

# DiNeMo: Distribution Network Modelling platform to design urban grid areas

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## Research context and motivation

- Nowadays the emerging electrical paradigm is focusing on the central role of the consumers. At the distribution level a variety of emerging technologies and services, such as vehicle-to-grid and demand response are becoming more widespread. From a techno-economic point of view a deep understanding of these technologies is key to address current challenges and their potential benefits on the whole system.
- Emerging technologies such as, electric vehicles, distributed storage and demand response are also candidates for providing the required flexibility to the distribution system. The role of the Aggregator is naturally emerging to cope with this task. Indeed, the interaction with the Distribution System Operator (DSO) and with other new actors needs to be understood and properly assessed.
- The relative limited number of available distribution network layout, the lack of well documented network grids parameters, which often are manually designed inevitably require the creation of an adequate platform able to reproduce the configuration of specific urban networks area.

## Addressed research questions/problems

- How can reliable electricity distribution network grids be designed for an urban area of interest?
- How representative reference distribution network grids be statistically validated with real networks?
- What are the main technical difference across the European DSOs and how are they managing the new charging infrastructure installation within their operating network?

## Novel contributions

- The creation of "DiNeMo" an online platform which allows the development of a distribution network model based on OpenStreetMap information. The platform is also bound to become the virtual place where diverse users, with different roles, will collaborate with the aim of building reliable models to be used in order to design and develop the smart cities of tomorrow.  
**DiNeMo:** <https://ses.jrc.ec.europa.eu/dinemo>
- The Distribution System Operator report aimed at updating and upgrading the distribution grid techno-economic data, of the first release, through an on-line questionnaire directly filled by DSOs' representatives. In this second release in fact we expanded the available sample, having collected information from a wider pool of European DSOs representing a larger part of the European networks.  
**DSO Report:** <https://ses.jrc.ec.europa.eu/distribution-system-operators-observatory>

## Submitted and published works

- M. G. Flammini, G. Pretico, G. Fulli, E. Bompard and G. Chicco, "Interaction of consumers, photovoltaic systems and electric vehicle demand in a Reference Network Model", 2017 International Conference of Electrical and Electronic Technologies for Automotive – Torino 15-16 November 2017.
- A. Lucas, G. Pretico, M. G. Flammini, E. Kotsakis, G. Fulli, M. Masera, "Indicator-Based Methodology for Assessing EV Charging Infrastructure Using Exploratory Data Analysis", *Energies* 218, 11 (7), 1869.
- M. G. Flammini, G. Pretico, A. Julea, G. Fulli, A. Mazza and G. Chicco, "Statistical Characterisation of the Real Transaction Data Gathered from Electric Vehicle Charging Stations", *Electric Power Systems Research* 166: 136-150, 2019.
- Pretico, G., Flammini, M. G., Andreadou, N., Vitiello, S., Fulli, G., Masera, M., Distribution System Operators observatory 2018 - Overview of the electricity distribution system in Europe, EUR 29615 EN, Publications Office of the European Union, Luxembourg, 2019, ISBN 978-92-79-98738-0, doi:10.2760/104777, JRC113926.
- Andreadou N. Flammini M. G., Vitiello S., *Business Models for Electricity Distribution in Europe: Evidence from the JRC DSO Observatory 2018*, CIRED 25th International Conference on Electricity Distribution – Madrid 3-6 June 2019.
- Flammini M. G., Pretico G., Mazza A., Chicco G., Electricity Price forecasting through generators bidding strategies: the North-Italian case (submitted to Energy Policy)
- Flammini M. G., Grzanic M., Pretico G., DiNeMo: Distribution Network Modelling platform methodology and validation (submitted to Energies)

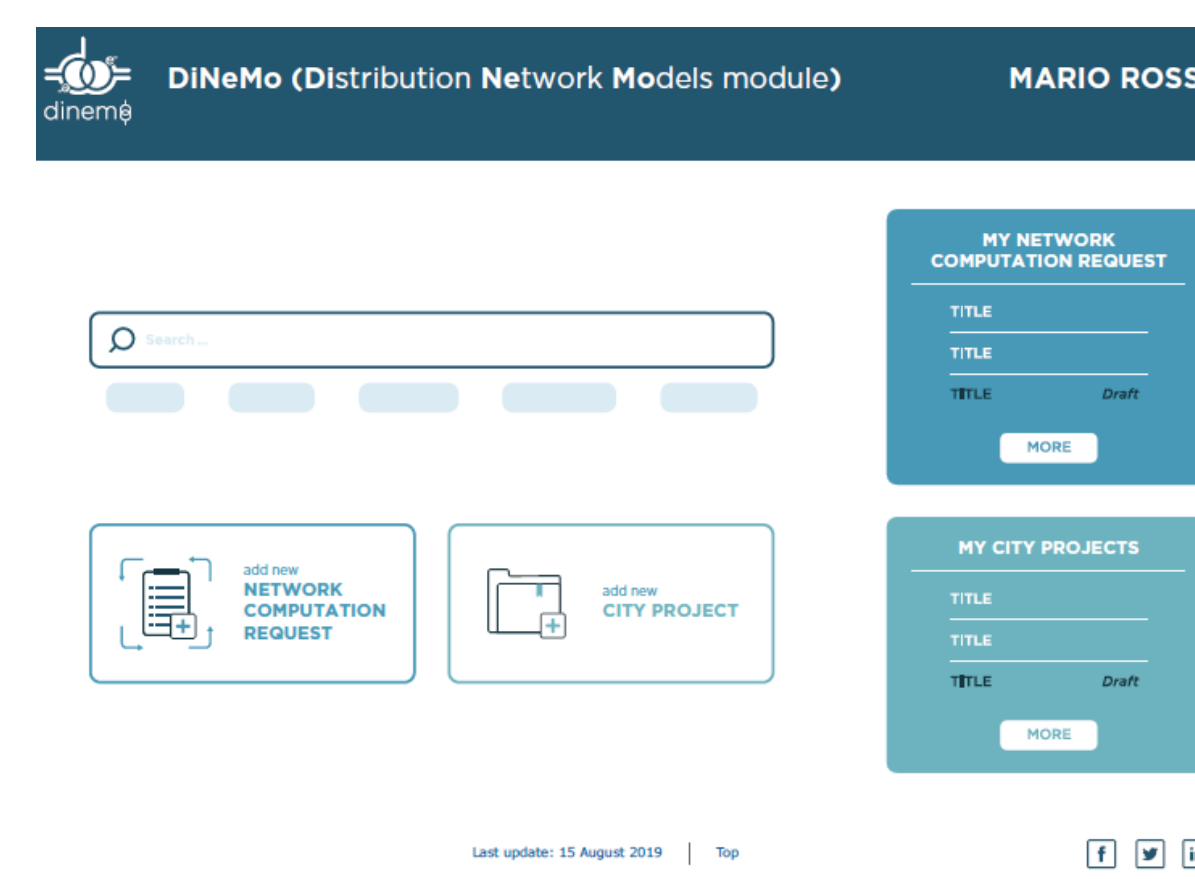
## Adopted methodologies

1. Deepen the knowledge of distribution grids and operators by collecting data directly from DSOs representatives through a survey focusing on technical features.
2. Determine a set of 10 indicators from the 36 collected which can be utilized to build a representative reference networks.
3. Develop an online platform (DiNeMo) to provide to stakeholders in the electricity sector a tool to design distribution network grids for of a given area of interest.
4. Interact with European DSOs in order to statistically validate the electricity distribution network grids built with the platform and compared to the real one. In addition to this, improve the user experience, fix bugs and modify the platform layout.
5. Perform power flow analysis and optimization algorithm to understand the most convenient location to install electric vehicle charging stations.

Distribution Grid Network with DiNeMo



DiNeMo user homepage platform



## Future work

- Further development of DiNeMo by testing and validating further distribution network grid with European DSOs (for i.e. with ENEL, Endesa, etc.).
- New Survey in which technical information concerning substation, cables and lines will be collected from each DSO.
- Improving the user experience and the layout of DiNeMo, as well as increasing the interaction with the users by developing a city project section.

## List of attended classes

- 01LGSRV – Characterization and planning of a small-scale multigeneration system (2017, 25)
- 01LYXRV – Electrical load management, forecasting and control (2018, 25)
- 01SHMRV – Entrepreneurial Finance (2019, 5)
- 01SYBRV – Research Integrity (2019, 5)
- 01SWQRV – Responsible research and innovation, the impact on social challenges (2019, 5)
- 01LEVRV – Power system economics (2017, 15)
- 02LWHRV – Communication (2018, 5)
- 01RISRV – Public speaking (2018, 5)
- 01SWJRV – Control and optimization in Smart Grids (didattica di eccellenza vp) (2018, 20)
- 08IXTRV – Project management (2018, 5)
- 02RHORV – The new Internet Society: entering the black-box of digital innovations (2018, 6)
- 01SWPRV – Time management (2018, 2)
- 01QTOIV – Towards ZEV: technologies for vehicle pollutant emissions control (2018, 20)
- The Italian Wholesale Electricity Market – REF-E (2017, 16)
- Python Course for Scientist & Engineers – JRC (2019, 30)
- Fundamentals of peer review – JRC (2019, 4)
- Energy Exemplar software – PLEXOS (2019, 18)
- Personal resilience – JRC (2019, 2)