SUCCESS CASE 42.2025

SOLORMAX

A REAL-TIME DIGITAL TWIN DEMO FOR RENEWABLE CURTAILMENT OPTIMISATION IN LOW VOLTAGE NETWORKS BASED ON GRID STATE ESTIMATION

THE CHALLENGE

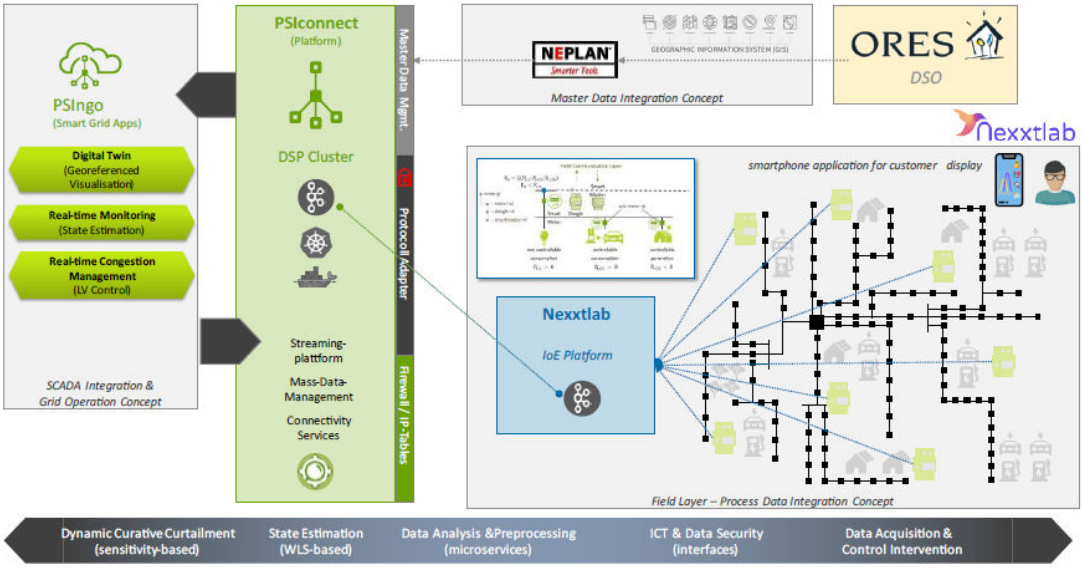
Belgium has one of the highest penetration rates of residential photovoltaic (PV) in relation to the total installed PV power, resulting in **overvoltage problems for PV-saturated low-voltage (LV) grids**. The Solormax initiative aimed to put in place a field demonstrator to verify that the promising theoretical simulations carried out using an **Optimal Power Flow (OPF) and using active power curtailment** have a similar impact on real networks. According to the simulations, if the aim is to maintain a standard voltage across the network, the use of an OPF via active power curtailment proved to be **one of the most effective systems for minimising curtailed energy while maximising the solar energy produced overall on the feeder.**

THE SOLUTION

The DSO ORES strategically selected **five LV networks** for the SOLORMAX project. Via a communication plan for each customer who agreed to take part in the project, ORES connected a device named **dongle Smartbirds from Nexxtlab** for **measuring energy data in real time at the smart meter level**. This dongle reports 10-second data to a customer application named Smartbirds that allows consumers to view this real-time energy data. By sharing their data, customers enable **ORES to collect energy flows in real-time at various network measurement points**. Using Application Programming Interfaces (APIs) that interrogate a data pool where ORES centralised information, the **digital twin of Ores' partner PSI,** named **PSIngo,** calculates the real-time status of the electricity networks under study. For consumption points with no measurement availability, the solution **applies load curves specific to the customer's profile to match reality as closely as possible**.

To validate the optimal sensor equipment in rural LV grids, a **sensitivity analysis of the grid state estimation** is carried out. Recommendations for the optimal sensor configuration are made by

comparing a scenario with transformer measurements and dongle measurements and one with dongle measurements only. Moreover, at certain **strategically chosen customer positions on the grid** (an arbitrary choice of two curtailed customers per network), ORES installed an **additional device capable of controlling the inverter via an IP protocol**. Therefore, when the digital twin PSIngo considers that there is an overvoltage on the network, it can decide to **send modulation orders for the injection of active energy** to these customers, thus **preventing other downstream inverters from tripping**.



IT architecture of the SOLORMAX project.

RESULTS

The initial conclusions drawn by ORES are as follows. Field demonstrators such as SOLORMAX face additional difficulties compared to those taking place in labs. While **customer participation plays a key role**, ORES encountered some difficulties in engaging with some of them. In fact, due to the architecture of the project, the installation of the required equipment could not be carried out (e.g., for customers who do not have a smartphone or wifi reaching their smart meter). While the system shows strong potential as the most efficient curtailment solution to **maximise overall production on the feeder**, identifying other channels for communicating energy data in real time will be essential for its potential industrialisation. This will potentially **open new business opportunities for aggregators**. On the other hand, the power curtailment of the inverters worked well, fulfilling **adjustability and response time** requirements.

WAY FORWARD

The project is underway and will finish end of 2025 with the delivery of a complete activity report.