

## RESEARCH TOPIC FOR THE PARISTECH/CSC PHD PROGRAM

**Field:** *Energy, Processes*

**Subfield:** Energetics, Optimization, Life cycle, Microgrids, Multi-energy,

**Title:** Impact of the life cycle of multi-energy micro-grid systems on their energy efficiency

**ParisTech School:** Arts et Métiers Sciences et Technologies

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**Research group/Lab, Lab location:** LISPEN, Aix-en-Provence, France

**(Lab/Advisor website):** <https://lispen.ensam.eu/>

### **Short description of possible research topics for a PhD:**

This research project aims at developing a decision tool that proposes various multi-energy mix compromises (electric, photovoltaic, wind, thermic, hydraulic, nuclear...) able to ensure autonomy for a given territory and optimizes environmental, technical and economic objectives, taking into account the life cycle of the mix.

Most energy optimization studies focus either on the modelling / dimensioning of a single energy system, or on long term global prospective studies of single energy mix like MARKAL-TIMES models who ignores most of the physical parameters. This work aims at developing a microgrid model of energy mix using aggregated energy models of each production, storage and grid technology, based on technological parameters that represent each device on its global life cycle. The use of metaheuristic optimization methods will result in a decision-support tool that provides a wide range of energy mix defined by technological parameters, improving objectives like the global energy consumption, gases emissions and cost.

Previous works from our research team have developed a microgrid model that mainly focuses on the operating phase [1]. The main goal of this PhD is to improve this existing innovative tool with the life cycle of the energy mix and assesses its global environmental and economic impact.

**Required background of the student:** Energetics, Engineering, Computer science

### **A list of 5 (max.) representative publications of the group:**

1. N. Dougier, P. Garambois, J. Gomand and L. Roucoules, « Systemic approach for local energy mix assessment », Proceedings of JCM 2020, Aix-en-Provence.
2. T. Lambert, P. Gilman, and P. Lilienthal, « Micropower System Modeling with Homer, in Integration of Alternative Sources of Energy », F. A. Farret et M. G. Simões, Éd. Hoboken, NJ, USA: John Wiley & Sons, Inc., p. 379-418, 2006.
3. N. Maïzi, E. Assoumou, M. Bordier, G. Guerassimoff, and V. Mazauric, « Key features of the electricity production sector through long-term planning: the french case », IEEE PES Power Systems Conference and Exposition, p. 1796-1801, 2006.
4. A. Chaouachi, R. M. Kamel, R. Andoulsi, and K. Nagasaka, « Multiobjective Intelligent Energy Management for a Microgrid », IEEE Transactions on Industrial Electronics, vol. 60, no 4, p. 1688-1699, 2013.
5. E. Kuznetsova, Y.-F. Li, C. Ruiz, and E. Zio, « An integrated framework of agent-based modelling and robust optimization for micro-grid energy management », Applied Energy, vol. 129, p. 70-88, 2014.