# 049 SNOOPI
# Smart Network Control with Coordinated PV Infeed

*Project duration: from 10.2015 to 09.2018*
*Report submitted: 19.12.2019*

## Publishable Summary

The increasing amount of PV systems in distribution grids leads to an inverse load flow and a considerable voltage rise along the feeder at times with high PV generation. In order to enable further integration of PV systems into the distribution grid and keep the voltage within predefined limits (in Germany ±10 % of the nominal voltage), it is necessary to reduce the voltage. By providing reactive power, PV and battery inverter can reduce the voltage rise along the feeder and can contribute to an increased amount of PV systems without the necessity of grid reinforcements.

Within the framework of the project SNOOPI (Smart Network Control with Coordinated PV Infeed), new regulation tools have been developed to comply with set voltage boundaries. The voltage regulation tool based on reactive power control was designed to be scalable and transferable and can be applied to all distribution systems with high PV infeed paving the way for an even higher penetration of PV. Apart from developing and testing the voltage regulation tool, this study investigates the steady-state and dynamic hosting capacity of three low voltage grids and their corresponding medium voltage grids in Germany. The project was carried out by a consortium of the German engineering firm Energynautics GmbH, the German distribution system operator (DSO) EWR Netz GmbH, the Swedish university KTH and the Austrian inverter manufacturer Fronius International GmbH.

The main outcome of the project is an autonomous and transferable SNOOPI-Box controlling PV and battery inverters so that all inverters along a feeder provide reactive power in a coordinated way. The SNOOPI-BOX is completely autonomous because the box works independently without communicating with other boxes or devices. Thus, no communication infrastructure has to be implemented and even in remote locations with unstable communication situations, the SNOOPI-Box works reliably. Only violations of voltage limits can be reported to the DSO.

Without any communication or configuration, the SNOOPI-Box learns its position in the grid. Depending on its position, the reactive power control is adjusted. Thus, inverters located at the beginning of a feeder contribute in providing reactive power as much as inverters at the end of a feeder although they register smaller voltages. Even if the topology of the grid changes, e.g. through a switching of the grid, the algorithm adapts autonomously to this change by detecting the topology change. Without this ability, the inverter would provide too less or even none reactive power any more, if the location has changed from the end of a feeder to the beginning of a feeder where the voltages are lower.

The SNOOPI-Box is transferable because it is applicable to almost any arbitrary PV or battery inverter. This is achieved by using a SunSpec protocol enabling an interaction with all compliant devices of members and partners of the SunSpec Alliance. Among them are the world's leading manufacturers of inverters: SMA, Huawei, SolarEdge, Sungrow, ABB, Fronius and many others.

The control algorithm was successfully tested in a simulation model and in a laboratory setup, as well as in a real distribution grid in the network area of EWR.

## Project consortium

Coordinator and all contact details:

| | |
|---|---|
| Full name of organisation | Energynautics GmbH |
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Participating countries and financing:

| **Country** | **Number of organisations involved** | **Project costs in EUR** | **Public funding in EUR** |
|---|---|---|---|
| Germany | 2 | 526'063 | 302'496 |
| Austria | 1 | 0 | 0 |
| Sweden | 1 | 235'915* | 235'915* |
| *Total* | *4* | *761'978* | *538'411* |

## Funding agencies involved and contracts

| **Funding Agency** | **Contract N° and Title** |
|---|---|
| Projektträger Jülich, Germany | 0325771A |
| Projektträger Jülich, Germany | 0325771C |
| Energimyndigheten, Sweden | 68302 |