



AALBORG UNIVERSITY  
DENMARK

## Doctoral School of the Technical Faculty of IT and Design, Aalborg University

### PhD course 2023:

#### Advanced Energy Systems Analysis on the EnergyPLAN model

Again in the spring of 2023, Aalborg University, Denmark, hosts its annual EnergyPLAN PhD course. The course has been conducted every year since 2005. The course gives an introduction to advanced energy system analysis using the EnergyPLAN model. The course takes place on 24-27 April 2023 and with following online Q&A sessions and final presentation of cases 11 May 2022. Registration via **Moodle** no later than on 4 April 2023. To register, you need to create a profile in Moodle and search for Advanced Energy System Analysis on the EnergyPLAN Model (2023).

After the course the participants are expected to be able to understand methodologies of advanced energy system analysis and to be able to use the EnergyPLAN computer model as a tool in making energy system analysis.

The course is conducted as a combination of lectures and computer workshops of a total of 4 days (32 hours) and assignments of a total of 6-7 days (52 hours). Results of assignments will be presented by the participants.

#### Contents:

The course starts with an introduction to EnergyPLAN (installation, using, constructing new data sets) and proceeds to focus on the use of the model in

- sustainable cities and communities
- technical analyses of large-scale integration of wind.
- analyses of exchange with external electricity markets
- combinations of different renewable energy technologies.
- designing flexible energy systems using flexible technologies such as heat pumps, hydrogen storage, pumped storage etc.
- district heating systems versus individual houses and zero energy buildings
- designing energy systems based on multiple criteria

Organiser:	Professor Henrik Lund, e-mail: lund@plan.aau.dk
Lecturer(s):	Poul Østergaard, Henrik Lund, Jakob Zinck Thellufsen and Brian Vad Mathiesen
ECTS:	5
Time:	24-27 April and online 2, 9 and 11 May 2023
Length:	5 days and assignments of 6-7 days (see above)
Place	In-person attendance at Aalborg University, Aalborg, Denmark followed by online Q&A sessions and online presentation of final case
Fee:	PhD fellows enrolled at a Danish university: Free PhD fellows enrolled at a university outside Denmark: 100 EUR Professionals (consultancy, industry, etc.): 1000 EUR
Registra- tion:	Registration from 1 February to 3 April 2023 via this <a href="#">link</a> . Registration is binding.
Payment:	Payment upon registration. Credit card payment is required.
Deadline:	3 April 2023

See Sustainable Energy Planning Research Projects [here](#).



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## Preparations prior to the course

1. Install EnergyPLAN from [energyplan.eu](http://energyplan.eu)
2. Consider how you wish to use EnergyPLAN – preferably in your PhD project – alternatively in independent analyses only made for the PhD course (notice that this will be on the agenda for the first morning) - fill in form on Moodle (obligatory request to finalize enrollment).
3. Read the FIDE guide (Finding and inputting data to EnergyPLAN) from [energyplan.eu](http://energyplan.eu) and consider what data you will need to do 2.
4. There are a number of training exercises at [energyplan.eu](http://energyplan.eu). You are expected to do these beforehand as this will enable you to make more advanced independent analyses during the actual course: <https://www.energyplan.eu/training/exercises/>
5. Read the articles
  - a. EnergyPLAN – Advanced Analysis of Smart Energy Systems  
<https://doi.org/10.1016/j.segy.2021.100007>
  - b. Reviewing EnergyPLAN simulations and performance indicator applications in EnergyPLAN simulations, <http://dx.doi.org/10.1016/j.apenergy.2015.05.086>
  - c. Reviewing optimisation criteria for energy systems analyses of renewable energy integration, <http://dx.doi.org/10.1016/j.energy.2009.05.004>
  - d. Smart Energy Systems for coherent 100% renewable energy and transport solutions, <http://dx.doi.org/10.1016/j.apenergy.2015.01.075>
  - e. Smart Energy Denmark papers
  - f. Heat Roadmap Europe: Combining district heating with heat savings to decarbonise the EU energy system, <http://dx.doi.org/10.1016/j.enpol.2013.10.035>
  - g. A renewable energy scenario for Aalborg Municipality based on low-temperature geothermal heat, wind power and biomass, <http://dx.doi.org/10.1016/j.energy.2010.08.041>

The course is conducted as a hands-on workshop based on each participant making an energy system analysis individually or in a group. The idea is to combine inspiration from lectures with work on your own analysis.



Lecturers: Henrik Lund, Poul Alberg Østergaard, Brian Vad Mathiesen and Jakob Zinck Thellufsen

# Programme

Venue: Aalborg University, Rendsburggade 14, DK-9000 Aalborg

	Monday 24 April 2023 (HL/PAØ/JZT) Room 3.429 (Building level 4)	Tuesday 25 April 2023 (HL/JZT) Room 3.429 (Building level 4)	Wednesday 26 April 2023 (JZT/HL/BVM) Room 3.429 (Building level 4)
09:00 - 12:00	<p><b>Introduction</b></p> <p>Welcome and programme (HL)</p> <p>Introduction to Energy System Analysis and EnergyPLAN (HL)</p> <p>Participants' presentations of PhD projects and suggestions for energy system analysis - part 1</p>	<p><b>How to get data and set up a model</b></p> <p>Setting up an EnergyPLAN model and finding the data (JZT)</p> <p>Simulation strategies in EnergyPLAN (JZT)</p> <p>Workshop</p>	<p><b>Workshop</b></p> <p>Workshop: Work on individual analyses</p> <p>Technical energy system analyses and electricity market exchange analyses (BVM)</p>
13:00 - 16:00	<p><b>Study and scenario design</b></p> <p>Optimisation Criteria in high RE systems (70m PAØ)</p> <p>Participants' presentations of PhD projects and suggestions for energy system analysis - part 2</p>	<p><b>Workshop</b></p> <p>Workshop on cases</p> <p>Lecturers will be available</p>	<p><b>Smart Energy Systems</b></p> <p>Smart Energy Systems integrating electricity, heat and transport systems (BVM)</p> <p>Workshop: Work on individual analyses</p>
18:00	<b>Dinner</b>		
	Thursday 27 April 2023 (HL/JZT) Room 3.429 (Building level 4)	Online (Tuesday 2 May and Tuesday 9 May)	Thursday 11 May 2023 (HL/PAØ/JZT) (online)
09:00 - 12:00	<p><b>Empirical cases</b></p> <p><b>Seminar: Other models</b> Guest lecturer</p>		<p><b>Participant presentations</b> Presentation of analyses and results followed by questions. 20 minutes per group/person.</p> <p><b>Feedback on the course</b></p>
13:00 - 16:00	<p><b>Climate Neutral Scenario</b></p> <p>The IDA 70% CO2 reduction scenario using EnergyPLAN (HL/JZT)</p> <p>Q&amp;A session</p>	<p><b>Q&amp;A online sessions (time will depend on participants time-zones) likely 12:00-15:00 CET</b></p>	