Wind Energy Forecasting for Distributed Generation in Local Energy Neighbourhoods



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qr5 Vertical Axis Wind Turbine
7.5kW peak aerodynamic, 13.6m²
1500-5000 kWh p.a.
Decentralised energy production
Integrated with society
Cost: £20,000 + installation

The gr5 Wind Turbine



Trend towards clusters of turbines in a given area
5 turbine array in Cleveleys, Lancashire



Understanding the Wind Resource







Demand Side Management

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storage

Local energy generation included in concept
Minimising negative impact on grid
Creating new value stream!

Local Generation

Schedulable

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The Grid

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SEVENTH FRAMEWORK PROGRAMME

Smart Control of Demand for Consumption and Supply to enable balanced, energy-positive buildings and neighbourhoods



SmartCoDe Node

- Small size, low-cost chip
- On-board power measurement
- Control capability
- Wireless mesh networking
- Security designed in



SmartCoDe Concept

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SmartCoDe Nodes on Energy using products and local energy producers
Wireless mesh network communicates information and control

•Energy Management Unit coordinates strategic decisions on timing of energy use

Schedulable

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Smart CoDe

Node

Smart CoDe

Node

The Grid

Smart CoDe

Energy Forecasting



Key requirement for effective Demand Side Management with local energy production is to have a form of **energy forecasting**

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Energy Forecasting



- •Wind resource and weather forecasts as input
- Micro-scale
 correction for small
 wind turbine site
- •Exploring diurnal models as an option

 Advanced Energy Yield Model translates
 between available
 wind resource and
 resultant energy
 forecast

•Energy resource forecast feeds the Demand Side Management decisions

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Wind Resource Forecasting







Corrections to macro-scale resource information (including weather forecasts) based on topography variation and measured directional terrain roughness.

Directional terrain roughness illustration from S. McIntosh, "Wind Energy for the Built Environment", PhD thesis, University of Cambridge, May 2009.



Wind Resource Modelling



Simple diurnal model is proving a very promising alternate approach for wind resource prediction



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Advanced Energy Yield Model



Special care has to be taken to ensure the turbine energy yield model can provide useful values for shorter periods and complex wind resource

The SmartCoDe Approach



- Network of SmartNodes feeds information on local energy use to Energy Management Unit (EMU)
- Information on grid tariff
- Local energy production supply forecast from turbine
- "Cost function" broadcast to SmartNodes which can then act upon individual energy using products

Clusters of Small Wind and the Distribution Network

- Larger turbine clusters introduce challenges to distribution network
- A Demand Side Management approach that integrates the local energy production:
 - Reduces grid-side volatility of the turbine cluster
 - Maximises the value of the generated electricity for the customer

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