

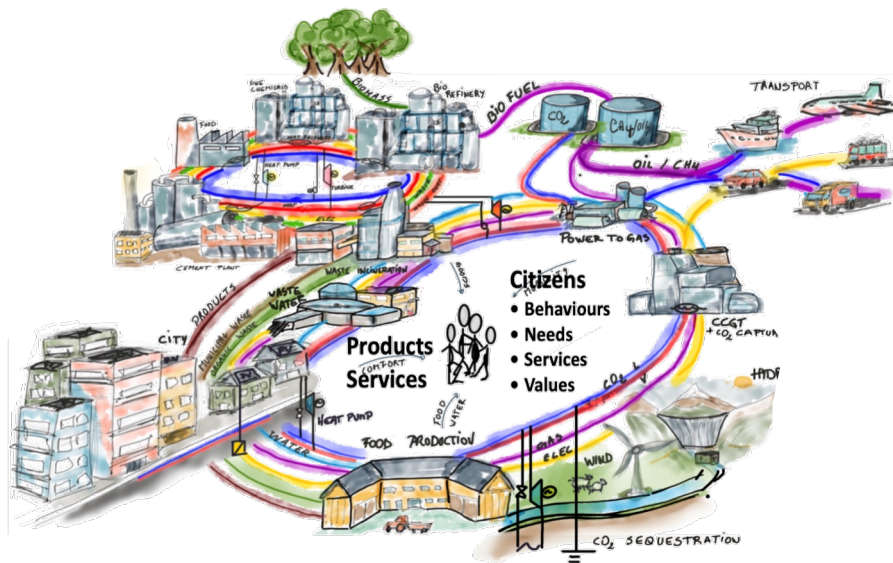
EPFL



Semester and master projects in IPESE

Cédric Terrier

EPFL – 09.12.2024



<https://ipese-web.epfl.ch/project-proposal/>

Urban systems and energy planning

Master project in industry: **Energy strategy for the Grand-Fribourg**

Paid master project in **Groupe E** (Fribourg) supervised by **Cédric Terrier**.



Content of the project:

1. Energy transition strategy for Fribourg
2. Role of existing energy infrastructure
3. Optimal level of distributed energy capacities
4. Influence local investments with energy market mechanisms
5. Investment planning to reach objectives in 2050
6. Promote a technology transfer from academia to industry



It is highly recommended to perform a semester project in IPESE as a preparation for the master project



Master project: Local Energy Communities

Helping detangle the main concept of the energy transition for the Swiss communes: Power to the People - literally

What: Master Thesis or Semester Project

Where: IPESE Lab, EPFL Valais Campus (Sion)

“Work in the lab or from your favorite coffee spot—no judgment on pajama days!”

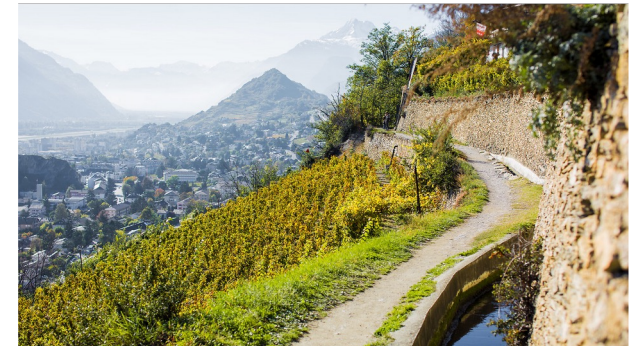
When: Flexible start and end dates

“Like yoga for your schedule!”

Project Highlights:

- Innovate KPIs: Crafting fun yet effective energy performance indicators
- Map Community Actors: Creating the ultimate energy squad map
- Design an Interactive Tool: User-friendly GIS with a hint of sass
- Scale Nationwide: Spreading the energy love across Switzerland

Questions: Jonas Schnidrig & Cédric Terrier



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Impact of Climate Change on the Energy Transition

Supervised by Arthur Chuat, Jonas Schnidrig & Cédric Terrier

Impact of climate change on resources and demands

Shared Socioeconomic Pathways (SSPs)

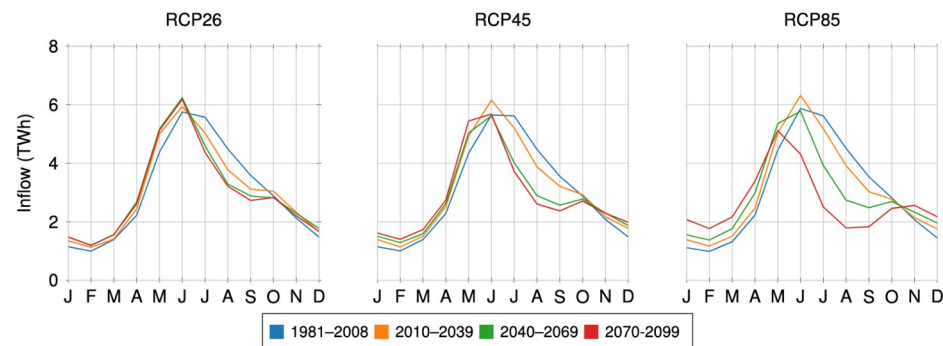
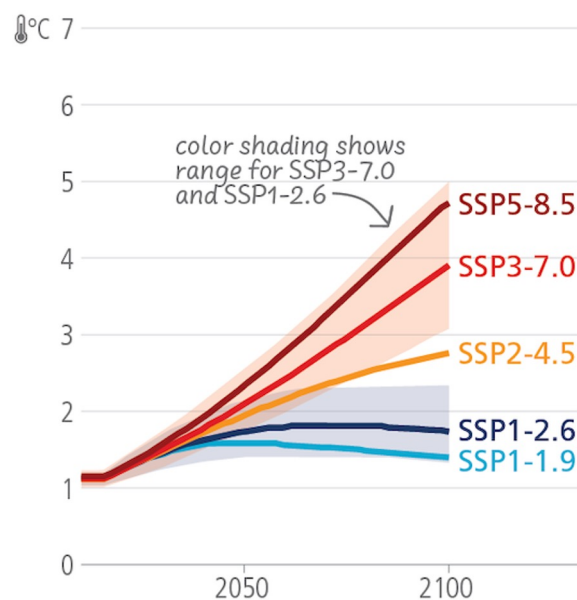


Figure 2: Inflows to hydropower plants (run-of-river and storage lakes) under different RCPs and climatic periods.

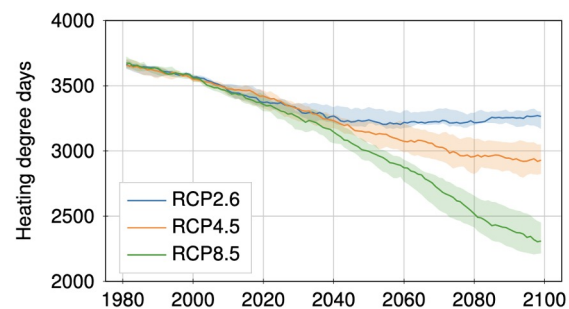


Figure 3: Population weighted heating degree days in RCP 8.5, RCP 4.5 and RCP 2.6.

Interested ?



Semester project: A big blue battery in the heart of Europe

Powering Europe's Future: Optimizing Switzerland's Hydro Dams

What: Semester Project

Where: IPESE Lab, EPFL Valais Campus (Sion)

Surrounded by the dams

When: ASAP *Perfect timing for your busy schedule!*

Project Highlights:

- Integrate Climate Effects: Modeling melting glaciers and shifting rains
- Optimize Hydro Operations: Maximize efficiency and revenue
- Extra Mile *why easy, when it is possible to make it complicated → Master project possibility*
 - Swiss Hydro Network Modeling: Puzzle pieces in the Alps
 - Market Opportunities: Becoming Europe's energy knight

Questions: Jonas Schnidrig



go.epfl.ch/IPESE-Dams



Master project: Melting glaciers, increased cooling...

The effects of climate change on the energy system: Mixing climate science with energy strategy!

What: Master Project

Who: Jonas Schnidrig

Where: IPESE Lab, EPFL Valais Campus (Sion)

We still have snow - and a lot of Sun

When: Flexible start and end dates *Flexible calendar, happy life!*

Project Highlights:

- Model Climate Impacts: Integrate SSP scenarios into energy models
- Assess Demands & Resources: Analyze heating, cooling, and renewable variability
- Adaptive Strategies: Propose resilient and sustainable solutions

Questions: Jonas Schnidrig, Arthur Chuat



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Master project in IPESE laboratory: **GIS platform to improve waste management (towards circular economy) in the canton of Valais**

Master project held in IPESE lab supervised by **Soline Corre**.

Content of the project:

1. Collect existing data on waste plastics, minerals and municipal solid waste for the canton of Valais
2. Verify the data and fill data gaps
3. Propose improvement for the canton of Valais for their waste collection and management using GIS modelling

[More informations here !](#)





Master project in IPESE laboratory: **Prospective modeling for plastic waste management: reducing environmental impacts for a circular economy**

Master project held in IPESE lab supervised by **Soline Corre**.

Content of the project:

1. Compare different treatment technologies to recycle and valorize plastics
2. Use indicators as economics and environmental impacts
3. Process design and modelling
4. Analyse the existing plastic waste treatment system in Valais and propose improvements for decision-makers in Valais

More informations here !





Master project in IPESE laboratory:

Techno-Economic Analysis of adsorbent based CO₂ Capture technologies

Master project/semester project, flexible start/end dates

Master project held in IPESE lab supervised by **Sanjay Venkatachalam**.

Content of the project:

1. Compare different technologies for capturing **CO₂ from industrial flue gas**
2. **Optimize the models** developed already using process modelling tools for energy consumption and cost
3. Perform techno-economic analysis comparing different technologies and adsorbents in reporting **CO₂ capture cost**

Contact person: Sanjay Venkatachalam (sanjay.venkatachalam@epfl.ch)



Master project in IPESE laboratory:

Life cycle assessment of CO₂ Capture technologies

Master project/semester project, flexible start/end dates

Master project held in IPESE lab supervised by **Sanjay Venkatachalam**.

Content of the project:

1. Conduct a **cradle-to-grave analysis** to quantify the environmental impacts of adsorbent materials in carbon capture.
2. Compare the sustainability of carbon capture technologies using environmental indicators such as greenhouse gas emissions, energy use, and resource depletion.
3. Assess the environmental trade-offs of using different adsorbent like MOFs, Silica, and Zeolites in terms of production, usage, and disposal stages.

Contact person: **Sanjay Venkatachalam** (sanjay.venkatachalam@epfl.ch)



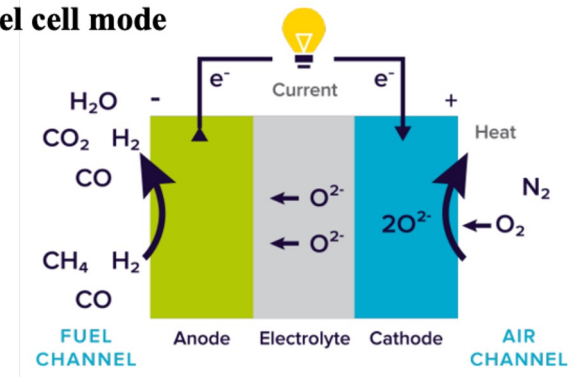
Master project in IPESE laboratory: **Ideal SOFC: Back to fundamentals to find areas for improvement**

Semester/Master project held in IPESE lab supervised by **Arthur Waeber**

Content of the project:

1. Understanding the basics of the **“ideal” SOFC system** (thermodynamic aspects, heat flows, ...)
2. **Modelling** a generic system in Aspen Plus to simulate ideal performance based on CH₄
3. Considering one-by-one the **non-idealities** and getting their physical meaning, **impact**.
4. Generalizing the procedure to **other fuels** and find place of improvements in the management of heat and flows.
5. Possibly generalize the approach and methodology to **SOEC** (Electrolyzer) and eventually reversible systems (**rSOC**).

Fuel cell mode



More informations here !



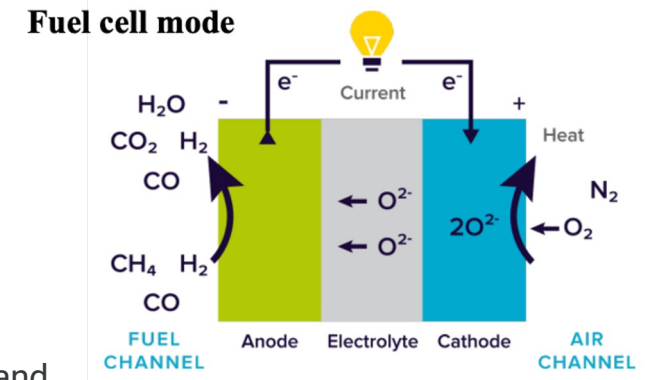


Master project in IPESE laboratory: **Solid Oxide Cells - dynamic model validation**

Semester/Master project held in IPESE/GEM lab supervised by **Arthur Waeber**

Content of the project:

1. Building the model in gPROMS, a **flowsheeting software**, that features dynamic modelling and model validation
2. Isolate the **crucial parameters** for model validation
3. Gather and pre-process **experimental data** from GEM lab, considering various conditions
4. **Validate** the model using in-place features and statistical tools of gPROMS.
5. Possibly generalize the approach and methodology to **SOEC** (Electrolyzer) and eventually reversible systems (**rSOC**).



More informations here !



Master project in industry: **Carbon capture, reuse and sequestration potential in CIMO Group**

Paid master project in **CIMO Group** supervised by **Daniel Flórez-Orrego and Basile Laurent**:

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Industrial Process
and Energy Systems
Engineering



Content of the project:

1. Mapping of point sources of CO₂ from CIMO waste treatment facilities.
2. Identification of appropriate CCS technologies and strategies at the Monthey chemical site.
3. Development of a systemic approach to identify promising CCS options based on techno-economic, energy and sustainability metrics.
4. Opportunity to participate in other studies for achieving climate neutrality.



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Master project in industry: **Optimization study of the Chablais industrial ecosystem: Net-zero 2050**

Master project held in **CGES** supervised by **Daniel Flórez-Orrego**:

Content of the project:

1. Study the feasibility of climate neutrality for the Monthey industrial zone.
2. Propose different climate neutral scenarios based on different sustainability metrics.
3. Propose a transition scenario for energy agents and chemical agents.
4. Identify the technological solutions and investments needed.
5. Assess the uncertainty on energy prices.
6. Direct interaction with the industry engineers.

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■ **IPESE**
Industrial Process
and Energy Systems
Engineering




CGES
Coalition for Green
Energy & Storage

Master project in industry: **Decarbonization strategies for the heavy industry: greener aluminium production**

Master project in **Novelis** supervised by **Daniel Flórez-Orrego and Dareen Dardor**:



Content of the project:

1. Understanding the energy audits of the Novelis plant
2. Estimate waste heat recovery potential in existing infrastructure
3. Integration of renewable energy and seasonal storage systems
4. Direct interaction with the enterprise and manufacturers
5. Promotion of knowledge transfer from academia to industry



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* for scope 1 and 2 emissic

Master project in industry: Integration of advanced cogeneration systems (rSOC and sCO₂) for valorizing industrial waste heat and materials

Master project held in IPESE group supervised by **Daniel Flórez-Orrego**:

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and Energy Systems
Engineering

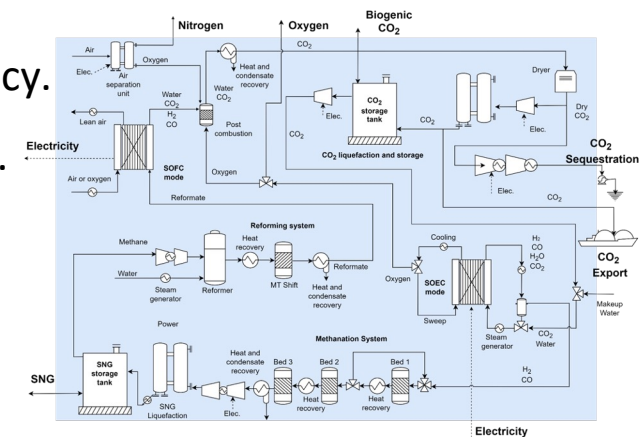


Content of the project:

1. Understand and leverage existing detailed models of rSOC and sCO₂ technologies.
2. Evaluate the performance of the rSOC and sCO₂ systems integrated to industrial applications.
3. Simulate seasonal fuel and heat storage for an enhanced system efficiency.
4. Estimate the cost of energy-efficient solutions in three industrial sectors.
5. Knowledge transfer between researchers and industry.

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Novelis



Master project in industry: **Decision-support database for the industrial decarbonization**

Master project held in IPESE group supervised by **Daniel Flórez-Orrego**:

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Industrial Process
and Energy Systems
Engineering



Content of the project:

1. Participation in a collaborative technology program of the **IEA**
2. Contribution of a database of models and methods for assessing industrial symbiosis
3. Analysis of the role of the industrial process integration in the industry decarbonization
4. Collaborative research with 12+ international partners to develop data-driven models
5. Promotion of technology transfer between industry and researchers

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iea
International
Energy Agency

Master project in industry: **Process integration tools for the industry decarbonization**

Master project held in IPESE group supervised by **Daniel Flórez-Orrego**:

■ **IPESE**
Industrial Process
and Energy Systems
Engineering



Content of the project:

1. Development of process modeling and integration tools.
2. Automatization of data handling and interpretation for feeding pinch analysis tools.
3. Interaction with engineers and IT to define the future tools for analyzing industrial processes.
4. Proposing new visualization methods for representing and improving the energy systems.
5. Close collaboration with the **Swiss Federal Office of Energy**.
6. Knowledge transfer between academia, industry and government.

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Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Swiss Federal Office of Energy SFOE

Master project in industry: **Biofuels production by upgrading biorefinery wastes in LDC company**

Master project held in **LDC** supervised by **Daniel Flórez-Orrego and Vibhu Baibhav**:

Content of the project:

1. Analyze the thermochemical and biological routes for upgrading the byproducts of LDC company.
2. Estimate the waste heat recovery potential in those route to produce combined heat and power.
3. Assess the potential to produce net negative biodiesel and ethanol biofuels.
4. Direct interaction with the enterprise and manufacturers
5. Promotion of knowledge transfer from academia to industry

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Industrial Process
and Energy Systems
Engineering

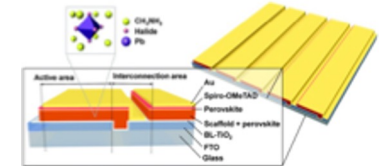


LDC.
Louis Dreyfus Company



Semester project in IPESE laboratory: **Techno-economic modelling for Perovskite solar cells (PSCs)/modules recycling strategies**

Semester project held in IPESE lab supervised by **Naveen Bhati** (naveen.bhati@epfl.ch)



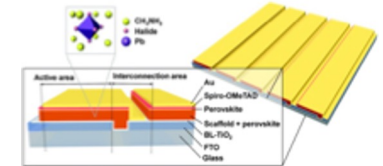
Content of the project:

1. - creating process design for PSCs based on existing literature using a methodological framework
2. - overview of different technologies used at various steps of the recycling process
3. - first principle models for each of the process steps based on mass and energy balance
4. - defining characteristics of techniques like cost, energy consumption, size limit, material and energy efficiencies
5. - developing database for material inventory and equipment inventory for PSC production/recycling
6. - finding or developing correlation for equipment cost and efficiency with production capacity
7. - finding or developing correlations for labour and space requirements for manufacturing/recycling plant
8. - developing the model for techno-economic analysis of recycling of PSCs and calculating various associated KPIs



Semester/Master project in IPESE laboratory: **Data analysis and Machine learning with Perovskite databases**

Semester project held in IPESE lab supervised by **Naveen Bhati** (naveen.bhati@epfl.ch)



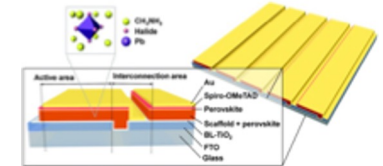
Content of the project:

1. - developing an understanding of the existing database features
2. - feature engineering, identifying the feature importance using dimensionality reduction techniques like PCA
3. - creating more exhaustive database by adding the required features from existing literature and online existing database
4. - developing different ML models based on regression techniques to identify and predict interesting insights
5. - Using LLMs for reverse engineering of perovskite solar cells based on the exhaustive database



Semester project in IPESE laboratory: **Life cycle assessment (LCA) of different recycling strategies of perovskite solar cells**

Semester project held in IPESE lab supervised by **Naveen Bhati** (naveen.bhati@epfl.ch)



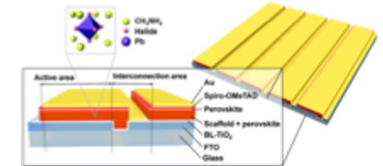
Content of the project:

1. - overview of different technologies used at various steps of the recycling process
2. - first principle models for each of the process steps based on mass and energy balance
3. - creating process design based on existing literature using a methodological framework
4. - developing database for material inventory and equipment inventory for solar modules production
5. - developing the model for LCA of different recycling strategies of perovskite solar cells and calculating various KPIs
6. - carrying out uncertainty analysis using monte-carlo simulations



Semester/Master project in IPESE laboratory: **Using artificial intelligence (AI)/ large language models (LLMs) with Perovskite solar cells optimization**

Semester project held in IPESE lab supervised by **Naveen Bhati** (naveen.bhati@epfl.ch)



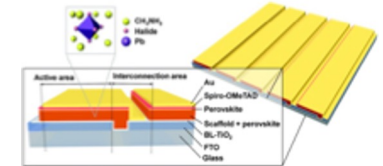
Content of the project:

1. - Developing complete mathematical framework for optimization problem
2. - Developing an understanding of the existing models for different KPIs calculation
3. - Integrating the different models together for calculating various KPIs
4. - Performing optimization for realizing the complete recipes for the perovskite solar cells depending on different KPIs



Semester/Master project in IPESE laboratory: **Process modelling and integration in Perovskite solar cells manufacturing in (R)OSMOSE**

Semester project held in IPESE lab supervised by **Naveen Bhati** (naveen.bhati@epfl.ch) and **Pullah Bhatnagar** (pullah.bhatnagar@epfl.ch)



Given the technological maturity of perovskite solar cells, the industrial production of perovskite solar modules will start soon. This also implies the scope of process modelling and integration to further optimize the overall production process for these modules. Therefore, it is crucial to get insights into the overall scope of making the fabrication process more efficient both economically and environmentally.

Content of the project:

1. - Developing models for different fabrication steps in (R)OSMOSE
2. - Identify the mass and energy balance for different flows
3. - Developing complete framework for process integration in (R)OSMOSE and identifying the potential for cost savings