TRANSNATIONAL ACCESS
USER PROJECT FACT SHEET

USER PROJECT	
Acronym	DiNODR
Title	Distribution Network Oriented Demand Response
ERIGrid Reference	01.004-2016
TA Call No.	1

HOST RESEARCH INFRASTRUCTURE			
Name	SYSLAB, Technical University of Denmark (DTU), Department of Electrical Engineering, Energy System Operation and Management Research Group		
Country	Denmark		
Start date	28/08/2017	**Nº of Access days**	15
End date	15/09/2017	**Nº of Stay days**	20

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1. USER PROJECT SUMMARY (objectives, set-up, methodology, approach, motivation)

DiNODR project focuses on distribution network oriented application of demand response. Current demand response (DR) programs are designed for wholesale markets and utility level issues, neglecting the local challenges that distribution network operators face in daily operation. There is need to consider distribution network operation and constraints during demand response applications. Moreover, deployment of DR to specific parts of distribution networks can enable additional services and benefits. DiNODR project is aiming to contribute to this important area of study by developing a variety of device based DR methods, by evaluating the response performance of different devices and significantly by field testing of innovative DR methods on distribution networks.

The project has three main objectives; namely, to develop distribution network centered DR approaches, to investigate distribution network threatening cases in wholesale market-driven DR applications and to design integrated programs comprising local level and utility level DR solutions.
In the first stage of the tests, technical issues that can arise with in distribution networks were imitated using the test infrastructure and DR solutions were implemented using the available devices. The second stage was related to the impact of wholesale market or utility-driven DR actions on the local network. The last stage of the project was devoted to the development of coordinated DR programs that take into account the operational criterions and constraints of both transmission and distribution networks. The host research infrastructure is SYSLAB of Technical University of Denmark (DTU), Department of Electrical Engineering. It includes different types of residential loads, distributed generators, substations, low voltage (LV) network configuration options together with advanced communication and control availabilities.
This project is one of the first efforts to field test distribution network centered demand response applications.

2. MAIN ACHIEVEMENTS (results, conclusions, lessons learned)

Field-tests with internal control options of domestic appliances in two houses with real residents showed that, 4 to 7 kW DR performance can be achieved per house, improving voltage profile by around 1.5%. The length of response depends on the participating appliances' operational

constraints (temperature dead band limits, thermal insulation, program cycles and many more), while it is possible to maintain a determined response level based on the coordination of available devices in the portfolio of an aggregator. DR actions for phase balancing and reconfiguration support have also promising results with location specific deployment. Considering that real LV networks have lines with rather smaller cross-sectional areas and more devices that can participate in DR actions, better performances can be achieved in typical LV networks. The investigated localized feeder problems also confirmed the previous observations with IEEE European LV test system.
Utility driven DR actions that conflict with the current state of the local network have particularly critical negative impact on customers located far from the substation. Therefore, during wide utility-driven DR deployments, it is vital to consider local network constraints.
The final stage of the tests showed that it is possible to deploy local network oriented DR and utility-driven DR actions with inverse targets on the same LV network simultaneously, with a proper grouping of loads that have minor impact on each other's buses. Real time transition from one target to another for a number of devices is also possible, in the case of insufficient response to mitigate a local problem. Voltage sensitivity matrix with less than 100 mV error rate can be derived by collecting 30 samples per step change in power of each of the buses, highlighting the interrelations between the buses in a local network.

3. PLANNED DISSEMINATION OF RESULTS (journals, conferences, others)

The project has a number of dissemination tools. Formal dissemination activities are going to be scientific publications (two journal papers and one conference paper) and the project website, while there are three semi-formal activity groups as a session in a workshop, social media pages (LinkedIn and ResearchGate), newsletters as well as reference on the websites of the Departments of Electrical Engineering of both Istanbul Technical University (ITU) and Western Macedonia University of Applied Sciences (TEIWM). In every 2 months following the field tests, a newsletter that explains dissemination activities will be published. It is planned to be distributed through a registered mailing list and also the user project website.