

Energy Modelling Lab's activities in the ETSAP community

Spring 2021 – Spring 2022

Introduction

As an active member of the ETSAP community, Energy Modelling Lab has over the past year expanded the TIMES framework and network.

Energy Modelling Lab is both building new TIMES models, e.g., for Azerbaijan and Dublin, extending current TIMES models, e.g. by adding the agricultural sector and storage to TIMES-DK, and develop the model framework itself. To give back to the community, several models are open source on GitHub.

The models have been used in a range of analyses, where Energy Modelling Lab has investigated both clean energy scenarios in the Nordic Countries, the role of agriculture in the Danish energy system, future fuels for the shipping sector, and many more.

To give back to the community, Energy Modelling Lab is supervising several bachelor students and a PhD student in using TIMES for different projects. Energy Modelling Lab is also happy to get inspired and inspire others through different ETSAP activities.

Projects

Energy Modelling Lab has been expanding and is using TIMES for more new projects.

<i>Project</i>	<i>Content</i>
HOPE 2021 - 2022	<p>Clean shipping in the Nordics</p> <p>The HOPE project aims to investigate future fuels for shipping in the Nordic countries.</p> <p>As part of the project Energy Modelling Lab is updating the ON-TIMES model to represent the shipping sector in Denmark, Norway, and Sweden in more detail.</p> <p><i>Model: Open Nordic Model (ON-TIMES)</i> <i>Collaborators: IVL – Swedish Environmental Institute</i></p>



<p>Dublin 2022</p>	<p>District heating from datacentres in Dublin</p> <p>Energy Modelling Lab is building up a city model of Dublin. The focus is on district heating, especially reusing heat from datacentres in the district heating grid.</p> <p>The work in Dublin is part of a bigger project, Ten21, that aims to help cities in Europe reusing wasted thermal energy for district heating and cooling.</p> <p><i>Model: TIMES-Dublin</i> <i>Partners: Ten21 and IVL – Swedish Environmental Institute</i></p>
<p>Vietnam 2021 - 2022</p>	<p>Modelling & reporting the in Vietnam</p> <p>In Vietnam Energy Modelling Lab has assisted the local modellers in expanding the TIMES-Vietnam model. One contribution is to include the savings when reducing air pollution as part of the green transition. The final work has been to write the Energy Outlook Report for Vietnam.</p> <p><i>Model: TIMES-Vietnam</i> <i>Client: The Danish Energy Agency & Government of Vietnam</i></p>
<p>Biogas Project 2021</p>	<p>Modelling biogas in Denmark</p> <p>Energy Modelling Lab has developed an add-on for the Danish energy agencies InterAct model (TIMES-DK model). The add-on is intended to secure coherent use of biomass across the entire energy system.</p> <p><i>Model: DK-BioRes</i> <i>Client: The Danish Energy Agency</i></p>
<p>Investment demands 2022</p>	<p>Investment demand from the green transition in Denmark</p> <p>In the spring of 2022, the Danish Parliament Suggested a carbon tax intended to meet the Danish GHG targets in 2030 and 2050. This carbon tax suggests an increased investment need in near future.</p> <p>In 2023 Energy Modelling Lab are doing further analyses in collaboration with KRAKA to investigate the proposed CO2-tax, energy islands, P2X plans, etc.</p> <p><i>Model: TIMES-DK & DK-BioRes</i> <i>Client: KRAKA</i></p>
<p>District heating modelling 2021</p>	<p>Power capacity in the Danish district heating system assessment in TIMES-DK model</p> <p>The Danish district heating system is today a dominant actor in the power market and contains the main stock of flexible power capacity</p>



in all of Denmark. A decreasing costs for Large-scale heat pumps and larger surplus heat sources from PtX and Data centers combined with an ageing CHP stock.

Model: TIMES-DK

Client: The Danish District heating association

Development

During the past year the TIMES-DK has been expanded with some new features, some of which can be transferred to other TIMES models in the future.

- **Ancillary services**
In the first quarter of 2022, we have introduced ancillary services to TIMES-DK based on the documentation and data provided by the ESTAP project “Enhancing the flexibility in TIMES: Introducing Ancillary Services Markets” by Evangelos Panos et al. into the TIMES-DK model. We calibrated the model against data from NordPool and the Danish TSO.
- **Storage**
Inspired by discussions at the Biannual ETSAP meeting in Oslo in 2021, we set up a new structure for how we model power and heat storages in TIMES. Each storage technology is described by three individual TIMES processes (loading, storage, unloading). For existing storages, the individual capacities can be set, for future investments, the capacity nexus of the three processes can be fixed by a user constraint, or it can be left to the model to find the optimal setup. All storages allow or inter-seasonal and inter-period energy shifts and can be defined on every time-slice level.
- **Using GIS-data in model development**
Since early 2022, we deploy geographical information systems to aggregate data, which is supplied with location information (x/y coordinates). For example, for a district heating expansion exercise, we utilize heat density maps that are supplied as shapefiles to aggregate heating demands by region and building type, and floor area. Many other applications are conceivable, also in terms of displaying results on maps, rather than on charts.
- **Increasing the flexibility of time granularity**
Switching between different time-slice aggregations without the necessity to synchronize the model each time, helps developing a TIMES models. The main advantage is time saved, not just by avoided synchronization, but also using improved aggregation regimes for different use-cases, such as a coarse aggregation for bug-fixing, or very high granularity for testing specific features like storages



behaviour. We achieve this necessary flexibility by using supersets on time slice level, while each selected aggregation has its individual Subannual file.

Training

Over the past year, Energy Modelling Lab has been expanding the modelling community, by taking in students and training new employees.

- **New employees**
New employees in EML has been following the official TIMES course and also internal training and upgrading have been carried out.
- **Three bachelor students modelling Germany**
Three bachelor students from the Technical University of Denmark developed a German TIMES-model. The aim is to investigate the future hydrogen demand in Germany, and where the hydrogen should come from. This bachelor project allowed EML to further develop on its flexible TIMES model generator.
- **PhD student modelling Gothenburg in Sweden**
Co-supervision of a PhD from Chalmers University focussing on modelling urban areas with TIMES. The idea is to develop a tool municipality can use for planning which climate mitigation options to invest in fulfilling local targets.

Spreading the word and engaging in the community

Even though the lockdown has decreased the possibility for travelling Energy Modelling Lab has attended several events both physically and online.

ETSAP gathering in Freiburg (June 2022) back-to-back with the IEW conference

- **ETSAP workshop (May 2022)**
Mikkel Bosack Simonsen from EML participated online in the workshop
While EML had several projects ongoing in 2022 regarding the model development presentations would not be possible at this time and moved to the Winter meeting in 2022. Denmark have had a long-time development with TIMES models and few projects had high potential for integrating into Danish energy system models
 - The TIMES-Belgium has been linked to an LCA models with a strong focus on material usage in the industrial sector. Although Denmark has very little heavy industry the chemical and glass and concrete sectors are very energy intensive in Denmark and modelling sub modulars component in these could provide a better insight into energy transition, CO2 reductions and CCS improvements in the individual sectors
 - How higher spatial resolution impacts energy system analysis from the TIMES-Ireland model
 - Impact of including ancillary services in the models, example from Norwegian TIMES



- Synthetic fuels in TIMES models – a review and recommendations

- ETSAP workshop (November 2021)
(Kenneth Karlsson and Till Ben Brahim from EML participated physically in the workshop in Oslo)
Interesting highlights relevant for implementing or utilising in the Danish models:
 - Modelling of different thermal energy storages
 - VEDA online version was presented and EML have already tested this option
 - New data for technologies for industries to become net-zero
 - And Kenneth Karlsson presented EML TIMES model for Azerbaijan

ETSAP online gathering in 2021 and 2022

Because of the corona situation most ExCo-meetings and workshops in the period has been online, except the ones in November 2021 which was a hybrid.

- 86th ExCo-meeting
(Kenneth Karlsson from EML participated online in the ExCo meeting)
The meeting was following the standard agenda, but we can mention some highlights:
 - IEA gave an overview of all recent publications and the ones in pipeline
 - The operating agent Kari Espegren gave an overview of the organisation and budget (which looks good)
 - A discussion on how to continue and share the global TIMES model was carried out

And the final report documenting ETSAP member publications and developments (2019-2021) is almost ready for publishing.

- 85th ExCo-meeting (February 2022)
(Kenneth Karlsson from EML participated online in the ExCo meeting)
The meeting was following the standard agenda, with no special things to report.

- 84th ExCo-meeting (November 2021)
(Kenneth Karlsson from EML participated online in the ExCo meeting)
The meeting was following the standard agenda, with some highlights shown below:
 - Incoming suggestions for projects was ranked for funding. EML participated with a proposal for linking GIS tools with TIMES models, but unfortunately, we did not get on the list of funded projects

- 83th ExCo-meeting (September 2021)
(Kenneth Karlsson from EML participated online in the ExCo meeting)
The meeting was following the standard agenda, with some highlights
 - Outreach activities was discussed – how to get more countries on board
 - It was discussed to make an early stage modeller session at the ETSAP workshops to get input from experienced modellers



Contact

All projects above and many more can be found on www.energymodellinglab.com . Feel free to contact us if you have any question or would like to start up a collaboration.

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