# BUILDING AND URBAN ENERGY

## DESIGN OF DISTRIBUTED URBAN ENERGY SYSTEMS UNDER UNCERTAINTY

### **BACKGROUND & AIM**





Uncertainty characterization refers to the task of identifying the uncertain parameters of an a. energy hub model and assigning a mathematical description to their uncertainty.



Optimization under Uncertainty (OU2) aims to identify "how to act now, before uncertainty is C. resolved". Stochastic Programming (SP) and Robust Optimization (RO) are used to optimally design an energy system "here and now" that will minimize the expected and the worst-case cost/emissions, respectively, for any realization of the uncertain parameters.



scenarios Elec price scenarios Gas price scenari Grid carbon

Conceptual illustration of an urban energy hub and the different types of uncertainties that are considered in this PhD

Uncertainty and Sensitivity Analyses (UA&SA) aim to b. investigate uncertainty's impacts by examining the energy hub model's output variation due to input uncertainty and qualitatively and quantitatively identifying the main parameters that drive this variation.



Monte Carlo variation of optimal energy system design for a building (each red line refers to a Monte

### Carlo run, while the dashed line refers to a deterministic design).



2D histogram of a building's annual and peak heating and electricity energy demands









