

Project – Modeling and optimization for EPFL energy systems

Lecture ME 454

Modeling and Optimization of Energy Systems

Prof. F. Maréchal

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Course organization

Lecture aggregated by topics

- 12 topics over the semester
- The calendar might change over the semester, check it from time to time

Project material

- Project description (pdf)
- Project starter pack and tutorial (gitlab)

Course website

- Link in moodle in the Lecture section
- Lecture notes: theory supporting material
- List of theory questions

Week	Date	Agenda class	Theory covered	Project work	Submissions
1	09.09.2024	Course introduction Introduction to Part 1		Project overview + Task 1	
2	16.09.2024	Holiday		Task 1	
3	23.09.2024	Lectures T1, T2 Introduction to Part 1 NR	T 1: Energy demand analysis: building modeling T 2: Equations and solving methods	Task 1	
4	30.09.2024	Lectures T3, T4 Work on Part 1 Introduction to Part 2	T 3: Key Performance Indicators T 4: Estimating the investment	Task 1+2	
5	07.10.2024	Lecture T5	T 5.1: Flowsheet simulation and DOF T 5.2: Stating optimisation problem and solving strategies	Task 2	
6	14.10.2024	Lecture T6 Work on Parts 2	T 6: Solving optimization problem	Task 2	
7	21.10.2024	Holiday			
8	28.10.2024	Lectures T10, T11 Introduction to Part 3	T 10: MILP optimization methodology T 11: Techno-economic analysis by MILP optimization	Task 3	
9	04.11.2024			Task 3	
10	11.11.2024	Lecture T7, T8 Work on Part 3	T 7: Constitutive equations T 8: Resolution sequence definition	Task 3	
11	18.11.2024	Lecture T9 Work on Part 3 Introduction to Part 4	T 9: Data reconciliation and parameter identification	Task 4	Submit Preliminary Report
12	25.11.2024	Flip class		Task 4	
13	02.12.2024	Work on Part 4		Task 4	Submit Review
14	09.12.2024	Lecture T12	T 12: Multi-objective optimization	wrap up	
15	16.12.2024	Project presentation and feedback		wrap up	

It is not graded !

Each group must prepare a **thematic discussion** on:

- The theory of the course
- How they applied it in the project
- Reply to some questions from the students / TAs

The goal is to do a summary of the theory and to have an interactive discussion

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Project and Grading

The project is split into 4 main Tasks

Grading Method

- Oral Exam
- Group Project (5-6 Students)
- Review

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Milestones and Deliverables

Project milestones

- Project presentation and feedback on the last day before Christmas break.

Project deliverables – Submitted in moodle:

- Midterm report, 1 per group (not graded)
- Peer-review, 1 per person (graded)
- Final Report , 1 per group (graded)
- The final report is due 10 days before oral exam (early-mid January)

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Important Platforms

Moodle (forum),

Virtual machine: your working platform !

Quarto: reporting and coding

Auxiliary website: project QA, Lecture, theoretical questions

Mattermost: interaction with TAs

Miro: presentation

Moodle contains all **material** & **files** necessary for the course & project (together with gitlab).

Check before each class, updates may occur !

▼ **Project material** This week

During the semester, we will be using Quarto (qmd) to perform calculation and reporting of the results. Once your group is formed, you will get access to a **gitlab** repository containing a qmd template for your project. Any data required for the project is available in this repo. In addition, a quarto Tutorial is given. Download the .zip file, open the _book folder and double click on any of the html file to open the document.



Project description



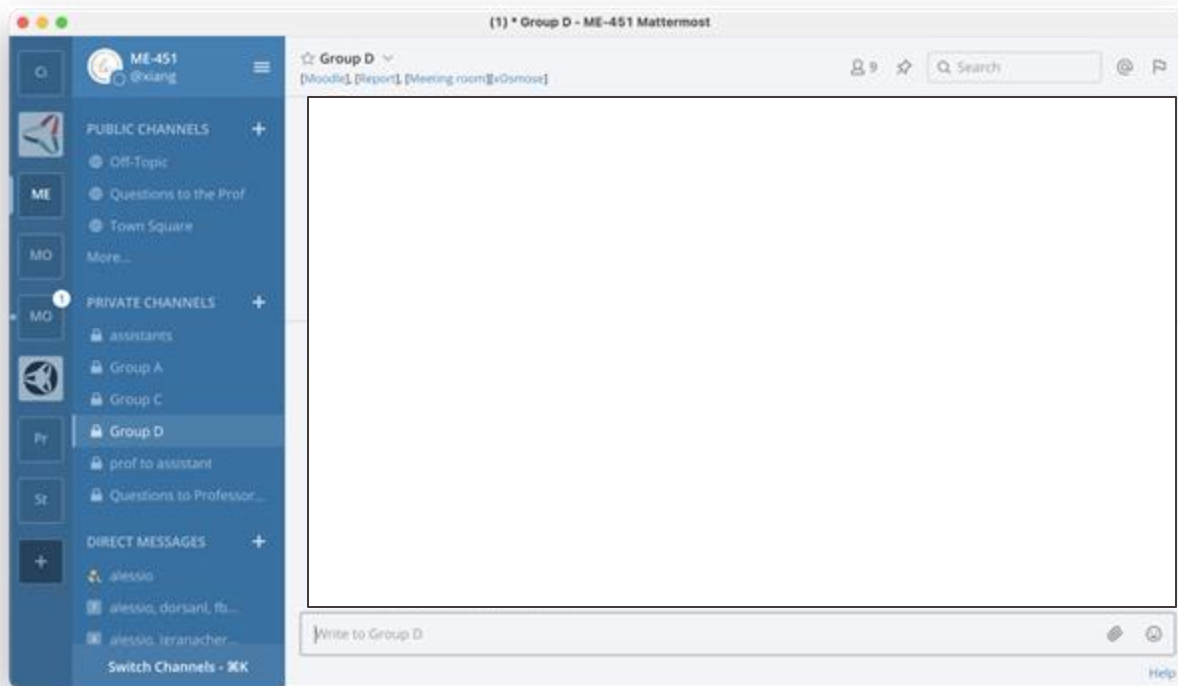
Quarto tutorials

Link to join the mattermost group is in moodle

[Docs](#)[Features](#)[Apps & Integrations](#)[Blog](#)[Contribute](#)[Enterprise](#)[Download](#)

Direct communication with assistants
and your group members via chat.

- **Install** the software from the website
- **Sign up** in a group on moodle
- Please ask questions to TAs **only in group channel**, not with private messages !



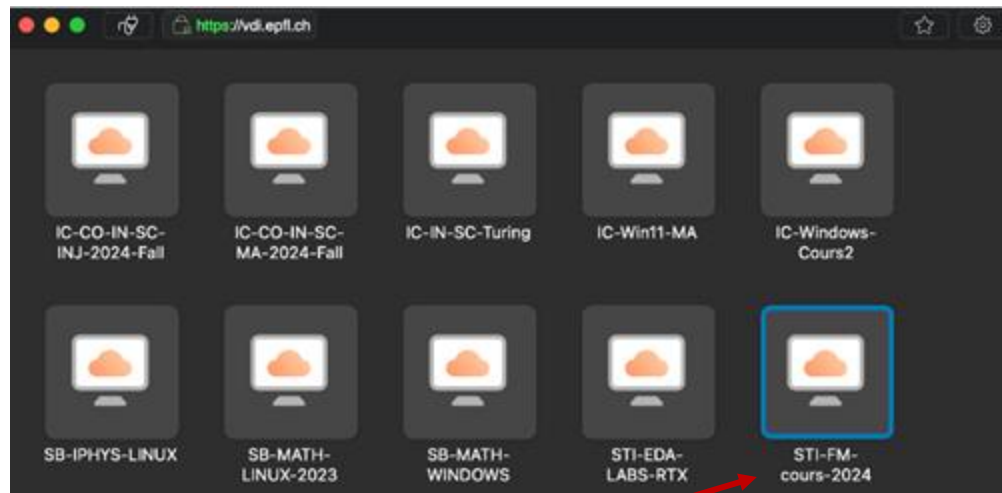
Virtual machine (VM)

In the VM:

- All tools setup are already done
- Pay attention to **save your files in your personal documents !** (otherwise you'll lose your work when disconnecting the VM !!!)

How to access your VM:

1. go to: <https://vdi.epfl.ch/>
2. Install **VMware Horizon Client** (give it right to access your local repositories if needed)
3. Type your gaspar username and password
4. Choose **STI-FM-cours-2024**

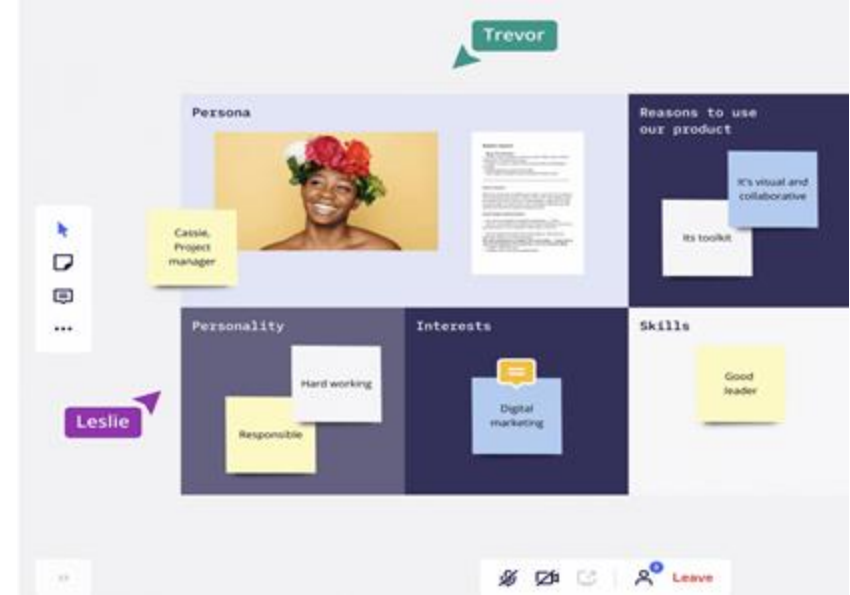


- For reporting and coding (similar to jupyter notebooks)
- Tutorial available on moodle (in *Quarto tutorials*)
- Multiple programming languages and formats (R, python, jupyter notebooks, ...)
- Generate html and pdf files
- Interactive and automated reports



Miro

- A tool for group presentations and the oral exam
- You can use it as well for brainstorming
- <https://miro.com/app/dashboard/>



- Engineer / Modeler
 - Problem formulation (python, ampl)
 - Mathematical modeling and optimization
 - Data collection & analysis
 - Programming & results visualization

- Energy consultant
 - Knowledge on key facts
 - Techno-economic-ecological analysis
 - Decision-making
 - Reporting (quarto)
 - Team working (peer review, coordination, delegate, coaching)



Your TA team



François Maréchal



Eduardo Pina



Cédric Terrier



Sai Ravi



Lorenzo Aimone



Giulia Giacomini



Maxime Blanchouin



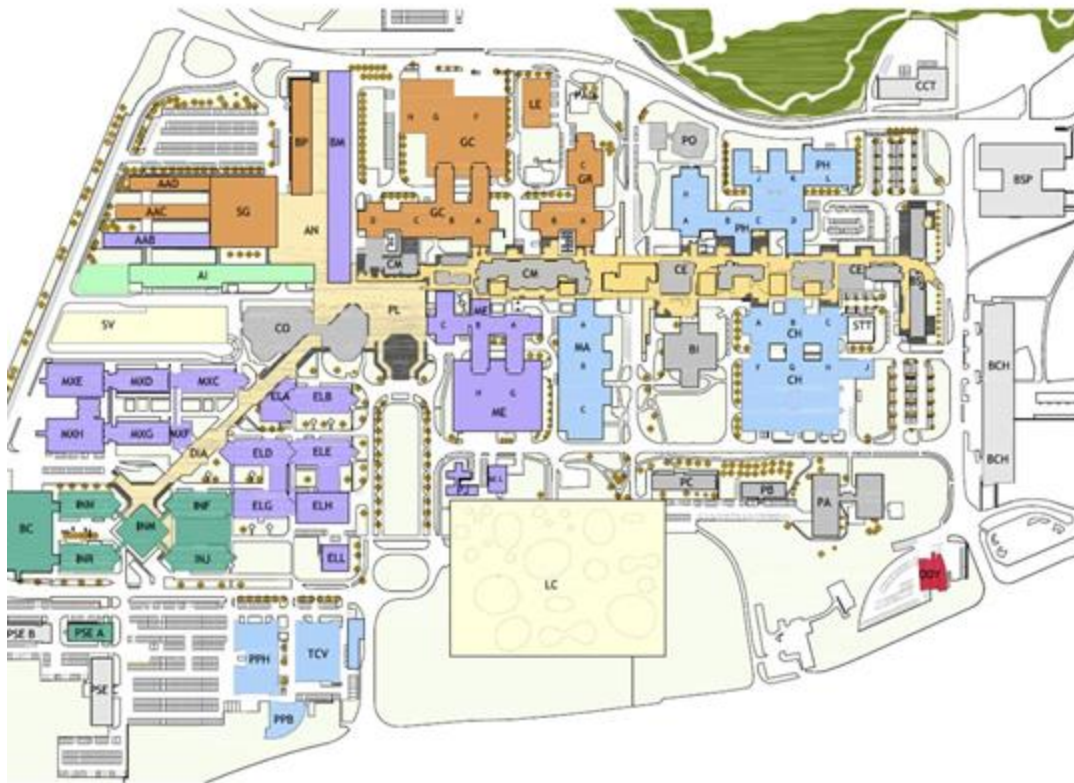
Pedro Marques



Project overview

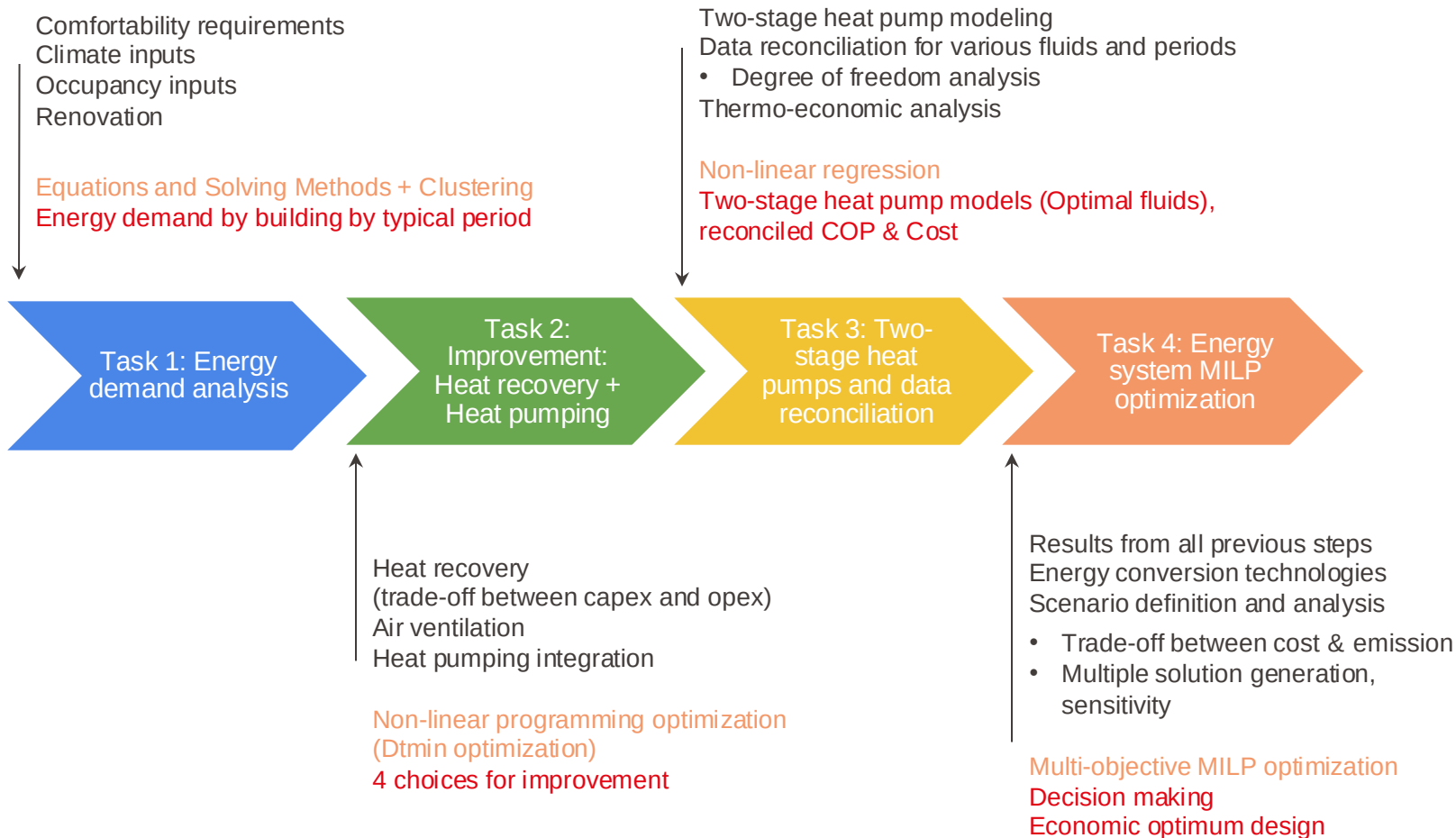
Background

- The **energy system** of EPFL supplies heating, cooling and electricity.
- The **heating system** is about to reach the end of its lifetime.
- The management board is searching for **replacement** of the existing system.

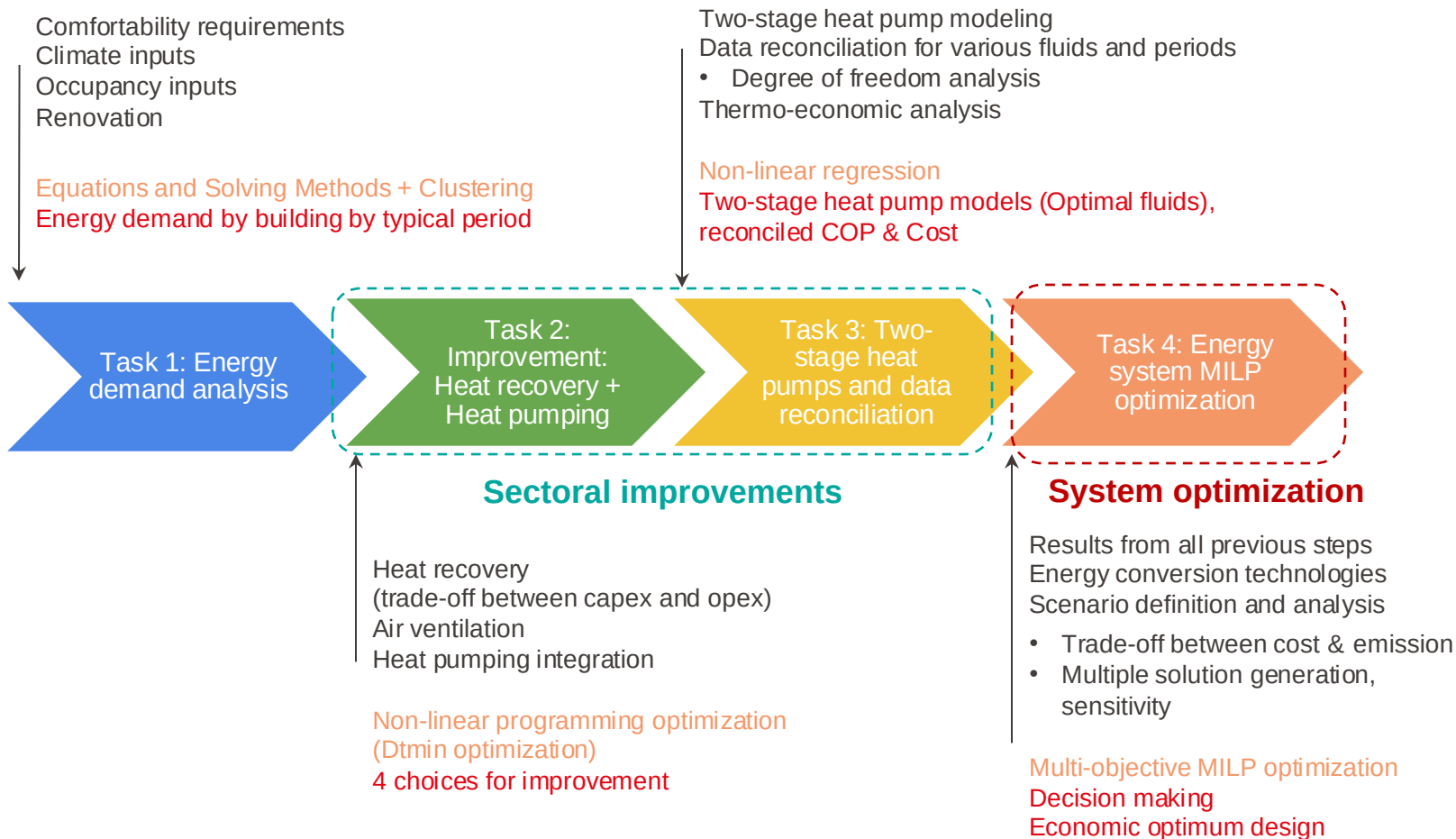


Energy planning

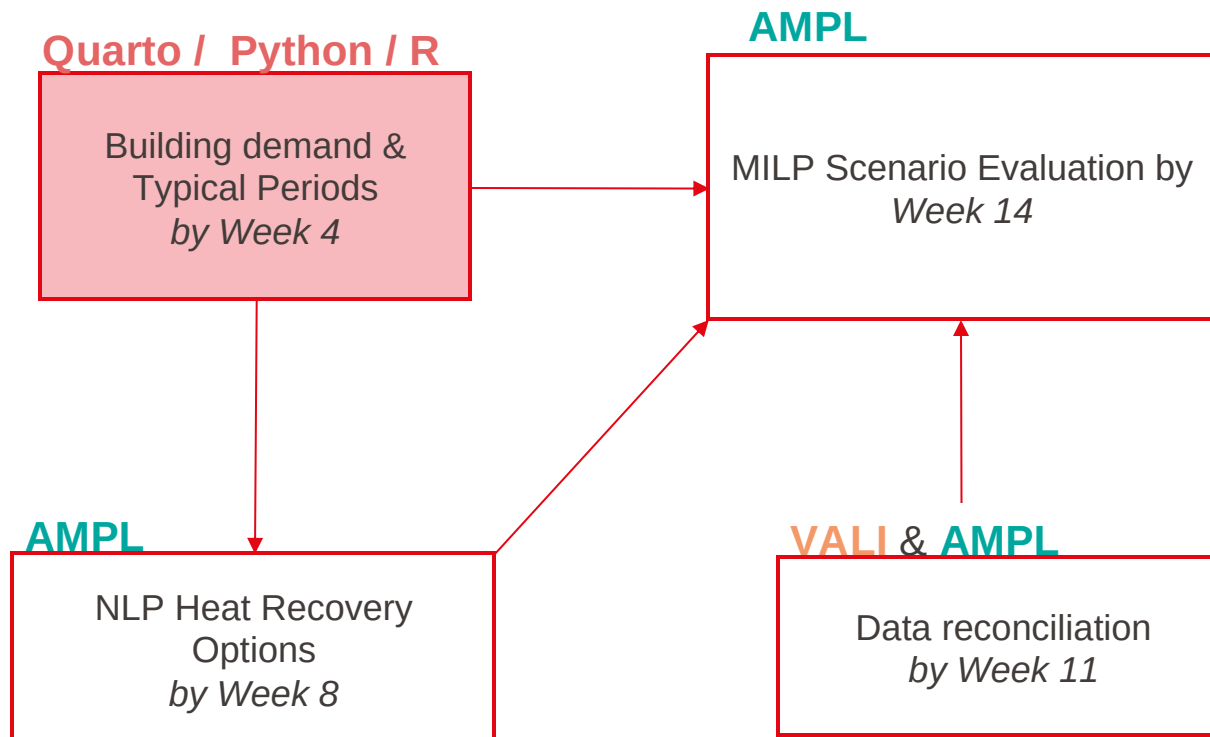
Project Overview



Project Overview



Project Overview



Other aspects:

- ✓ One zoom meeting per week with your TA is possible (rendez-vous needed, elaborate your questions in detail and send it to your TA 2 days before the meeting using the Mattermost group)

Your TODOs

- ✓ **Form a Group (in moodle) : to be finished before next week**
- ✓ Set up Tools (Mattermost, Virtual machine, Quarto) and test if they work well
- ✓ Download Project files from moodle - [Project description.pdf](#)
- ✓ Get started with Part 1 Task 1 – [Project materials on gitlab and Quarto Tutorial on moodle](#)
- ✓ If you are fast, start reading about Task 1.2 where you will use Newton-Raphson to find the values of k_{th} and k_{sun} . More information on that task will come next week.