



## Internship

Date : 07/11/2023

**Company :** Centre Scientifique et Technique du Bâtiment (CSTB)  
Technopole Sophia Antipolis, Côté d’Azur, France  
SIMULABS Division

**Internship tutor:** Enora GARREAU

### Optimisation of the decarbonisation trajectory for a group of buildings

**Applications:**

CV and covering letter to the following mailing list:

[robin.girard@mines-paristech.fr](mailto:robin.girard@mines-paristech.fr)

[Enora.GARREAU@cstb.fr](mailto:Enora.GARREAU@cstb.fr)

[Thierry.Guiot@cstb.fr](mailto:Thierry.Guiot@cstb.fr)

Please indicate the desired internship period

**Context:**

In order to support stakeholders in implementing the national low carbon strategy “Strategie National Bas Cardone” (SNBC) and the decarbonisation roadmap, it is necessary to define optimal decarbonisation trajectories (carbon/cost) for their building stock. This involves providing support to local authorities (guiding regional policies, helping to define and implement climate, air and energy plan for the country’s territory “Plan Climat Air Energie Territoire” (PCAETs), etc.) and building managers (prioritising and scheduling work to define their strategic plan, etc.).

To address these issues, a Python module called SHAPE has been developed at CSTB thanks to several PhD theses. This module focuses on the thermal renovation of a housing stock. The characterisation of buildings is based on the open-source French National Buildings Database (see <https://bdnb.io/>), energy consumption is calculated using a simple thermal calculation method equivalent to the energy performance certificate (EPC), and the modelling of renovation work is based on a database of renovation actions associated with Life Cycle Cost Analysis impacts. The optimisation and constraints are formulated for the entire building stock under consideration (in terms of energy, CO2 and costs) and a calculation of renovation scenarios for each building (series of renovation actions) is produced for a given time horizon at each time step.

The optimal trajectories are identified using a Knapsack-type method that calculates the global optimum of a constrained optimisation problem.

**Tasks:**

After a phase of familiarisation with previous work and becoming comfortable with the SHAPE module, the aim of this work placement is to go back over the characterisation of the optimisation space, to ensure that the current resolution method is the most appropriate, to identify the optimisation software modules that exist under free or paid licence (currently MOSEK), and then to test them.

This internship may lead to a PhD thesis focusing on the robustness of the SHAPE module with respect to uncertainties affecting the module's inputs.

**Qualifications:**

- A solid background in operational research: the candidate will need to mobilise and deepen his/her knowledge of constrained optimisation methods.
- An interest in participating in a professional research project, as the internship could lead to a thesis focusing on the qualification of the robustness of the SHAPE module.

**Qualities required:**

- Sensitivity to environmental issues and an understanding of the challenges of climate change. The candidate will be immersed in a research team focusing on these issues applied to the construction sector.
- Significant experience in Python.

**Expected deliverables:**

- Detailed analysis report
- Summary analysis report to be presented to the team

**Learning/teaching/experience acquired at the end of the internship:**

- Contribution to the development of an innovative decision-making tool.
- Use of mathematical skills applied in a specific research context
- Working as part of a team of researchers
- Use of collaborative software development tools
- Introduction to a PhD thesis to be started from Q4 2024.

**Candidate profile:** Engineering student, 5 years' higher education.

**Placement:** Sophia Antipolis (possibility of working from home once the integration phase is over).

**Duration:** 4 to 6 months in 2024, starting as soon as possible.

**Bonus:** Between €1,000 and €1,200 gross per month, depending on year of study and time spent on the course.