredictable generation of electricity. The expected impacts include increased price volatility, greater investment uncertainty, and much greater weather risk. In particular, electricity consumers will be much more exposed to periods of calm, cold weather leading to very high electricity prices, whilst generators face increased risk with long periods of warm wet and windy weather leading to low electricity prices. Understanding how these risks can be mitigated through interconnection, storage, back-up plant and market design is critical to ensure a stable, affordable and low-carbon electricity system.

**Energy, carbon and climate change**  
Dr Neil Strachan, University College London

This presentation undertakes a whole energy systems perspective of the long-term evolution towards a decarbonised and secure energy system. An integrated set of insights will be discussed, generated from quantitative energy modelling on the key drivers, trade-offs and uncertainties in the long-term restructuring of the energy system. Of particular interest in the role renewable energy and associated energy vectors could play in the UK's energy future. The presentation will conclude with an assessment of how the changing physical climate is both considered in whole energy systems analysis and how it may potentially impact the costs and likelihood of reaching the UK's greenhouse gas targets.