

Leveraging Networked Data for the Digital Electricity Grid

UNLOCK THE POWER OF DIGITAL GRID DATA

Distribution system operators (DSOs) must assure the reliable and efficient electricity supply to geographically distributed customers – today, and in a green energy future.

Medium-voltage and particularly low-voltage (LV) grids are in most cases still designed and operated based on

- Historical assumptions for consumption and generation profiles to ensure correct voltage levels;
- Customer calls for time consuming fault-localization.

An increasing number of digital grid-related data sources (see Fig. 1) enables potential solutions that improve grid operation such as

- Smart meters at customer sites;
- Smart inverters connecting storage or distributed generation devices.

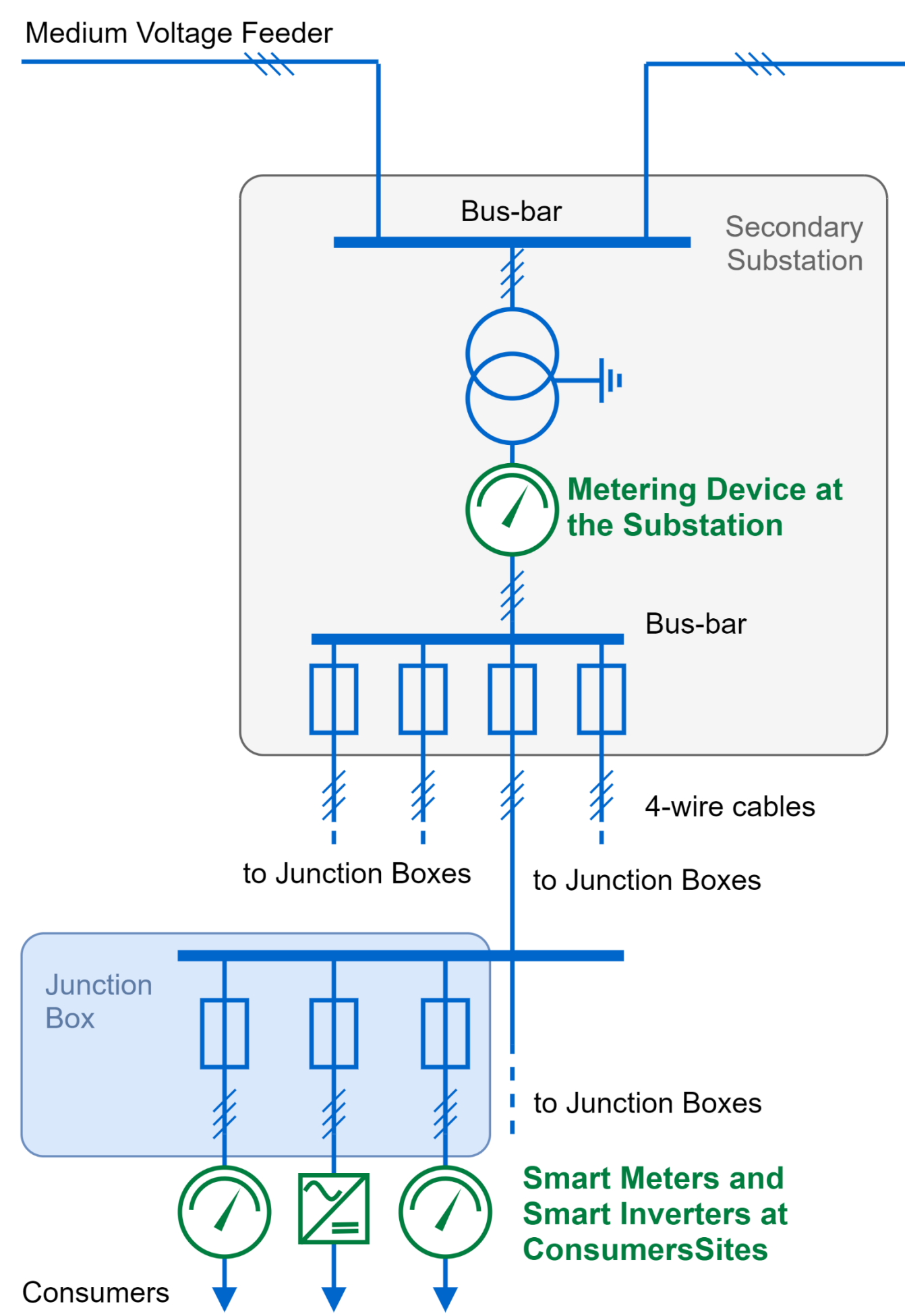


Figure 1: Visualization of measurement data sources in an abstracted LV grid representation

INCREASED GRID RELIABILITY, OPERATIONAL EFFICIENCY & HOSTING CAPACITY

Challenges:

- Development of a proof-of-concept solution for **LV grid observability applications** for voltage quality, grid operation efficiency and grid outage diagnosis;
- Subsequent use of the achieved observability applications by specifically developed novel **control coordination approaches** for voltage quality enhancement, loss minimization and an increased hosting capacity for distributed renewable energy sources.

Net2DG approaches:

- Leveraging measurement data from **non-DSO data sources** such as smart meters and smart inverters based on off-the-shelf computing hardware and available communication technologies;
- **Correlation** of non-DSO data sources **with DSO data sources**;
- Utilization of **existing** smart meter and smart inverter **actuation capabilities** in conjunction with selected existing DSO actuation;
- Establishment of DSO reference groups on national and European level for additional inputs and feedback on solution approaches;
- Experimental evaluation including simulations and **field trial validations** in two LV grids.

Figure 2 illustrates the Net2DG architectural approach. Grid measurement data from various sources are delivered to the ICT Gateway to allow an estimation of the LV grid (right side). On the basis of this data, the Grid Control Coordination can actuate the appropriate control action (left side).

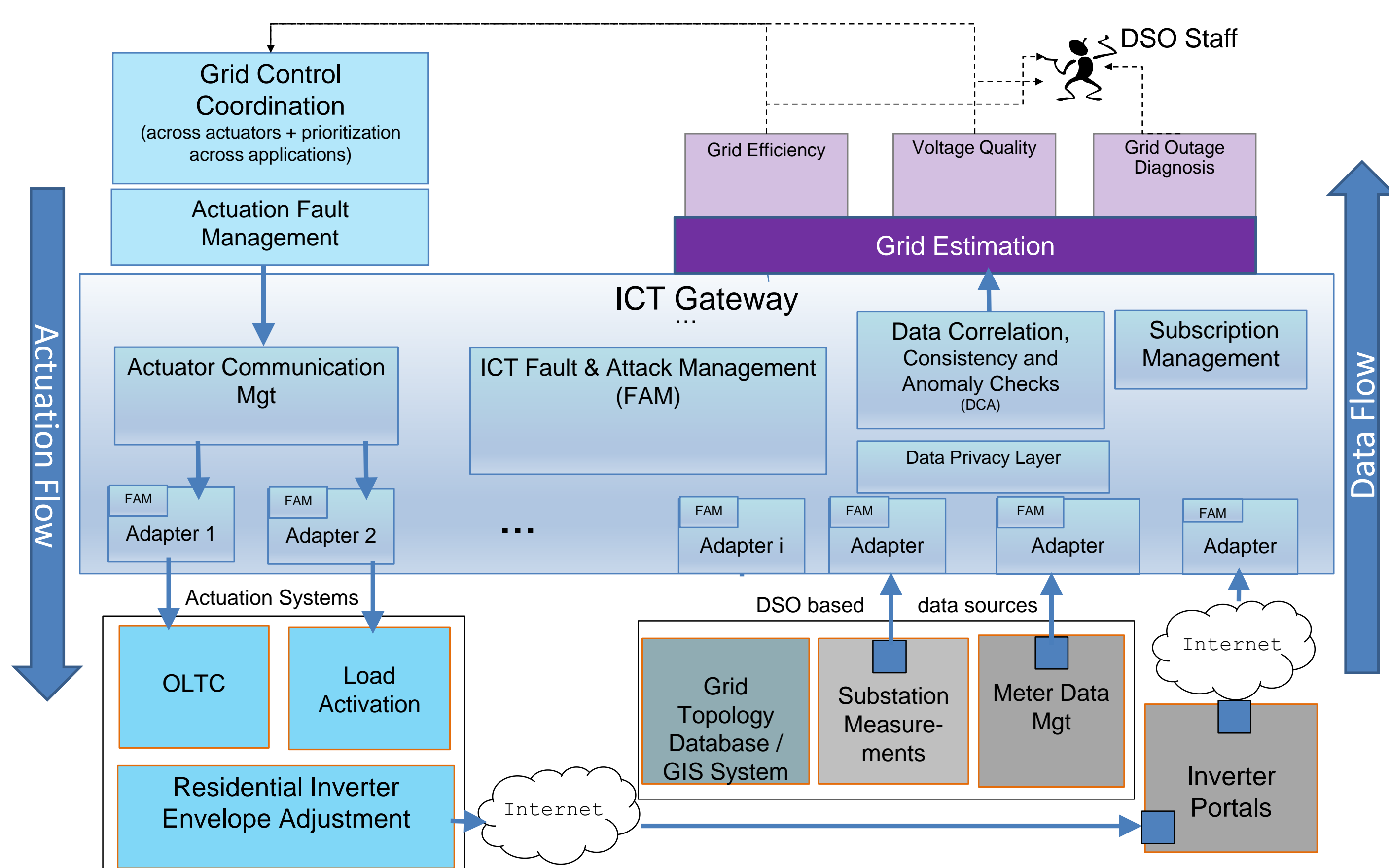


Figure 2: Architecture of Net2DG

The use of **off-the-shelf components**, the system level resilience and security solution, and the offered **customizability** of the Net2DG approach specifically address the needs of **regional DSOs**. Therefore, the Net2DG solution allows regional DSOs to become early adopters of digital technologies for LV outage diagnosis, grid operation efficiency optimization and voltage quality.

USE CASES FOR DIGITAL GRID DATA

The following **use cases** have been identified based on the DSO needs in the consortium:

1. Pre-outage LV grid fault detection
 - By detection of increased grid losses (see example in Fig. 3)
2. Post-outage LV grid fault detection, diagnosis and localization
3. Voltage quality measurement and optimization
 - Understand the causes of voltage variations and voltage dips/swells
 - Understand the contributions to reactive power behavior (see example in Fig. 4)
 - Investigate the mitigation of the above via inverter control
4. Loss measurement and minimization
5. Support for regional energy product design

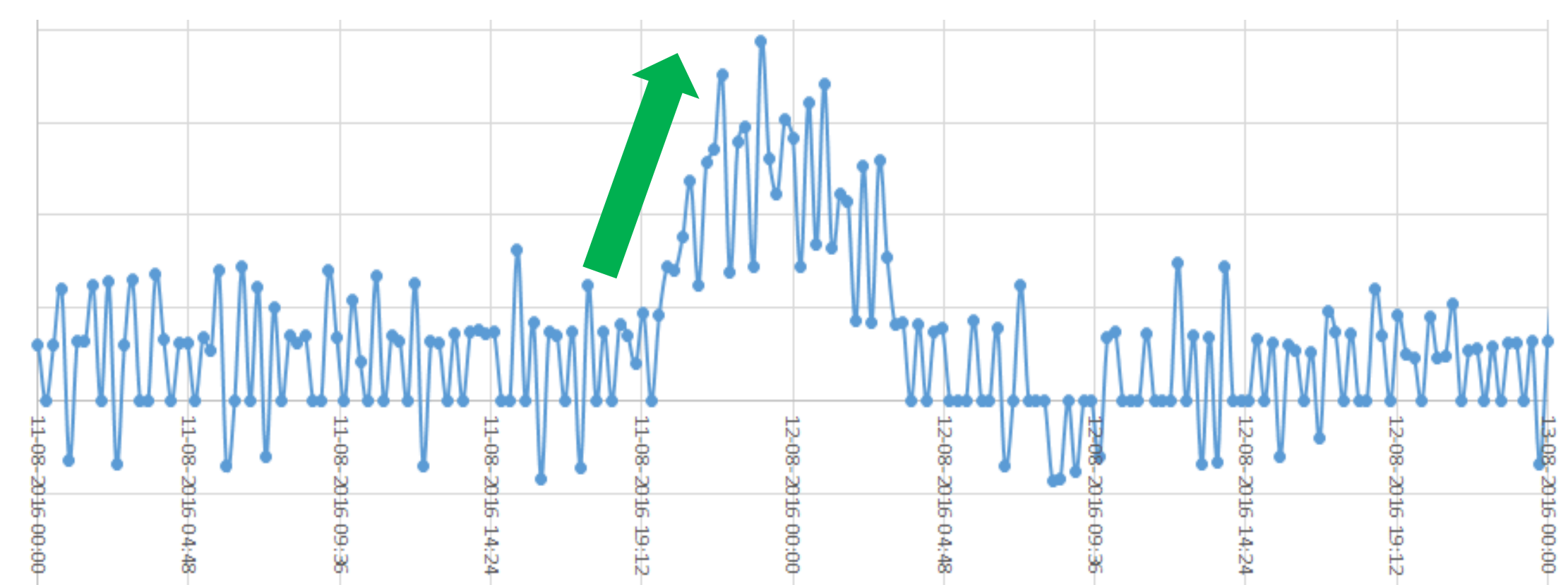


Figure 3: Pre-outage grid fault detection – observed increase of grid loss over time (several hours) at a secondary substation before an earth fault was localized

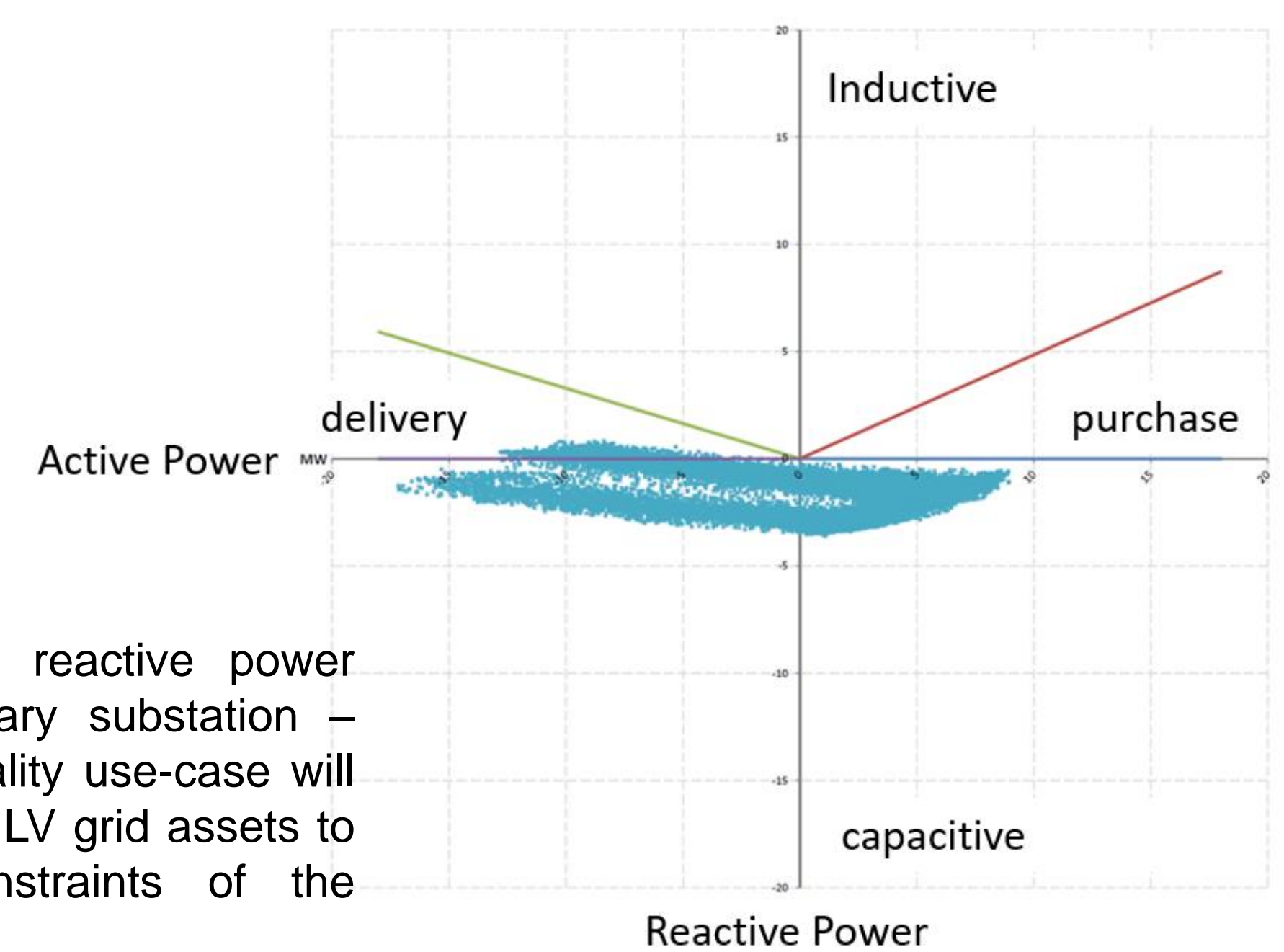


Figure 4: Active and reactive power measurement at primary substation – part of the voltage quality use-case will address means to use LV grid assets to achieve required constraints of the upstream grid operator

ADDED VALUE THROUGH PRIVACY-PROTECTING AND SECURE DIGITAL TECHNOLOGIES

How can LV measurement data be used to understand what happens in the grid, and how can this data be used to ensure a reliable & efficient digital distribution grid?

The success of the Net2DG approach will enable regional DSOs to **create value** from smart meter and smart inverter data in a secure and privacy-protecting manner. It will enable DSOs to

1. Detect and diagnose outages in low-voltage grids proactively and fast;
2. Obtain a detailed measurement of the actual energy losses in the grid and subsequently reduce energy losses without investments into additional grid infrastructure;
3. Measure and predict voltage quality in the distribution grid and mitigate voltage quality issues without investments into additional grid infrastructure.

As a consequence of increased observability and novel control coordination, LV grid reinforcement investments of DSOs for increased hosting of renewable generation are expected to be reduced by 30% in comparison to the currently used worst-case planning methods.

MORE INFORMATION AT [HTTP://WWW.NET2DG.EU](http://www.net2dg.eu)