AALBORG UNIVERSITY
DENMARK

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

PhD course 2021:
Advanced Energy Systems Analysis on the EnergyPLAN model

Again in the spring of 2021, 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. The course will take place on 19-21 April 2021 and 3-5 May 2021. Registration via Moodle no later than on 5 April 2021. To register, you need to create a profile in Moodle and search for ***Advanced EnergyPLAN Model (2021).***

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, Brian Vad Mathiesen
ECTS:	3
Time:	19-21 April and 3-5 May 2021
Length:	5 days and assignments of 6-7 days (see above)
Place	**Online course (due to Covid-19 restrictions)**
Fee:	PhD fellows at Danish Universities: Free participation PhD fellows at universities outside Denmark: 50 EUR Participants from companies: 500 EUR
Registra-tion:	Create a profile and register at https://phd.moodle.aau.dk. Registration is binding.
Payment:	Credit card payment is required and link to payment will be sent by e-mail after regis-tration.
Deadline:	5 April 2021

See Sustainable Energy Planning Research Projects here.

The PhD course is organised by Aalborg University in collaboration with the RE-INVEST and CITIES projects

Preparations prior to the course

1. Install EnergyPLAN from 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)
3. Read the FIDE guide (Finding and inputting data to EnergyPLAN) from energyplan.eu and consider what data you will need to do 2.
4. There are a number of training exercises at 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
   f. EnergyPLAN – Advanced Analysis of Smart Energy Systems https://doi.org/10.1016/j.segy.2021.100007
   g. Trends in tools and approaches for modelling the energy transition https://doi.org/10.1016/j.apenergy.2021.116731

The course is conducted as a hand-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

	Monday 19 April 2021 (HL/PAØ)	Tuesday 20 April 2021 (HL/JZT)	Wednesday 21 April 2021 (HL/BVM/JZT)
09:00 - 12:00	**Introduction** Welcome and programme (HL) Introduction to Energy System Analysis and EnergyPLAN (HL) Participants' presentations of PhD projects and suggestions for energy system analysis	**How to get data and set up a model** Hourly distribution data and add on tool (HL) Setting up an EnergyPLAN model and finding the data (JZT)	**Modelling high-RES systems** Technical energy system analyses and electricity market exchange analyses (BVM) Energy systems analyses: Hydrogen in EnergyPLAN (HL) Workshop: Work on individual analyses
13:00 - 16:00	**Smart Energy Systems** Optimisation Criteria in high RE systems (70m PAØ) Workshop: Work on individual analyses	Remainder of day allocated for independent analyses. Lecturers will be available though not necessarily present in the seminar room.	**Role of systems analyses** Smart Energy Systems integrating electricity, heat and transport systems (BVM) Workshop: Work on individual analyses
	Monday 3 May 2021 (HL/JZT)	**Tuesday 4 May 2021 (HL/JZT)**	**Wednesday 5 May 2021 (HL/PAØ)**
09:00 - 12:00		**Empirical cases** Overview of energy system analysis models and trends (Miguel Chang) Workshop: Work on individual analyses	**Participant presentations** Presentation of analyses and results followed by questions. 20 minutes pp. **Feedback on the course**
13:00 - 16:00	Workshop: Work on individual analyses **Seminar: Other models** Guest lecture on Energinet 70% CO2 reduction scenario: Christian Bjørn, Danish TSO, Energinet	The IDA 70% CO2 reduction scenario using EnergyPLAN (JZT) Workshop	