

Summary

Smart cities, with prosumers at the centre, are at the front line of the energy transition. The national and international policies should encourage then this transition by promoting, among many aspects, energy digitalization, massive penetration of renewable energies and electrification of the transport sector. To embrace all these changes, a holistic view, covering not only the distribution system, is necessary to plan, design and reorganize in particular urban areas. The radical distribution networks transformation is monitored and presented, both considering technical and non-technical aspects, which aims at encouraging potential directions that distribution system operators can pursue.

The thesis work has three main objectives. From the distribution system operator (DSO) perspective, the main objective is to investigate how the technical and non-technical features vary among distribution system networks in Europe. From the modelling perspective, the second main objective is firstly to define a method which incorporates the previous findings to properly design a tool able to reproduce representative urban networks and secondly to validate the results through a statistical methodology. From the electric vehicle's infrastructure perspective, the third main objective is firstly to understand the electric vehicles demand behaviour and develop models capable of reproducing them, and secondly to assess, through a dedicated methodology, the electric vehicles charging infrastructure features and performance.

The results from this thesis indicates that the increasing attention toward the distribution sector should not be underestimated by the main actor, distribution system operator, which appears to have different approaches in smartening and digitalizing their network especially concerning electric mobility, demand response and

data management between distribution and transmission system operators (TSO). It is urgent for policy makers and stakeholders involved to align distribution system operators to a common strategy to tackle the introduction in the distribution network grids of new players. Tools like DiNeMo platform applied in this thesis may be used to perform preliminary research studies concerning the installation of new charging infrastructure, renewable energy generators or network reinforcement analysis. Indeed, it is crucial for regulators to take into account the physical layer of distribution grids when designing new policies and incentives in order to address challenges of tomorrow's cities.

Keywords: distribution network; charging station; modelling; distribution system operators; synthetic grids; optimization; electric vehicles.