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# Integrated cyber-physical solutions for intelligent distribution grid with high penetration of renewables

## Results in Brief

### A ‘pluggable’ toolbox seamlessly imparts intelligence to today’s passive distribution grids

Sustainably ensuring reliable energy distribution to meet the world’s growing demands is a great challenge, complicated by the need to integrate an increasing proportion of intermittent renewable energy sources. A smart toolbox and cross-platform could be the solution.



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Among the enablers of future intelligent distribution grids are smart sensor technology and digitalisation that will support self-learning and self-healing approaches. Powerful edge based computing and cloud-based information processing will support the interconnection of the assets controlled by distribution system operators (DSOs). Exploitation of all these technologies and data streams will require comprehensive smart tools.

The EU-funded [UNITED-GRID](#)  project, coordinated by the Chalmers University of

Technology, has addressed these pressing needs. The team has delivered integrated cyber physical solutions to secure and optimise the operation of future intelligent distribution networks given their unprecedented complexity.



## Plug and go: Simple activation of comprehensive control

Stakeholders, including DSOs and energy providers, need a clear path for the transition from today's passive distribution grids to tomorrow's active and intelligent ones. UNITED-GRID's 11-member consortium of experienced research organisations, DSOs, a distribution management system (DMS) provider and expert SME partners was uniquely qualified for this complex endeavour. Anh Tuan Le, UNITED-GRID coordinator, explains the solution: "The project's core deliverable is a toolbox that can be 'plugged in' to an existing DMS via UNITED-GRID's cross-platform based on Atos' Codex Smart Edge technology to support advanced energy management, grid-level control and protection."

The toolbox integrates a renewables forecast tool, a congestion forecast tool, an advanced measurement solution, and a distribution state estimator. "These tools support capabilities including: forecasting of photovoltaic production and grid congestion; advanced real-time grid monitoring and control, the latter harnessing coordinated voltage control based on model predictive control as well as a self-healing function; microgrids protection; and dynamic state estimation-based protection for secure operation of the distribution grids," notes Le.

The new solutions embedded in the toolbox go beyond state of the art to optimise the operation of the grid with real-time control solutions integrating a high level of automation and cyber-physical security. They enhance reliability while ensuring that the grid resources are used more efficiently, leading to lower losses in the grids.

## From the edges to swarms and into the cloud

"The technical architecture of UNITED-GRID solutions is based on the Atos technology [Codex Smart Edge](#) , which relies on the deployment of a set of software nodes, called smart nodes. Smart nodes can collaborate via secured [middleware](#) . Unlike standard Internet of Things architectures where data is collected with no local pre-processing and directly sent to the public cloud, Codex Smart Edge allows local processing (edge computing) as well as collaborative local strategies between smart nodes (swarm computing)," explains Le.

The maturity of the project's key exploitable results exceeded expectations. Atos, the owner of the toolbox and cross-platform, will work with their DSO customers as a first step towards commercialisation. Le adds: "As the project has engaged three DSOs that are very interested in the project results, there is significant potential for further market uptake." UNITED-GRID's realistic and easy-to-integrate solutions will enable the DSOs to manage their grids securely and efficiently with high penetration of renewable energy sources, having a meaningful impact on achieving Europe's carbon neutrality goals.

# Keywords

UNITED-GRID, distribution grid, renewable energy sources, Codex Smart Edge, distribution management system, distribution system operator, cyber physical security, edge computing, swarm computing

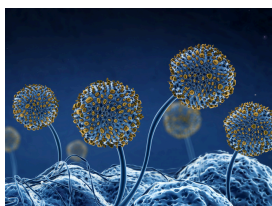
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### Project Information

#### UNITED-GRID

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