

# Energy Modelling Lab's activities in the ETSAP community

Summer 2023 – Winter 2024

## Introduction

Energy Modelling Lab is participating in the Energy Technology Systems Analysis Program (ETSAP), one of the longest running Technology Collaboration programs of the International Energy Agency (IEA). As an active member of the ETSAP community, we have expanded the TIMES framework and network over the past year.

On the modelling side, we have:

- Built a new TIMES model for Kuwait.
- Further developed and extended TIMES models for Jordan, Viet Nam, and Northern Europe.
- Started an ETSAP research project to create a new module for TIMES, representing the AFOLU sector (Agriculture, Forestry, and Other Land Use).

We have had the pleasure of supervising a master's student and a PhD student in using TIMES for different projects. Our participation in the ETSAP activities has offered us opportunities for mutual inspiration and collaboration.

## Projects

Energy Modelling Lab (EML) has been expanding and used the TIMES modelling framework for more new projects.

<i>Project</i>	<i>Content</i>
SpeedLocal 2024 - 2026	<p>Speeding up Nordic Green Transition</p> <p>SpeedLocal aims to develop tools for addressing "not in my backyard" complexities and is part of the Nordic Grand Solutions Programme. As part of the project, EML is updating the TIMES-NEU model to represent the island of Bornholm in detail.</p> <p><i>Model: TIMES-NEU</i></p> <p><i>Collaborators: Energiforsk, IVL, LabLab and Luleå University of Technology and Insitute for Technology (NO).</i></p>



<p>AFOLU 2023-2025</p>	<p><b>Agriculture, Forestry, and Other Land Use Sector Modelling</b></p> <p>A research project funded by ETSAP. The result should be a demo model of a new data module on the AFOLU sector, that is standardized and flexible and can integrate seamlessly with any TIMES model. It will enable the proper modelling of factors such as the forest capacity of CO2 uptake or the consequences of replacing crops.</p> <p><i>Model: TIMES</i>  <i>Partners: E4SMA, the Institute for Energy Technology (IFE, University College Cork (UCC) and VITO.</i></p>
<p>PtX Sector Coupling 2023 - 2024</p>	<p><b>Best locations of PtX plants</b></p> <p>As part of MissionGreenFuels, EML is collaborating with 13 partners on the PtX Sector Coupling and Life Cycle Assessment Project. The expected result is to create better ways to determine optimal ways of integrating PtX into the green transition. To this end we are developing and updating the TIMES-NEU model.</p> <p><i>Model: TIMES-NEU</i>  <i>Client: The Danish Innovation Fund</i></p>
<p>Future demand 2023</p>	<p><b>Analysis of the demand for PtX products</b></p> <p>EML has updated the ON-TIMES model and further developed it to the Northern Europe TIMES model (TIMES-NEU). It was used for analysis that CIP Foundation used as reference for their report "Roadmap to a Future, Danish hydrogen infrastructure".</p> <p><i>Model: TIMES-NEU</i>  <i>Client: COWI /CIP</i></p>
<p>Net-Zero emissions in Kuwait 2023</p>	<p><b>Supporting energy planning in Kuwait</b></p> <p>The government of Kuwait has pledged to reach net-zero emissions in the oil and gas sector by 2050 and by 2060 for the whole country. EML has contributed to the first step towards this end in the project Developing Kuwait's Long-Term Climate Pathways. EML has developed a database for energy and GHG emissions and a TIMES-Kuwait model featuring different scenarios including rapid expansion of the renewable fuel market and reduced exports.</p> <p><i>Collaborator: SDA, Sustainable Development Advisors</i>  <i>Model: TIMES-Kuwait</i>  <i>Client: UNEP</i></p>
<p>Vietnam 2023</p>	<p><b>Viet Nam targeting net-zero emissions</b></p> <p>EML has developed the scenarios that will be used in</p>



a new energy-system model for the Energy Outlook Report 2023. Together with our Vietnamese partners, we identified the questions to address, relevant analyses to undertake and updated the modelling framework accordingly. We strengthened the representation of new decarbonization technologies and integrated relevant constraints.

*Model: TIMES-VNM*

*Collaborator: E4SMA*

*Client: The Danish Energy Agency*

Viet Nam  
2023

#### Enhancing energy planning in Viet Nam

Energy Modelling Lab has updated the technology catalogue that is integrated into the present energy system model. The catalogue included decarbonization technologies that had not yet been used and described costs and relevant technical parameters.

*Model: TIMES-VNM*

*Client: UNOPS.*

*Collaborators: E4SMA, Electricity and Renewable Energy Authority (EREA), Viet Nam, Danish Energy Agency.*

Jordan  
2022-2024

#### Low emission strategy in Jordan

Energy Modelling Lab has developed an integrated assessment model, the TIMES-JO. The model includes a full investment catalog for the entire energy sector and shows the economically optimal, high-impact pathways for decarbonizing key sectors of the Jordanian economy.

*Model: TIMES*

*Partners: E4SMA, the Institute for Energy Technology (IFE, University College Cork (UCC) and VITO.*

Denmark  
2023

#### Future Green Energy and the Citizens

EML participated in local energy summits in the Danish municipalities of Kalundborg, Holbæk, and Vordingborg. The aim was engaging local citizens and industries to support the green transition. We used TIMES-DK to generate charts showing future energy demand, the optimal energy mix, land use etc., supporting informed decision-making.

*Model: TIMES-DK*

*Client: The Danish Board of Technology*



## Developments

During the past year, EML has developed one new TIMES model and upgraded three models.

Furthermore, we have updated and expanded the Danish Biomass Resource Model, DK-BioRes, for the IntERACT model (TIMES Framework) that we previously developed with the Danish Energy Agency. DK-BioRes is a flow-based model. It contains all Danish biomass resources from agriculture, forestry, and aquaculture. The updated model will feature several technologies that are used to reduce carbon emissions and nitrification. The model can generate comprehensive scenarios of climate neutrality when it comes to land use, yield, and emissions from agriculture, aquaculture, and forestry.

- TIMES-KUWAIT



We created a database for energy and GHG emissions and developed the TIMES-KUWAIT model representing the five key sectors of Energy, Industry, Agriculture, land use, and Waste. We generated several scenarios, including rapid expansion of the renewable fuel market and reduced exports.

- TIMES-VNM

We have strengthened the representation of new decarbonization technologies and integrated relevant constraints. We have also updated the technology catalogue in the present version of TIMES-VNM and have included electricity storage solutions, P2X, nuclear technologies, optimal use of biomass, and carbon capture and storage.

- TIMES-JO

We continued the EUDP project aiming to develop a default model setup which could fit any energy system regardless of its size. We tested the model setup on Jordan and have finalized a model representing all sectors including agriculture and water.



- TIMES-NEU

We have updated, expanded, and developed the ON-TIMES (Open Nordic TIMES) into the TIMES-NEU (TIMES Northern Europe) model covering Germany, Poland, Denmark, Norway, Finland, Iceland, and Sweden.



## Community building

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 have been following the official TIMES course and internal training and upgrading have been carried out.
- **One master's student modelling an island**  
Kenneth Karlsson supervised one master's student from the Technical University of Denmark on a project of modelling an energy island to explore the potential impact of energy production from energy islands on existing energy systems. He is now continuing to do his thesis with us.
- **PhD student modelling Gothenburg in Sweden**  
Kenneth Karlsson has continued to co-supervise a PhD student from Chalmers University. The focus is on modelling urban areas with TIMES. The idea is to develop a tool that municipalities can use for planning which climate mitigation options to invest in when aiming to fulfilling local targets.

Energy Modelling Lab attended several events on-site and online.

- **Semi-annual ETSAP meeting in Turin (November 2023)**  
*(Kenneth Karlsson, Andrea Marin Radoszynski, and Till Ben Brahim from EML participated in the workshop on-site).*

The meeting was following the standard agenda, but we can mention some highlights:

- Till Ben Brahim from EML made an interesting presentation on the possibility for the Nordic countries, especially Denmark, to become a green hub for export of green hydrogen and electricity to Europe.
- The ETSAP-TIAM global model should soon be ready. IER at Stuttgart University is writing the documentation.
- There was a discussion on the replacement of GAMS with open-source software such as Julia/Jump. It will be decided if this should be investigated at the next ExCo meeting in March 2024.
- The online version of VEDA-TIMES is now available to universities. A contact at a university can become license responsible and all students from that university can then use online VEDA-TIMES for training.

### Networking

- We had the opportunity to hold meetings with our Italian and Belgic colleagues and agreed to share knowledge and updates of our TIMES models.
- We also met with our Nordic colleagues from IFE and LTU. Like us, they are analyzing potential export of green hydrogen and electricity. We agreed to organize workshops, sharing results, and discussing assumptions



for the respective countries.

#### Interesting presentations

- Uwe Remme from IEA presented the newest carbon neutral scenario from IEA.
- Maria Cristina Pinto, RSE (Milan) and NOVA FCT (Lisbon) presented a modelling of import of green hydrogen from North Africa with JRC-TIMES. Screening of geopolitical and financial possibilities before including in TIMES. Finds Morocco the best option for export of green H2 to Europe.

- 92<sup>nd</sup> ExCo-meeting in Turin (November 2023)

*(Kenneth Karlsson from EML participated online in the ExCo meeting)*

The meeting was following the standard agenda, but we can mention some highlights:

- New projects were chosen for funding and EML got our project on including modelling of AFOLU in TIMES models funded.
- Kathleen Valliancourt from ESMIA in Canada was appointed new Operating Agent for ETSAP.

- 91<sup>st</sup> ExCo-meeting online meeting (September 2023)

*(Kenneth Karlsson from EML participated online in the ExCo meeting)*

The meeting was following the standard agenda, with no special things to report.

- Workshop in the sub-project “PtX Sector Coupling and LCA” under the MissionGreenFuels programme (November 2023)

Hybrid: Alexandra Institute in Aarhus and Teams.

*(Pernille Bramming and Kenneth Karlsson from EML participated in the workshop onsite and online)*

Highlights to mention are:

- The focus of the workshop was best practices when doing energy modelling on PtX and on explaining differences.
- Kenneth Karlsson made a presentation, “Modelling future PtX demand in TIMES”. The presentation was followed by a discussion of different methodologies and assumptions showing different results.

- 90<sup>th</sup> ExCo-meeting (June 2023)

*(Kenneth Karlsson from EML participated online in the ExCo meeting)*

The meeting was following the standard agenda with no special things to report.

- 89<sup>th</sup> ExCo-meeting, online meeting (March 2023)

*(Kenneth Karlsson from EML participated in the ExCo meeting)*

The meeting was following the standard agenda, with some highlights shown below:

- Incoming suggestions for projects were ranked for funding. EML participated with a proposal for TIMES AFULO modelling.



## Contact

You can read more about the projects mentioned above, our other projects, and our publications on [www.energymodellinglab.com](http://www.energymodellinglab.com). Feel free to contact us if you have any questions or would like to start up a collaboration.

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