



AALBORG UNIVERSITY  
DENMARK

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

### PhD course 2018:

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

Again in April 2018, we have the annual EnergyPLAN PhD course at Aalborg University, Denmark. The course has been conducted every year since 2005. The course gives an introduction to advanced energy system analysis using the EnergyPLAN computer tool and model. The course will take place in April 2017. Registration is open at <https://phd.moodle.aau.dk/course/view.php?id=940>. To register, create a profile at <https://phd.moodle.aau.dk> and search for the course title "Advanced Energy System Analysis on the EnergyPLAN model (2018)". Deadline for registration is 19 March.

The PhD course gives an introduction to advanced energy system analysis using the EnergyPLAN tool. 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.

#### Content:

Introduction to the EnergyPLAN model (How to download, install and use the model and how to construct new data-sets etc.) 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 RES technologies.
- designing flexible energy systems using flexible technologies such as heat pumps, H<sub>2</sub>-storage, Pump storage etc.
- district heating systems versus individual houses and zero energy buildings

Organiser:	Professor Henrik Lund, e-mail: <a href="mailto:lund@plan.aau.dk">lund@plan.aau.dk</a>
Lecturer(s):	Henrik Lund, Poul Østergaard, Brian Vad Mathiesen and Jakob Zinck Thellufsen
ECTS:	3
Time:	9-11 April and 24-26 April 2017
Length:	5 days and assignments of 6-7 days (see above)
Place	Aalborg University, Aalborg
Fee:	750 DKK (100 EUR) for PhD students. Others pay 7500 DKK. All participants must cover own costs for travel and accommodation.
Registration:	Create a profile at <a href="https://phd.moodle.aau.dk">https://phd.moodle.aau.dk</a>
Payment:	Use the following link: <a href="https://www.erap.aau.dk/event/index.php/ESAotEPM2018">https://www.erap.aau.dk/event/index.php/ESAotEPM2018</a>
Deadline:	27 March 2017



*The PhD course is organised by Aalborg University in collaboration with the RE-Invest, SuPREME, 4DH and CITIES projects*

## 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 Ph.D. project – alternatively in independent analyses only made for the Ph.D. course (notice that agenda for the first morning – third bullet-point)
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 strongly encouraged / expected to do these beforehand as this will enable you to make more advanced independent analyses during the actual course
5. Read the articles
  - a. Reviewing EnergyPLAN simulations and performance indicator applications in EnergyPLAN simulations, <http://dx.doi.org/10.1016/j.apenergy.2015.05.086>
  - b. Reviewing optimisation criteria for energy systems analyses of renewable energy integration, <http://dx.doi.org/10.1016/j.energy.2009.05.004>
  - c. 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>
  - d. 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>
  - e. Smart Energy Systems for coherent 100% renewable energy and transport solutions, <http://dx.doi.org/10.1016/j.apenergy.2015.01.075>

The course is conducted as a hand-on workshop based on each participant making an energy system analysis. Remember to bring a computer! The idea is to combine inspiration from lectures with work on your own analysis. Supervisors will be present in the room while working with the model.



Lecturers on the course: Henrik Lund, Poul Alberg Østergaard, Brian Vad Mathiesen, Jakob Zinck Thellufsen

## Preliminary tentative program

	Monday 9 April	Tuesday 10 April	Wednesday 11 April
8.30 - 12.00	<p><b>Introduction:</b></p> <ul style="list-style-type: none"> <li>Welcome and programme</li> <li>Introduction to Energy System Analysis and EnergyPLAN</li> <li>Participants presentation of PhD projects and suggestions for energy system analysis</li> </ul>	<p><b>Cases:</b></p> <ul style="list-style-type: none"> <li>Specific cases to be decided</li> </ul>	<p><b>Modelling high-RES systems</b></p> <ul style="list-style-type: none"> <li>Energy systems analyses: Simulation vs optimisation (1h HL)</li> <li>Optimisation Criteria in high RE systems (70m PAØ)</li> </ul> <p>Workshop: Work on individual analyses</p>
12.30 - 16.00	<p><b>Smart Energy Systems:</b></p> <ul style="list-style-type: none"> <li>Smart Energy Systems- Integrating electricity, heat and transport systems</li> <li>Technical energy system analyses and electricity market exchange analyses</li> </ul> <p>Workshop: Work on individual analyses</p>	<p><b>Remainder of day allocated for independent analyses</b></p> <p>Lecturers will be available though not necessarily present in the seminar room</p> <p><b>18.00: Work shop dinner</b></p> <p>Workshop dinner at a restaurant in the city centre. Individual payment</p>	<p><b>Role of systems analyses:</b></p> <p>Workshop: Work on individual analyses</p>
	Tuesday 24 April	Wednesday 25 April	Thursday 26 April
8.30 - 12.00		<p><b>Participant presentations:</b></p> <p>Presentation of analyses and results followed by questions. 20 minutes pp</p>	<p><b>Participant presentations:</b></p> <ul style="list-style-type: none"> <li>- continued</li> </ul> <p><b>Feedback on the course</b></p>
12.30 - 16.00	<p><b>Empirical cases:</b></p> <ul style="list-style-type: none"> <li>Heat Roadmap Europe, (1h DC)</li> <li>Smart Energy Europe (1h DC)</li> </ul> <p>Workshop: Work on individual analyses</p>	<p><b>Seminar: Other models</b></p> <p>Two guest lectures presenting other models (to be decided)</p>	