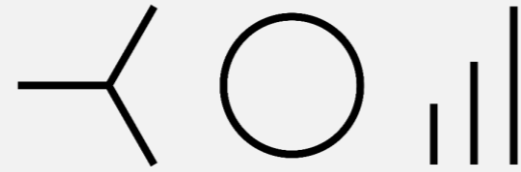


# Electricity System Modeling



## About Neon

[Neon](#) is a Berlin-based boutique consulting firm for energy economics, founded in 2014. We help our international [clients](#) from the public and private sector to design and navigate power systems and markets through studies, advisory and trainings.

We work on seven [topics](#): the market value of wind and solar energy, electricity market design, redispatch, (whole) system costs of renewables, balancing energy, power market modeling and open source / open data.

## Our trainings

- » For energy professionals in industry, finance, policy and think tanks
- » Extend your analytical understanding of electricity markets and energy economics
- » Understand Europe's electricity sector during crisis, transformation and decarbonization
- » Applied and relevant, yet scientifically sound and rigorous
- » 100% of previous participants would recommend it to a colleague

## Pricing and booking

- » Private sector: EUR 15000 + VAT
- » Public sector / NGOs: EUR 11000 + VAT
- » Contact us for bookings and inquiries:
- » [hirth@neon.energy](mailto:hirth@neon.energy)
- » [+49 1 57 55 199 715](tel:+4915755199715)

## Program overview

- I. [Introduction to electricity system modeling](#)
- II. [Do it yourself: Excel modeling](#)
- III. [Do it yourself: GAMS modeling](#)

Day 1 provides an overview of electricity market modeling. Since the best way of understanding models is to do it your self, on day 2 and day 3 we will build our own models. This is to understand the art and the science of electricity system modeling.

# Session overview

Day 1

## Introduction to electricity system modeling

1. Electricity System Modeling
2. Power Market Modeling
3. Open Modeling and Transparency

Day 2

## Do it yourself: Excel modeling

4. Cost Modeling
5. Merit Order Model
6. Market Value
7. Screening Curve Model

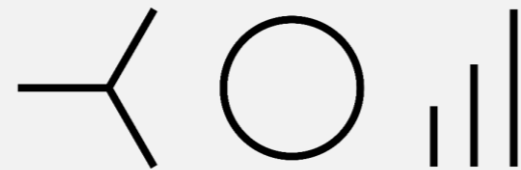
Day 3

## Do it yourself: GAMS modeling

8. Mathematical optimization
9. Getting started with GAMS
10. The simplest GAMS model ever
11. A long-term GAMS model
12. Adding realism: storage and balancing
13. The power market model EMMA

Modeling for insights.

A three-day introduction to power system modeling for the 21<sup>st</sup> century.



“I cannot remember when I learned so much in just three days.”

– Ulla Blatt Bendtsen, Senior Advisor of Climate & Energy Economy, Danish Energy Agency

“I’ve worked in the power sector for ten years. I’ve done numerical modeling before and took a number of courses, but this has been the most useful by far. One particular aspect that I really loved was how the course was structured and how everything connected in the end.”

– Alejandro Tovar-Garza, Hartree Consulting

Day 1

## Introduction to electricity system modeling

1. Electricity System Modeling
2. Power Market Modeling
3. Open Modeling and Transparency

### 1. Electricity System Modeling

- » Modeling for research, policy, profit
- » What is a “numerical model”?
- » Economic dispatch model, Unit commitment model, Integrated assessment model, Power market model, Capacity expansion model, Grid model, Load flow model, Greenfield model, etc.
- » How to make sense of this model ecosystem?

### 2. Power Market Modeling

- » A crash course in power market modeling
- » Core equations
- » Optimization
- » The modeling chain
- » Important limitations and caveats
- » Recognizing a good model

### 3. Open Modeling and Transparency

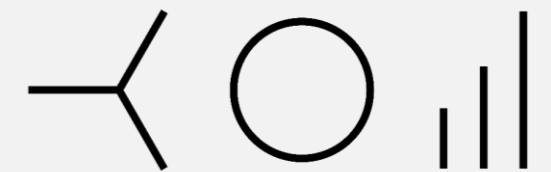
- » Transparency
- » Documentation
- » Open source models
- » Data sources
- » Open Power System Data

“On a scale from 1 to 5:  
seminar structure 4.6,  
quality of presentations 5.0,  
quality of assignments 4.6,  
Excel 4.5,  
GAMS 5.0”

– From the course evaluation, Agora Energiewende

Models matter for decision-making – in policy, industry and finance.

A crash course in electricity system modeling.



Day 2

## Do it yourself: Excel modeling

4. Cost Modeling
5. Merit Order Model
6. Market Value
7. Screening Curve Model

### 4. Cost modeling

- » Cost data of generation technologies
- » Levelized cost of electricity (LCOE)
- » Screening curves

### 5. Merit Order Model

- » Optimal plant dispatch
- » Generation mix
- » Price determination
- » Market value of wind and solar energy

Do it yourself!

Build your own power market model in a day.

“Ridiculously high quality across all course components (presentation, slides, Excel, GAMS).”

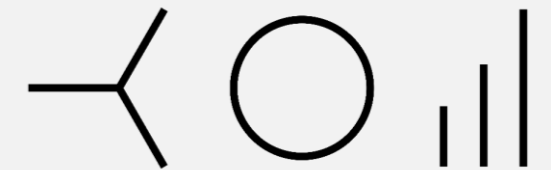
– From the course evaluation, Danish Energy Agency

### 6. Market Value

- » The “market value” (or capture price) of wind and solar energy
- » The “value factor” (capture rate)
- » Deriving the market value from observed prices and from models

### 7. Screening Curve Model

- » Load duration curves
- » The optimal thermal generation mix
- » The impact of carbon pricing
- » The impact of cost shocks
- » Residual load duration curves
- » The impact of renewable energy



Day 3

## Do it yourself: GAMS modeling

- 8. Mathematical optimization
- 9. Getting started with GAMS
- 10. The simplest GAMS model ever
- 11. A long-term GAMS model
- 12. Adding realism: storage and balancing
- 13. The power market model EMMA

### 8. Mathematical optimization

- » The principles of optimization
- » The intuition behind numerical solvers

### 9. Getting Started with GAMS

- » Understanding algebraic modeling
- » What GAMS can and cannot do for you
- » Basic GAMS syntax
- » Fundamental concepts
- » The structure of GAMS models
- » Tips & tricks

### 10. The simplest GAMS model ever

- » Building the simplest GAMS-based electricity market model in history
- » Thinking in equations

Most professional energy system models are written in GAMS.

Welcome to the world of optimization!

### 11. A long-term GAMS model

- » Build your own model from scratch
- » A screening curve-type of model in GAMS
- » Deriving the cost-optimal amount of wind and solar capacity
- » Simple yet insightful

### 12. Adding Realism: Storage and Balancing

- » Extending the GAMS model step by step
- » Peaking plants
- » Electricity storage
- » Must-run constraints and balancing energy
- » Looping for sensitivity studies

### 13. The EMMA model

- » Don't start from scratch!
- » Use a medium scale GAMS power market model
- » EMMA is free and open source
- » Tested and realistic
- » Expand the model according to your needs