European Metrology Research Programme

Delivering Impact

Supporting smart renewable energy

The risks posed by climate change and diminishing traditional energy supplies are challenging conventional methods of electricity generation and distribution. To support more efficient energy use and increased generation from renewables, traditional 'one-directional' electricity transmission grids need to evolve into 'smart grids' capable of actively managing a complex network of decentralised energy supply and demand.

Europe's National Measurement Institutes working together

The European Metrology Research Programme (EMRP) brings together National Measurement Institutes in 23 countries to address key measurement challenges at a European level. It supports collaborative research to ensure that measurement science meets the future needs of industry and wider society.

Challenge

Smart grids are a key component in the energy infrastructure needed to meet Europe's target of 20% of energy consumption from renewable sources by 2020. But widespread adoption of smart grids is dependent on investor and consumer confidence in their ability to provide a stable high-quality electricity supply. This is underpinned by radically different instrumentation and control processes to traditional grids and requires the development of an appropriate measurement infrastructure.

Maintaining grid stability has been a major hurdle preventing greater introduction of non-conventional power generation into the electricity distribution system. Smart grids have to balance fluctuating energy supply with variable demand in real-time to achieve sufficient power quality and grid stability to prevent blackouts. Phasor measurement units (PMUs) are expected to be the 'life-support monitor' for the smart grids of the future. Deployed throughout the grid, PMUs assess and compare the power signals across the network, enabling grid operators to monitor and control these complex energy networks.

Solution

The EMRP project *Metrology for smart electrical grids* evaluated electrical power stability and quality during trials on smart grids in Sweden and Greece. Knowledge gained during these trials was used to generate best practice guidelines which support PMU users to achieve high-accuracy measurements in operational environments. This improved understanding of PMU and power quality instrumentation was disseminated to the smart grid community via a series of meetings with stakeholders.

Impact

Wind energy has the potential to play a central role in Ireland's transition to a low-carbon economy by 2050. The rapid expansion of wind power in Ireland has highlighted the need for a coherent plan, which allows the stable integration of localised renewable energy into the established grid system. The Micro Electricity Generation Association (MEGA), established to support the Irish government's plans to increase small-scale renewable energy generation, is incorporating best practice developed in the project in its first small-scale smart grid.

With support from South Dublin City Council (Tallaght City), the International Energy Research Centre (IERC - National Tyndall Institute), Siemens, Intel and Microsoft, MEGA is piloting a 'smart energy cluster' in the outskirts of Dublin, which links small-scale renewable energy generators with local consumers through a smart grid. Instabilities arising from the introduction of large-scale renewable power generation into existing grid systems can be avoided by gradually building small cellular smart grids that can be individually linked to the grid or assembled into larger multi-cell local grids.

MEGA's smart cluster distributes locally-generated wind and biogas power using a microgrid power stabiliser incorporating a PMU, which links the cluster to the main grid system and allows inflow of power when renewable generation cannot meet local demand. This removes the previous problems of grid instability and the need to dump conventional power during times of non-conventional power over supply. Through engagement with the project, MEGA received help evaluating the smart cluster's PMU and best practice guidance to enable accurate grid stability monitoring. Support from the project will help to ensure a reliable power supply to users of MEGA's smart cluster and the success of the pilot project.

MEGA hopes to eventually interconnect local small-scale smart grids into a citywide system for Dublin. This will be an important step towards widespread renewable energy generation in Ireland and a more stable, low-carbon energy future for Europe.

Metrology for smart electrical grids

The EMRP project *Metrology for smart electrical grids* and its successor projects, *Smart Grids II* and *GridSens*, are developing the measurement infrastructure needed to support successful implementation of smart grids in Europe. This includes the development of analysis and measurement tools for monitoring grid stability and quality of supply, and revenue metering systems for ensuring fair trade.

EMRP
European Metrology Research Programme
Programme of EURAMET

The EMRP is jointly funded by the EMRP participating countries within EURAMET and the European Union

www.euramet.org/project-ENG04

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