Methods for analysing energy efficiency and renewable energy technologies

Méthodes d'analyse de l'efficacité énergétique et des technologies des énergies renouvelables

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Objective

Understand and apply several important methods for analysing technical and economic as well as environmental aspects of energy systems

Background material

Builds on:

- B.Sc. Studies, *Tronc Commun*
- *Fundamental of Energy Systems* (E. Trutnevyte)

Literature:

- David J. C. MacKay: Sustainable Energy – Without the Hot Air
- Kornelis Blok: Introduction to Energy Analysis, 3rd Ed. 2020/2021
- *Specific recommendations by method*

Software

- Microsoft Excel
  - Indispensible!
  - We assume you are familiar with it already
- OpenLCA
  - No prior knowledge needed
  - Life Cycle Assessment Exercise
- Python scripting (+Jupyter Notebooks)
  - No prior knowledge needed
  - Used in serveral exercises:
    - Uncertainty and Monte Carlo Method
    - Renewable energy balance techno-economic analysis
    - Energy System Optimisation

Course Content

1. Energy efficiency program evaluation and MCA
2. Input-Output Analysis
3. Energy statistics
4. Life cycle assessment
5. Technological learning
6. Uncertainty and Monte Carlo method
7. Techno-economic analysis
8. Pinch analysis
9. Energy system optimisation

After completion of this course:

- Understand the various methods covered and the underlying theory
- Obtain hands-on practical experience by applying the methods separately and in combination

Material

- Syllabus
- Assignments
- Additional material uploaded on Moodle

Organisation

- *Thursday morning (8:15 - 10:00)*: **Lecture**

- *Friday (08:15-17:00)*: **Practical assignment** (in pairs)
  - General feedback from previous assignment is given at 08:15.
  - Solution sheets will be uploaded in Moodle.
  - You are expected to individually prepare the weekly assignment before starting the practical computer-based assignment in pairs.
  - Communicate any change of couples to the teachers.
  - During the practical assignment, supervisors will be present to help you. Try to prepare specific questions.
  - If your presence is not possible on Friday for urgent reasons, please communicate this to the week supervisor.

Organisation

- **Deadline for assignments: Wednesday evening 17:00**
  - Each student submits the assignment into Moodle with the following name:

    Methods_weekX_NameSurname1_NameSurname2
  - Usually submit a **single pdf**
  - For some assignments, you may need to submit Excel files
  - If you cannot submit on time, please discuss with the coordinators **in advance** (not the day of the submission).
  - If we are not notified in advance, we will **deduct 0.5 points** from your mark for every day beyond the deadline.

Evaluation and Grading

1. 75% of the final grade:

   Weighted average of the submitted assignments.

2. 25% of the final grade:

   Oral exam.

Evaluation and grading criteria: Weekly assignments (75%)

- Answers should be numerically correct and demonstrate:
  - Good general insight
  - Insight into possibilities and limitations of a technology option or research method
  - Insight into which parameters and assumptions determine the outcome
  - Analysis and conclusions that are based on a critical analysis of the methods, data, and results.

- Also pay attention to:
  - Constructing a clear, logical and consistent argumentation
  - How you deal with uncertainties
  - How you handle and present data (tables and charts)
  - How you account for the feedback provided in previous assignments

Evaluation and grading criteria:
Weekly assignments (75%)

– Each weekly assignment will be graded
  - Together with your graded assignment you will receive an answer sheet, allowing you to check your calculations.

– Final mark for the assignments
  - Weighted average of marks of weekly assignments.

Evaluation and grading criteria:
Oral exam (25%)

- 3-5 questions randomly distributed across the various assignments.
- The questions are related to your understanding of key concepts introduced during the course
  - Not mathematical or programming skills
- The student may be requested to write a formula and interpret it using a whiteboard.

- ***Date of oral exam to be fixed closer to the time***

Schedule 2024

Date	Topic	Lecture	Exercise
1 THU 22.02.2024 (08:15-10:00) & Friday 23.02.2024 (full day)	Energy efficiency policy evaluation and MCA	M. Patel	I. Fouiteh, F. Sasso
2 THU 29.02.2024 (08:15-10:00) & Friday 01.03.2024 (full day)	Technological Learning	M. Patel	I. Fouiteh, F. Sasso
3 THU 07.03.2024 (08:15-10:00) & Friday 08.03.2024 (full day)	Input-Output analysis	T. Guibentif	T. Guibentif, J. Michellod
4 THU 14.03.2024 (08:15-10:00) & Friday 15.03.2024 (full day)	Pinch analysis	M. Babaei	M. Babaei, M. Kolahi, A. Mahmoudan
5 THU 21.03.2024 (08:15-10:00) & Friday 22.03.2024 (full day)	Life Cycle Assessment (LCA)	M. Patel	J. Michellod, P. Boiko

Schedule 2024: Holidays

Date	
THU 28.03.2024 **FRI 29.03.2023**	No course (Easter)
Easter holidays 30.03.2020-07.04.2020	

Schedule 2024

Date	Topic	Lecture	Exercise
6 THU 11.04.2024 (08:15-10:00) & Friday 12.04.2024 (full day)	Energy statistics	J. Chambers	I. Fouiteh, A. Mahmoudan
7 THU 18.04.2024 (08:15-10:00) & Friday 19.04.2024 (full day	Uncertainty and Montecarlo method	J. Chambers	M. Babaei, M. Kolahi
8 THU 25.04.2024 (08:15-10:00) & Friday 26.04.2024 (full day)	Techno-economic analysis	J. Chambers	J. Michellod A. Syla, A. Nyandwi
9 THU 02.05.2024 (08:15-10:00) & Friday 03.05.2024 (full day)	Energy System Optimisation	J. Chambers	A. Syla, M. Kolahi

Summary

- **Credits**
  - 6 ECTS
- **Evaluation**
  - Via assignments and oral exam
- **Group size**
  - Couples

- **In case of questions**

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