



# MSc thesis proposal

- Title of the research

**Preliminary Resilience Analysis of Energy Critical Infrastructures (ECI) Exposed to Extreme Natural Hazards by Means of Advanced System Modeling and Simulation Tools**

- Objectives of the research

**Context:**

Modern society depends on critical lifelines, like electric power and natural gas, telephone and other communication systems, water, wastewater and transportation systems. Many of these infrastructures are aging and are exposed to different natural hazards (e.g., earthquakes, tsunamis, hurricanes and floods), whose intensity and severity has been increasing in the past years, possibly due to climate change. Resilience has become a relevant attribute to consider in the design for the management of any infrastructure, for ensuring the capability of withstanding disruptive events and recovering performance.

Scenario simulation plays a key role for analyzing resilience and informing investments on prevention, mitigation and recovery. However, it becomes computationally demanding when exploring the response of the complex Critical Infrastructures (CI) under uncertain disruptive events. In this view, for example, Artificial Intelligence (AI) and stochastic simulation can be combined for simulating efficiently the response of an infrastructure exposed to an uncertain disruptive event, under uncertain operational and environmental conditions.

**Activities:**

Within this general framework, we will focus on the Energy Critical Infrastructures (ECI) for their pivotal role in supporting other infrastructures and society as a whole, in a scenario of energy transition. The main activities of the MSc student will be the following:

- carry out a synthetic literature review about the problem of resilience in Energy Critical Infrastructures (ECIs).
- build a *simplified model* of an Integrated Energy System (combining, e.g., a Gas Turbine Plant, a Nuclear Power Plant, and a Wind Farm), using preferably MATLAB or Python (anyway, other programming options can be discussed). The information about the ECI to model is precise and *already available in the open literature*.
- Option to be discussed: randomly generate few scenarios associated to extreme natural events (in particular, an earthquake and/or a tsunami). Perform preliminary evaluations about the robustness/resilience of the ECI with respect to such scenarios.

- Duration of the thesis

Around 6 months (anyway, this aspect can/should be discussed)

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