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Gearing up for a different grid

The increase in renewable energy sources and the increase in small generating plants is forcing a radical change in the management of electricity grids in Europe. The DISPOWER project - a consortium of 37 industry players and academic institutions - is supporting the transition of the grid's organisation to a more market oriented and decentralised structure. It is piloting new technologies and management systems that will enable grids to still provide a stable and safe supply of electricity to all consumers.

We all depend on electricity and presume that the sockets in our homes will reliably provide energy for us at the flick of a switch. Yet the large scale power blackouts in the United States and in parts of Europe in 2003 prove that the management of electricity grids has become a tricky business.

Firstly, the deregulation of the electricity industry in Europe has blurred the lines between producers and consumers. National grids have to cope with everything from large power stations to domestic solar panels. Secondly, a much larger proportion of electricity production comes from renewable - and highly unpredictable - sources, especially wind. Wind generators may sit idle or run at peak capacity, but their output is unrelated to demand.

Without effective management of capacity across the whole grid, electricity supplies could become as unpredictable as the weather itself. So how do you manage national and transnational grids so that supply meets demand, and electricity is available - at a standard voltage - to power everything from furnaces to freezers?

Preparing for change

The DISPOWER project has brought together 37 participants from across Europe. They include major energy producers and power plant operators, utility companies, grid managers and energy traders. The consortium also includes 17 academic and research institutions.

"The ultimate question is how can the future grid be organised to cope with fluctuation from sources, but be kept stable, with the same quality and reliability?" says Professor

Jürgen Schmid, one of the project's co-ordinators. "Our approach is that the grid must be transformed from a top down structure where the power stations are in control and deliver to consumers."

DISPOWER combines theory and practice in a wide ranging project that will prepare the way for distributed generation. The project considers the issues of grid stability and control; power quality and safety, and the requirements for information and communication between parties. Some participants have focused on management and communication structures and the socio-economic impact of distributed grids. Two laboratory grids have also been built to test new methods and technologies.

The different research strands are coming together in several pilot installations. These demonstrations will test the project's Power quality and Management System (PoMS). The PoMS development was led by DISPOWER second co-ordinator, Fraunhofer ISE.

The system actively manages distributed generation, controlling consumption, storage and power quality devices. It work towards the economic optimisation of regular operation as well as intervening during times of irregularity.

PoMS receives information on the operating status and costs from each component of the distributed grid and from the control centre of linked power stations. PoMS takes over the everyday operation of the distributed generators to ensure a stable supply of electricity. In addition, the power station can also ask PoMS to alter production according to the station's output. PoMS conducts load flow calculations and chooses the most economical combination of units that will provide sufficient power of acceptable quality.

Each pilot will test different aspects of PoMS. In Spain PoMS will control peak shaving in order to reduce the load at a 100 kVA transformer of a low voltage grid that is currently heavily overloaded. In Italy, PoMS will operate part an island grid. It will control the transitions between the island's connection to the regular grid and its functioning in island mode.

Harnessing the unpredictable

Another of the project's major successes has been the improvement of a wind power prediction tool. The model, developed by ISET in Germany, provides power forecasts for wind farms operated by National Wind Power, a large owner and operator of wind farms within the UK and a project participant.

The model uses artificial neural networks which are trained to learn the relationships between variations in the meteorological data (supplied by the UK's Met Office) and the wind power output, using historical data. In trials the new model successfully avoided a 2.7% production deficit and a 3.3% energy surplus.

Network communication

Ironically, another major achievement of the project so far is not related to the electricity grid, but to the network of partners. "Trying to co-ordinate so many participants across Europe requires a tremendous administrative effort. Imagine how many emails fly back and forth each day!" Schmid remarks. As project co-ordinator ISET has developed an online tool that manages all the documentation generated by the project, from emails and publications to news and appointments.

The Oracle based system allows every participant to access DISPOWER information and communicate with other partners. The software is now on the market and should help the management of similarly complex projects.

The DISPOWER project is partially funded by the European Commission within the Fifth Framework Programme (FP5), but it has already embraced FP6, forming a cluster with seven existing European projects. "Within this cluster we have formed cross-cutting activities," says Schmid, "including the exchange of laboratory experimental results and wider international co-operation. The well-balanced partnership will avoid duplication of work and will support a harmonised European approach for the introduction of the new technologies."

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