

CIVIL-603

Energy planning: modeling and decision support systems

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Cursus	Sem.	Type
Energy		Opt.

Language of teaching	English
Credits	3
Session	
Exam	Project report
Workload	90h
Hours	56
Courses	28
TP	28
Number of positions	

Frequency

Every 2 years

Remark

Last time: Spring 2020 Next time: Beginning of 2022 (last time before the teacher's retirement)

Summary

Solving the problems of energy planning : demand forecasting, evaluation of supply matrixes, probabilistic evaluation of demand/supply adequacy, multi-criteria assessment of medium and long term energy strategies, risk assessment of energy supply portfolios.

Content

1. Introduction to Energy Economics and Modeling
 - 1.1 Basic economics: microeconomic, macroeconomic theories
 - 1.2 Economic-Environment-Energy Modeling: optimization, simulation, time and space dimensions
 - 1.3 Various modeling approaches: Top-down, Bottom-up, Hybrid/Integrated approach
 - 1.4 Theory of energy economics: Cost-Benefit analysis, social welfare, marginal cost and investment decision, energy pricing
2. Energy Demand/Supply Adequacy
 - 2.1 Energy Demand modeling and forecasting: projection, econometric, techno-economic and hybrid models
 - 2.2 Electrical Power generation planning: deterministic, probabilistic models; generation planning in a competitive environment; planning of distributed energy resources
 - 2.3 Comparative assessment of energy strategies: Mono-Criterion, Multi-objective programming, Multi-Criteria Decision Making
 - 2.4 Simulation of energy markets: Multi-agent simulation of generation expansion in the markets of electricity, system dynamics
3. Modeling externalities of Energy
 - 3.1 Evaluation of environmental externalities
 - 3.2 Internalizing external effects in energy planning
 - 3.3 Case of Electrical Power Generating System
 - 3.4 Discussing the pricing of environmental externalities
4. Energy Risk Management
 - 4.1 Price volatility and risk management
 - 4.2 Energy derivatives
 - 4.3 Value-at-Risk
 - 4.4 Portfolio risk analysis and application to electricity supply planning
5. Case studies: Least cost planning of electrical generating system expansion

- 5.1 Electricity demand forecasting
- 5.2 Candidates for expansion and configurations of the system
- 5.3 Modeling the operation of the system
- 5.4 Elaborating expansion strategies
 - Case of electrical generating systems dominated by non-renewable energy sources
 - Case of electrical generating systems dominated by renewable energy sources

Assessment methods

Reading and Presentation of two articles by group: 30%
Cases studies using the software PLANELEC-PRO or HOMER : 70%

Resources

Websites

- <http://bpe.epfl.ch>