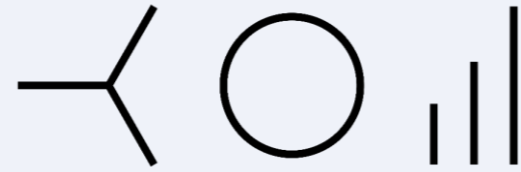


Power Markets & Energy Economics



About Neon

[Neon](#) is a Berlin-based boutique consulting firm for energy economics. We advise public and private sector clients on matters such as:

- » [Market value of wind and solar power](#)
- » [\(Whole\) system costs](#)
- » [Market design](#)
- » [Balancing power](#)
- » [Power market modeling](#)
- » [Data processing](#)
- » [Training seminars](#)

About your instructor

Prof. Dr. Lion Hirth is founder and director of Neon. He is energy economist and expert in wind and solar power, power market modeling, and electricity market design. He advises clients in the private and in the public sector. Previously, Lion spent five years with the Swedish utility Vattenfall. Lion holds a Ph.D. in energy economics and has published a number of highly cited academic articles.

- » [Curriculum vitae](#)
- » [Publications](#)
- » [Project references](#)

Executive training seminar

- » For energy professionals in industry, finance, policy making and think tanks
- » Extend your analytical understating of electricity markets and energy economics
- » Understand Europe's electricity sector during crisis, transformation and decarbonization
- » Applied and relevant, yet scientifically sound and rigorous
- » More than 98% of past workshop participants would recommend it to a colleague

Pricing and booking

- » Three days
- » Book individual sessions or the full seminar
- » Prices from EUR 400
- » 50% discount for NGOs and public sector
- » English or German language
- » Ask for in-house seminars and group discount
- » hirth@neon-energie.de
- » [+49 1 57 55 199 715](tel:+4915755199715)

Program overview

- I. [Fundamentals of electricity economics](#)
- II. [Renewable-based power systems](#)
- III. [Current topics in electricity economics](#)
- IV. [Energy policy](#)
- V. [Power market modeling: Excel](#)
- VI. [Power market modeling: GAMS](#)



Session I

Fundamentals of electricity economics

1. Energy data
2. The cost of electricity
3. The value of electricity
4. The optimal thermal capacity mix
5. The economics of renewable energy
6. Markets for electricity

Session II

Renewable-based power systems

7. Balancing power – [see example slides](#)
8. Power grids
9. Total system costs
10. Electricity storage & system integration
11. System-friendly renewables

Session III

Current topics in electricity economics

12. Market design
13. The power price plunge
14. Auto-generation

Session IV

Energy policy

15. Externalities and policy instruments
16. Renewables support schemes
17. Emissions trading

Session V

Power market modeling: Excel

18. Electricity system models
19. A simple Excel model

Session VI

Power market modeling: GAMS

20. A simple GAMS model
21. The power market model EMMA

Extra: Session VII

The economics of climate change

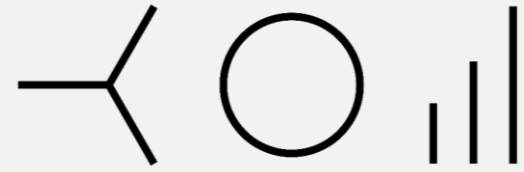
22. The physical science of climate change
23. The economics of climate change
24. The economics of climate policy

A matter of choice

Create your personal schedule

- » Each session = half a day
- » One session: EUR 400 + VAT
- » Two sessions: EUR 700 + VAT
- » Three sessions: EUR 1000 + VAT
- » Each additional session: EUR 200 + VAT
- » NGOs and public sector: 50% discount
- » Group discounts and in-house seminars

The details



Fundamentals of electricity economics

1. Energy data
2. The cost of electricity
3. The value of electricity
4. The optimal thermal capacity mix
5. The economics of renewable energy
6. Markets for electricity

1. Energy data

- » Units of measurement and orders of magnitude
- » Key numbers
- » Data sources
- » Energy flow charts
- » The new energy landscape in figures
- » Long-term historical trends and recent developments
- » Conceptual problems with energy statistics: thermodynamics and economics

2. The cost of electricity

- » Fixed and variable cost
- » Short-term and long-term profit
- » Cost structure of high- and low-carbon generators
- » Levelized costs of electricity
- » Screening curves
- » *What are the cost components for electricity generation and how can they be aggregated?*
- » *What is wrong with levelized costs of electricity?*

3. The value of electricity

- » Non-storability of electricity
- » Price setting in power markets
- » Fluctuating prices and its reasons
- » Market value
- » Electricity as an economic good with three-dimensional heterogeneity
- » *What determines the economic value of one MWh of electricity?*
- » *What drives the value gap of electricity from different plant types?*

4. The optimal thermal capacity mix

- » Load duration curves
- » Residual load duration curves
- » Optimizing the plant mix with pen and paper
- » The impact of renewable energy on the optimal generation mix
- » *What is the cost-minimal capacity and generation mix?*
- » *Why does base load disappear?*

5. The economics of renewable energy

- » “The Energiewende is all about wind and solar power” – is Rainer Baake right?
- » Cost structure and cost drivers
- » The dramatic decline of equipment cost
- » The role of resource quality in costs
- » The role of capital costs in costs
- » Market value of wind and solar power
- » *What drives the economics of renewable energy?*

6. Markets for electricity

- » The power sector value chain
- » Three markets for electricity: retail, wholesale, system services
- » Composition of retail prices
- » Future and spot markets
- » Power exchanges and over-the-counter trading
- » *Where is electricity traded?*
- » *Why are markets for electricity so fundamentally different designed?*

Electricity is different from other commodities.
Understand why.

Renewable-based power systems

- 7. Balancing power – [see example slides](#)
- 8. Power grids
- 9. Total system costs
- 10. Electricity storage & system integration
- 11. System-friendly renewables

7. Balancing power

- » Balancing reserve requirements
- » Balancing power auction design
- » Imbalance pricing
- » Recent reforms and further reform options
- » Balancing power provision by wind and solar power
- » *How much do renewables increase the need to hold balancing reserves?*
- » *How should balancing power be procured?*

8. Power grids

- » Fundamentals of AC power systems
- » Overview of transmission and distribution technology
- » DC load flow
- » Zonal pricing and nodal pricing
- » *What is N-1 security?*
- » *How are nodal prices calculated?*

9. Total system costs

- » Integration options for variable renewables
- » Definition of “total system costs” or “integration costs” of renewables
- » Cost estimates
- » *What are the costs of integrating renewable energy into power systems?*

10. Electricity storage & system integration

- » Flexibility options for renewable system integration
- » Long-distance interconnection
- » Flexible thermal power plants
- » Demand side integration
- » Hydro power
- » Electricity storage
- » Storage market update
- » Storage for balancing power

11. System-friendly renewables

- » System-friendly wind power (low wind-speed turbines)
- » System-friendly solar power (east- and west-oriented solar PV)
- » Hydro reservoirs: using the Nordic region as Europe’s battery?
- » Benefits and costs
- » *How can renewable energy technology help the power system?*



This session is concerned with more advanced topics in electricity systems. These become more pressing as renewable energy continues expanding.

Current topics in electricity economics

12. Market design

13. The power price plunge

14. Auto-generation

12. Market design

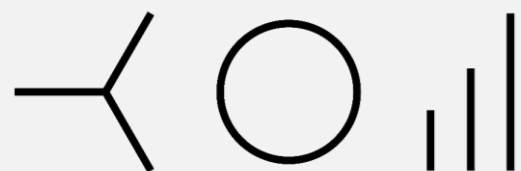
- » Electricity market design
- » Energy-only markets with scarcity pricing
- » The current capacity market discussion in Europe
- » Do we need capacity markets to keep the lights on?
- » *What is the weak spot of energy-only markets?*

13. The power price plunge

- » European electricity wholesale price development since 2008
- » The European utility crisis
- » Reasons for the price drop: Germany vs. Sweden
- » *Why is the wholesale electricity price so low?*
- » *How much of the price drop was caused by renewable energy, how much by the recession?*

14. Auto-generation

- » Auto-generation / self-consumption of electricity
- » Incentives to auto-generate
- » The costs and benefits of auto-generation
- » Implicit and explicit subsidies
- » Market design for a “prosumer world”
- » *Why do people generate their own electricity?*



Many of the current hot topics in energy are very intransparent. Energy economics principles and recent research help shedding light on these debates.

Energy policy

15. Externalities & policy instruments

16. Renewables support schemes

17. Emissions trading

15. Externalities & policy instruments

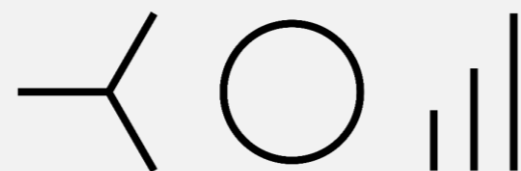
- » First theorem of welfare economics
- » Perfect and complete markets
- » Market failure
- » Internalization instruments
- » Price and quantity instruments
- » *When should the government intervene in markets?*
- » *How?*

16. Renewables support schemes

- » Reasons to support renewable energy – or not
- » Policy design
- » A history of the EEG
- » *How should support schemes for renewable energy be designed?*
- » *What is the key differences among exiting support schemes?*

17. Emissions trading

- » Kyoto emissions trading
- » EU ETS
- » Price determination in an ETS
- » Reasons for the price decline in the EU ETS
- » *Which emissions trading systems exist today, and what is their difference?*
- » *Is the EU ETS broke?*



The energy sectors is heavily influenced by policy. In this session we study the policy frameworks that shape decision-making in energy. How they *should* look like – and how they *do* look like.

Power market modeling: Excel

18. Electricity system models

19. A simple Excel model

18. Electricity system models

- » Types of electricity system models
- » Data requirements and sources
- » Applications and research questions
- » Optimization vs. simulation vs. agent-based models

19. A simple Excel model

- » Optimal generation and capacity mix model
- » Hourly resolution
- » Ideal to test your intuition and for first quantifications

Do it yourself! Build your own simple, yet insightful power market model in one day.

Power market modeling: GAMS

20. A simple GAMS model

21. The power market model EMMA

20. A simple GAMS model

- » Optimal dispatch and investment model
- » Optimal renewable investment
- » Hourly resolution
- » Power system details: combined heat and power and system service constraints
- » Runs on free test version of GAMS

21. The EMMA model

- » Use a medium-scale open-source GAMS power market model
- » Tested and realistic
- » Expand the model according to your needs

