

## EIFER & EDF R&D PhD project for 2024

### **INNOVATIVE DISTRIBUTION GRID PLANNING METHODS BY AN ARBITRAGE BETWEEN GRID REINFORCEMENT AND NEW FLEXIBILITY USES, IN GERMAN CONTEXT**

#### CONTEXT

EIFER – European Institute for Energy Research was founded by EDF (Electricité de France) and KIT (Karlsruhe Institute of Technology), to bridge the gap between science and energy industry. In the context of the European energy transition, EIFER provides research-based innovative energy solutions for the sustainable growth of cities, local communities and industries. The role of EDF R&D is to support the EDF Group's operational branches in the development of the power system and power grid in France, in Europe and worldwide.

The power distribution grid, managed by Distribution System Operators (DSO), will be particularly affected by the energy transition. All the scenarios for achieving carbon neutrality involve massive growth in decentralized generation. In Germany, the ambition of the “Energiewende” has dramatically increased with a share of renewables in the power mix in 2030 being set at 80% (against 47% in 2022). This development (mainly of wind and PV power) will be accompanied by new uses and technologies: electric vehicles, storage, demand response, production modulation, hydrogen, etc.

This new context is drastically changing power flows and voltage profiles. It thus creates already now many grid congestions that require costly remedial actions such as renewable curtailment, for over 4 billion euros per year (Germany 2022). This calls for a rethinking of the local grid design, selecting the right levers to achieve decarbonization target efficiently. New grid planning methods need to be developed that allow arbitrating between grid reinforcement and local flexibility use, from a techno-economic perspective. This PhD has the objective to identify and develop innovative methods for an optimal distribution grid design that considers existing and innovative levers to maintaining grid safety. These methods shall be generic enough to comply with different local energy configurations, starting from the current academic and industrial practices in France and Germany.

#### OBJECTIVES AND APPROACH

The general approach of the PhD (to be refined with academic supervisors and PhD student) will be broadly as follows:

- Analyze the state of the art of industrial and academic grid planning practices and grid design methods, in particular in Germany (in cooperation with EIFER).
- Develop and implement new planning approaches and tools (criteria, method, levers and indicators), adaptable to different grid types and scenarios.
- Validate the proposed methods, and compare different approaches, including reference ones to illustrate the added value.
- Apply of the developed method in realistic case studies: based on realistic local situations and grids, identifying reinforcement and flexibility solutions in different scenarios, to interpret results (technical and economical) and their sensitivities to parameters and local configurations.

Important skills and competencies:

- Knowledge in Energy Economics, or Electrical engineering and power grids.
- Knowledge in optimization.
- Experience in scientific programming, particularly in Python and/or Matlab.
- Good written and oral skills in English. French and German would be an advantage.

Appreciable skills:

- Knowledge in costs-benefits analysis.
- Experience with code management tools (e.g. Git).

Soft skills:

- Rigor in writing and presentation (conferences, reviews, manuscript, defense...).
- Rigor in programming. Programs must be clean, commented and documented.
- Team spirit
- Curiosity and interest in these topics
- Proactiveness
- Autonomy with ability to step back and interpret.

#### QUALIFICATION

Advanced university degree (master) in electrical engineering, industrial engineering or comparable program.

#### TOOLS

Python, Matlab.  
Experience with power grid tools would be an advantage (e.g. panda power)  
Usual office tools

#### CONTACTS

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#### CONDITIONS

The conditions will follow the format of the French CIFRE thesis (duration 3 years). The international opening will allow for at least an experience in EIFER, or extending the stay up to 50% of the 3-years-period in Germany. It includes the possibility for a double degree (cotutelle) with KIT.