
Czech
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Modeling of Emissions using TIMES in Czech Republic

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What it's gonna be about ?

- Motivation
- TIMES, The Integrated MARKAL-EFOM System
- GHG and Pollutants Emission Projections in TIMES 2025
- Future TIMES Modelling in CHMI

Motivation

- CHMI is responsible for the mandatory reporting of greenhouse gases and pollutants emissions projections every two years
    - Reporting under the Art. 18 of the Regulation EU No. 2018/1999
    - Directive (EU) 2016/2284 of the European Parliament and of the Council of 14 December 2016 on the reduction of national emissions of certain atmospheric pollutants, amending Directive 2003/35/EC and repealing Directive 2001/81/EC

- **In order to improve the reports, CHMI needs to enhance monitoring and emission projections**

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- **In order to improve the reports, CHMI needs to enhance monitoring and emission projections**

→ **By using the TIMES model, CHMI is able to model more realistic scenarios**

Background

- The most straightforward way to model emission is to use a computational model using only user-provided available data.
- This has been traditionally done by the GAINS model.
- GAINS is a **bottom-up, technology-based model** that estimates emissions based on technical and physical parameters.
- However, GAINS **does not account for economic and market-driven factors** (dynamically), which are crucial for long-term projections.
- TIMES provides a more comprehensive approach, integrating economic constraints, technology adoption, and policy scenarios.

TIMES
The Integrated MARKAL-EFOM System

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Predecessor to TIMES at CHMI

- In past, the CHMI used the **MESSAGEix** framework to model emissions from the energy sector.
- MESSAGEix is a versatile, **dynamic systems-optimization modelling framework** developed by the IIASA Energy, Climate, and Environment (ECE) Program since the 1980s.
- One major drawback of MESSAGEix was the **complexity of handling input data**, making it difficult to update and maintain.
- To improve efficiency, we transitioned to TIMES, which provides a more structured and flexible framework for energy system modeling.

The Integrated MARKAL-EFOM System (TIMES)

The TIMES model is being developed by IEA-ETSAP

- TIMES model generator combines **two different approaches** in modeling:
    - Technical engineering approach (modeling of different technical processes)
    - Economic approach (modeling of different economic and political plans)
- TIMES is a **technology-rich, bottom-up model** generator which uses **linear programming** to compute the partial equilibrium.
- Optimization is done over a variety of different constraints implemented by the user.
- A major advantage of the model is its ability to be developed on both regional and national scales
- The model can be used not only to model the economy of different countries but also for **environmental analysis**.

TIMES - CZ

CHMI participates on the ARAMIS project (Technology Agency of the CZE)

- **MO 2.2:** Emission projections of pollutants and greenhouse gases to 2050, with an emphasis on scenarios leading to climate neutrality, assessment of emission and immission reduction potential, and emission and immission scenarios.

  - The modeling expert for TIMES modeling is L. Rečka, Charles University Environmental Centre (CUEC)
  - The TIMES model corresponds to the National Energy and Climate Plan (NECP).

TIMES in CHMI

- The CHMI collaboration with CUEC is part of the ARAMIS → **share the model data/inputs**
    - Beginning in 2027, CHMI will be held accountable for the projections in the TIMES model.

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GHG and Pollutants Emissions Projections in TIMES 2025

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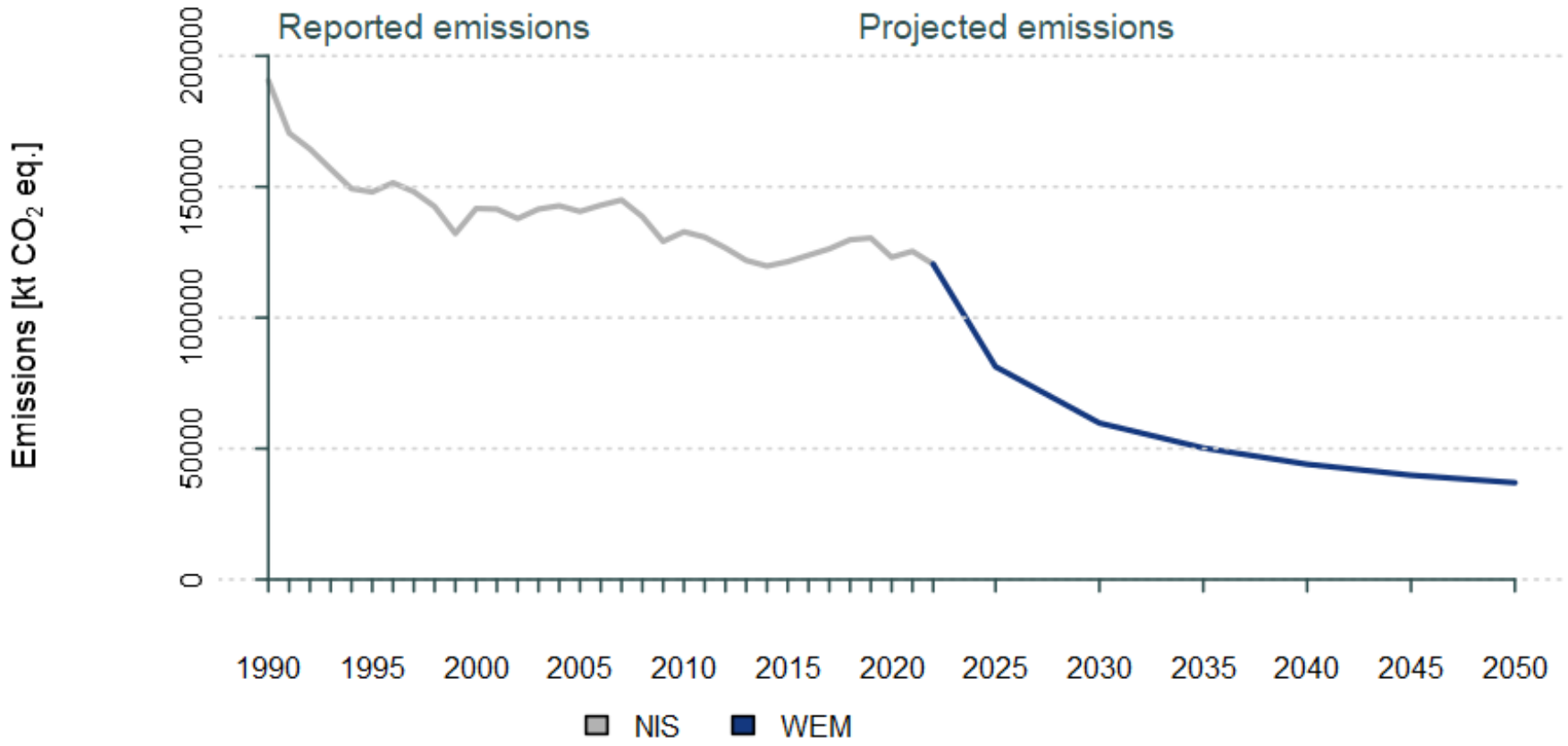
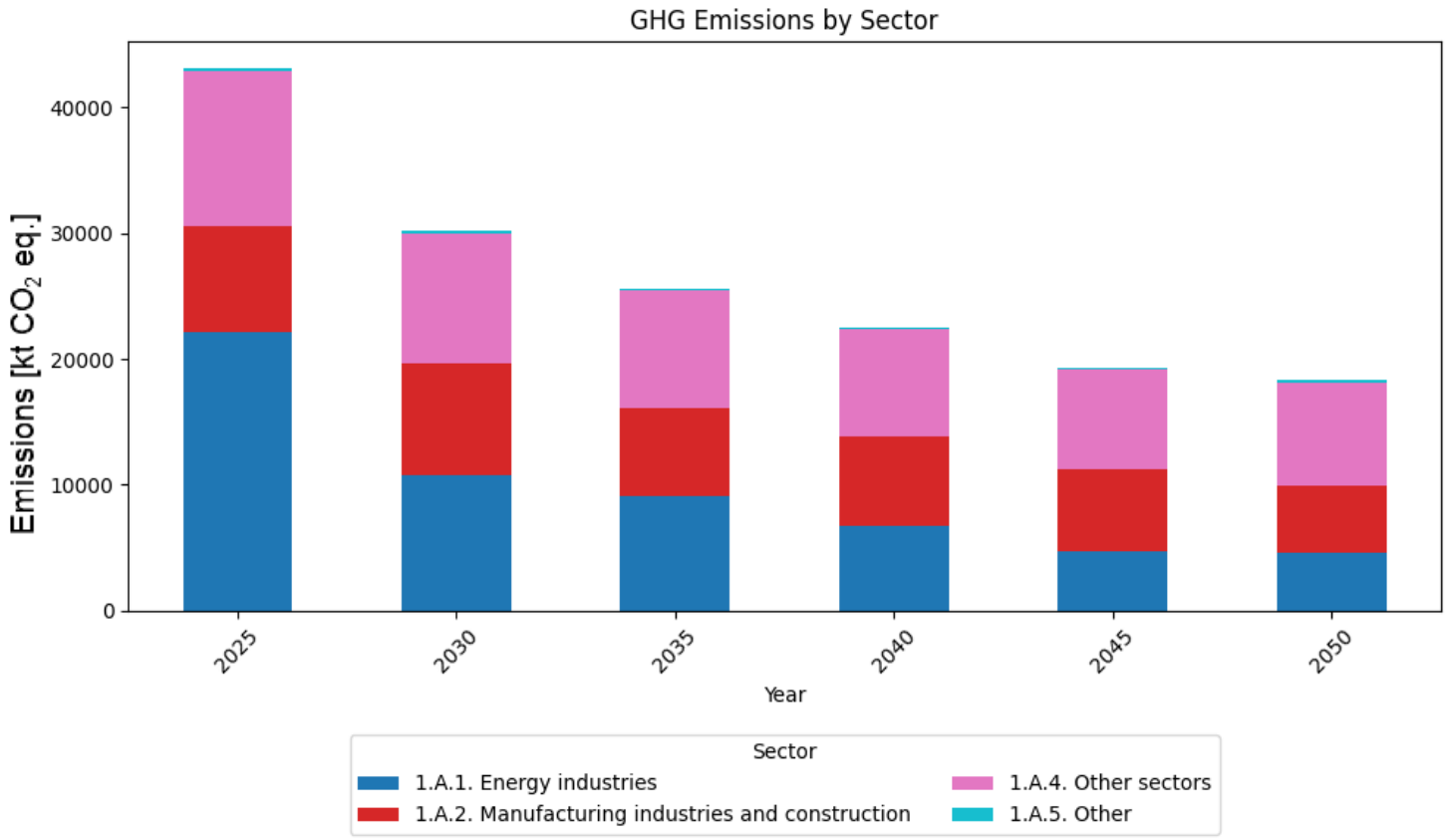
Projection submission of GHG emissions in 2025



Projection of total GHG emissions in CZE. (CO_2 ekv.)

Projection of GHG emissions from energy sectors

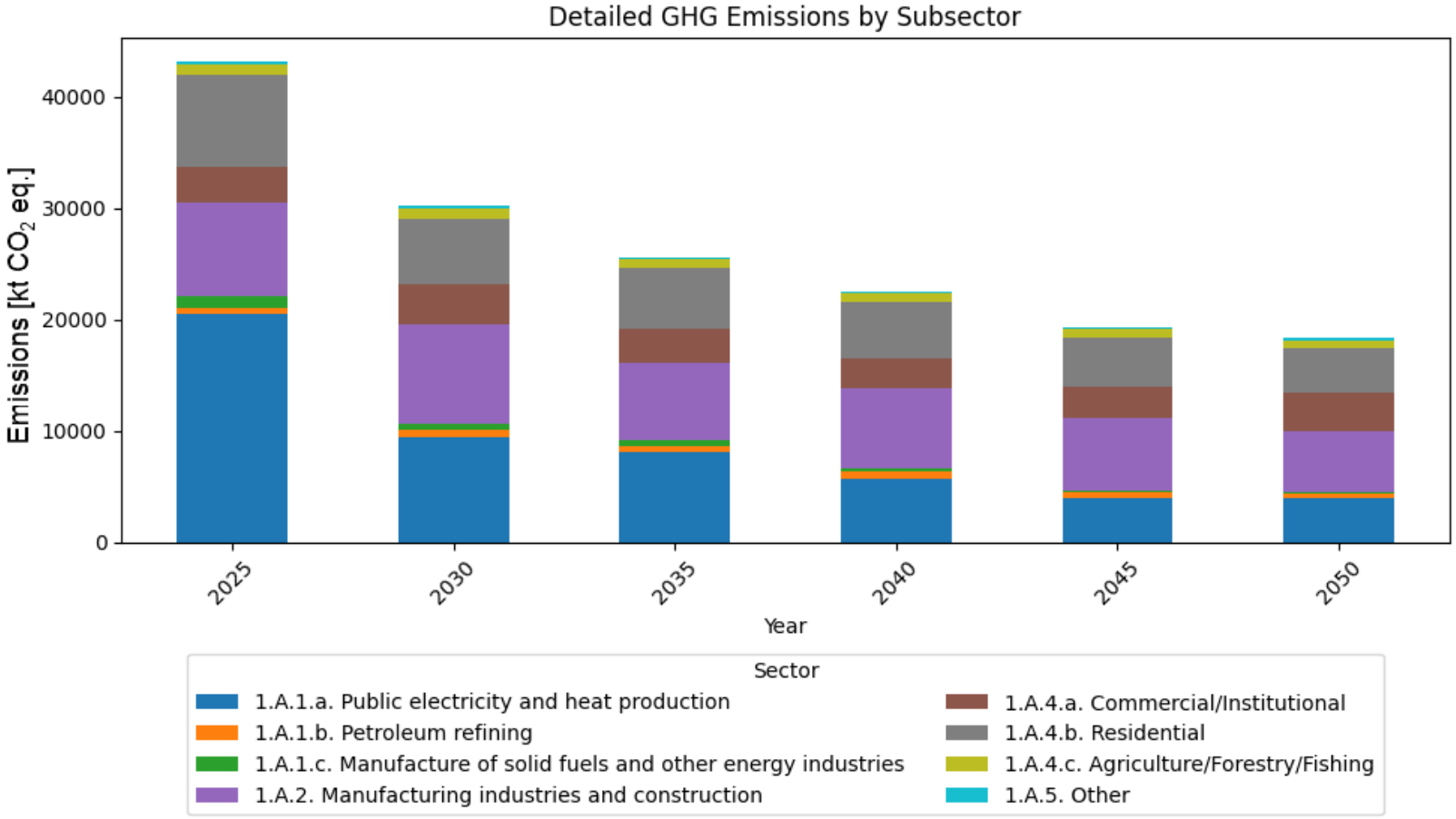
- **Modelled by TIMES**



Projection of GHG emissions in 1A1, 1A2, 1A4 and 1A5 energy sectors in CZE. (CO_2 ekv.)

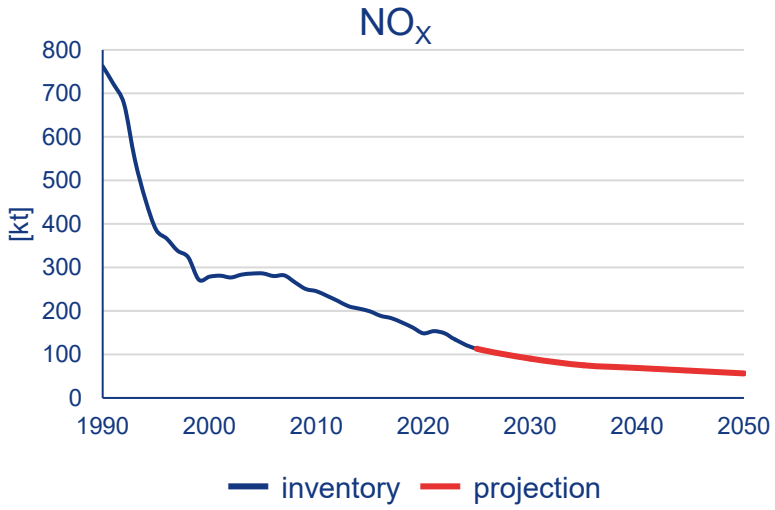
Projection of GHG emissions from energy sectors

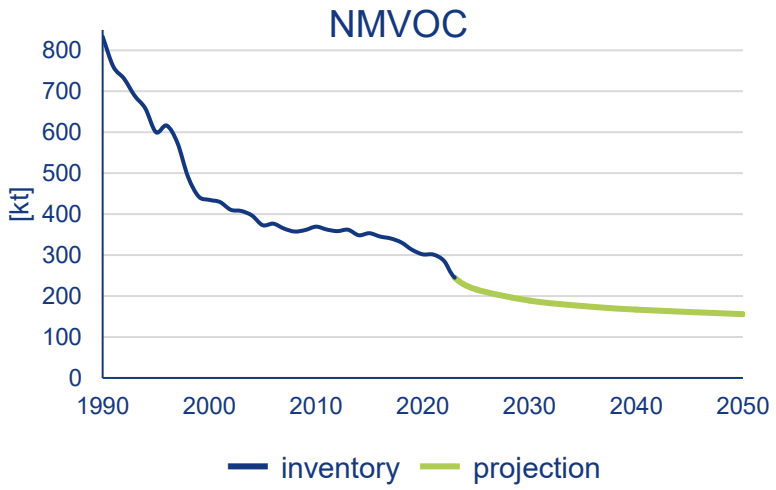
- **Modelled by TIMES**

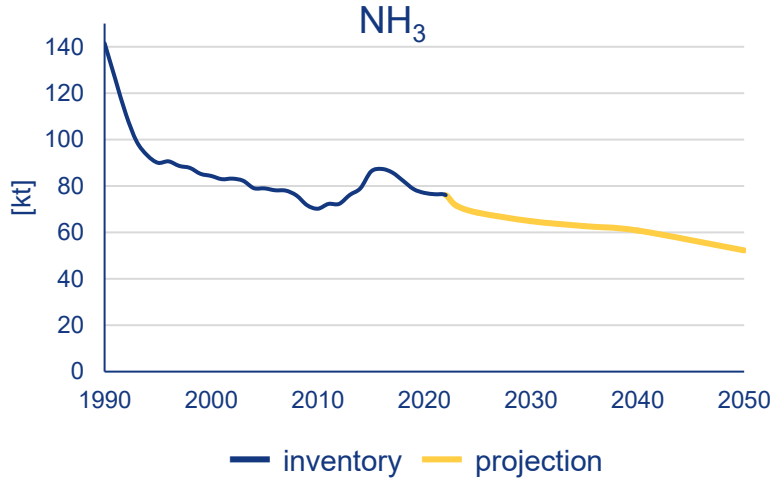


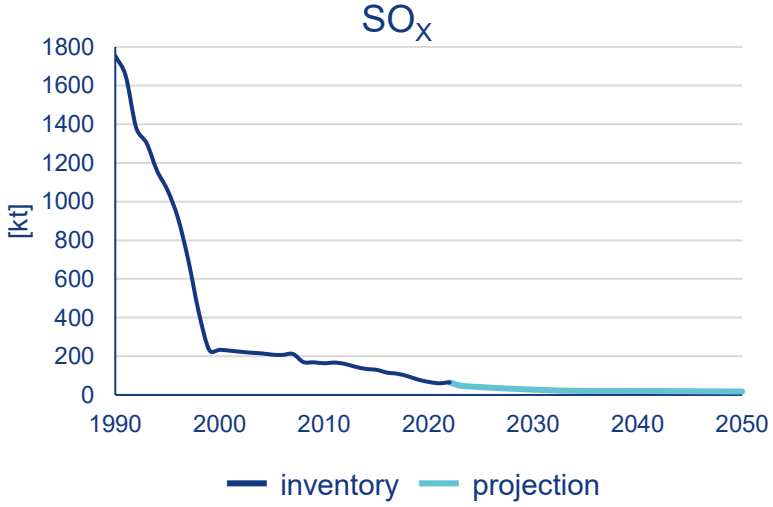
Projection of GHG emissions in 1A1, 1A2, 1A4 and 1A5 energy sub-sectors in CZE. (CO_2 ekv.)

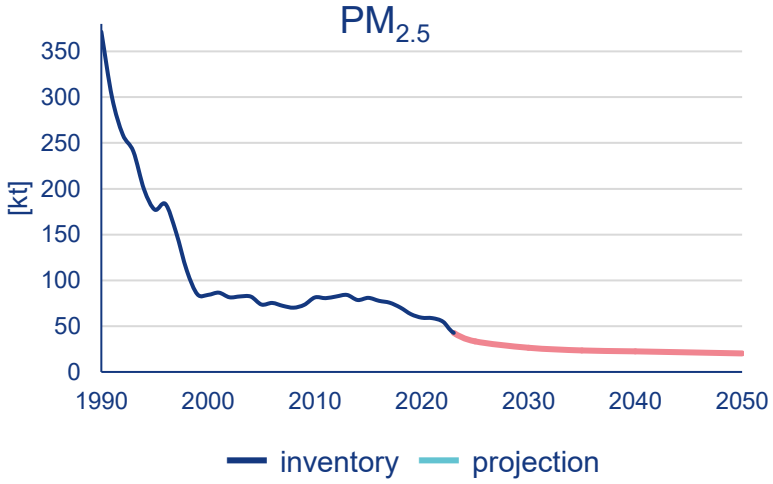
Projection submission of main pollutants emissions in 2025





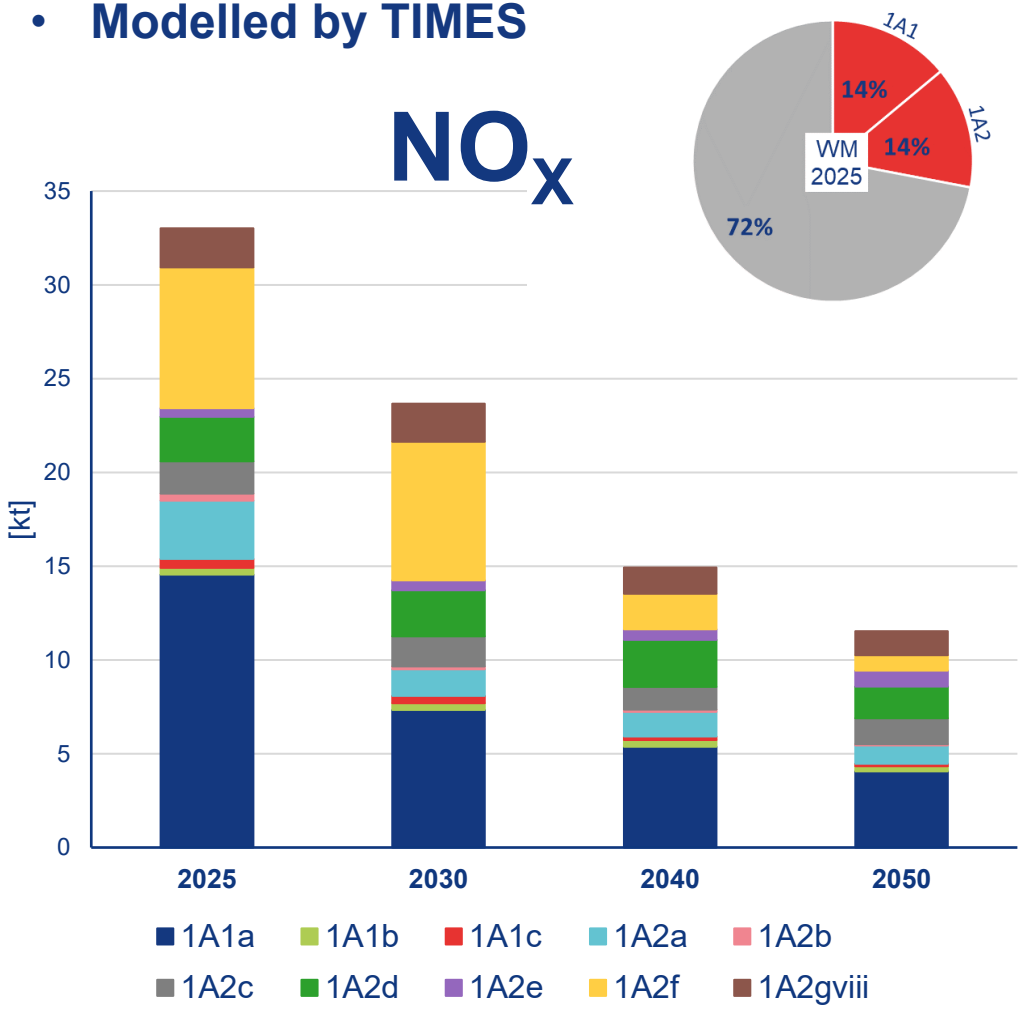


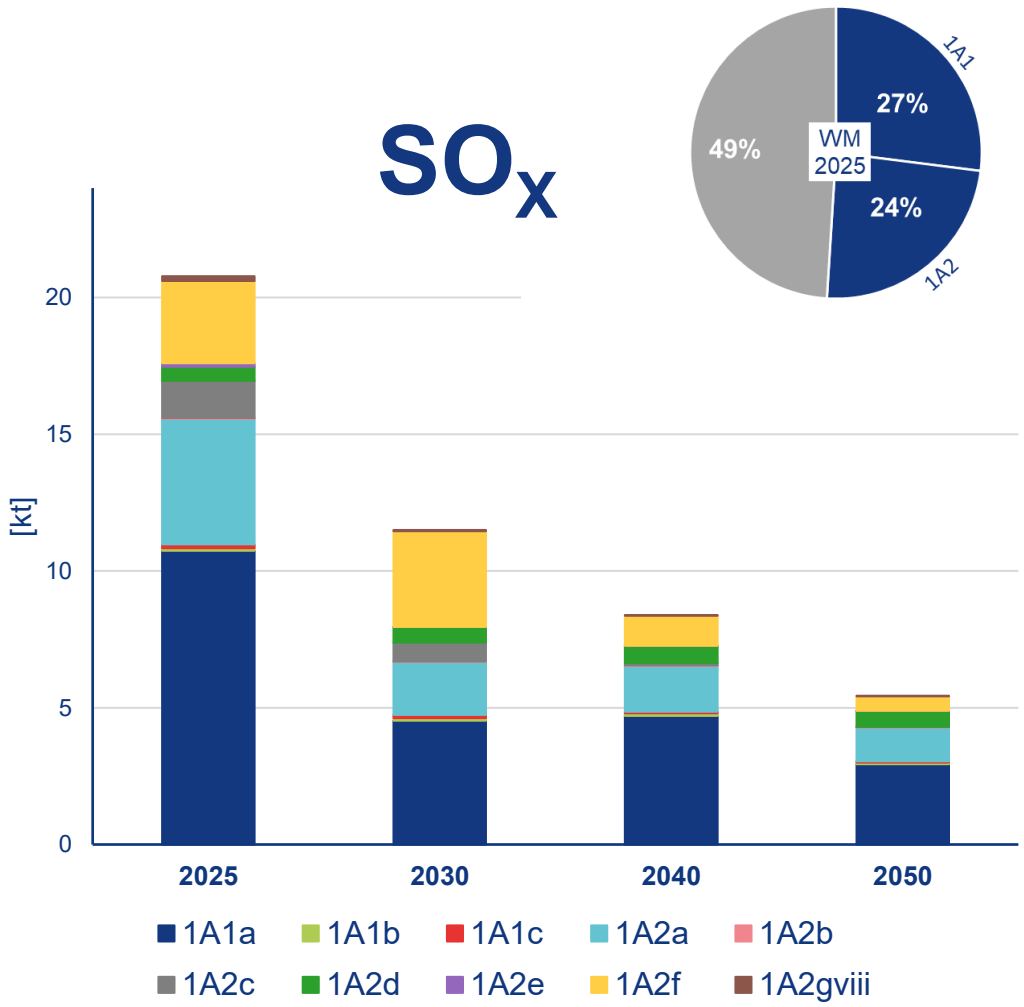




Projection of the main pollutants emissions

- **Modelled by TIMES**





Projection of main pollutants emissions in 1A1 and 1A2 energy sub-sectors

The Key to the Reduction

1. Legislative Pressure

- Czech Legislative Act No. 309/1991 Coll. and Act No. 86/2002 Coll. set limits for GHG and the main pollutants emission, introduced pollution charges and continual surveillance.
- Since joining the EU in 2004, CRLTAP obligations, EU directives, and other protocols have led to stricter regulations.

2. Economic Pressure

- Higher pollution fees, EU ETS
- BAT (Best Available Technology)
  - Modernization and reconstruction of technologies
  - Primary and secondary separators
  - Improved fuel mix

3. Renewable and Low-emission Sources Replacing Combustion-based Energy Sources

Future TIMES Modelling in CHMI

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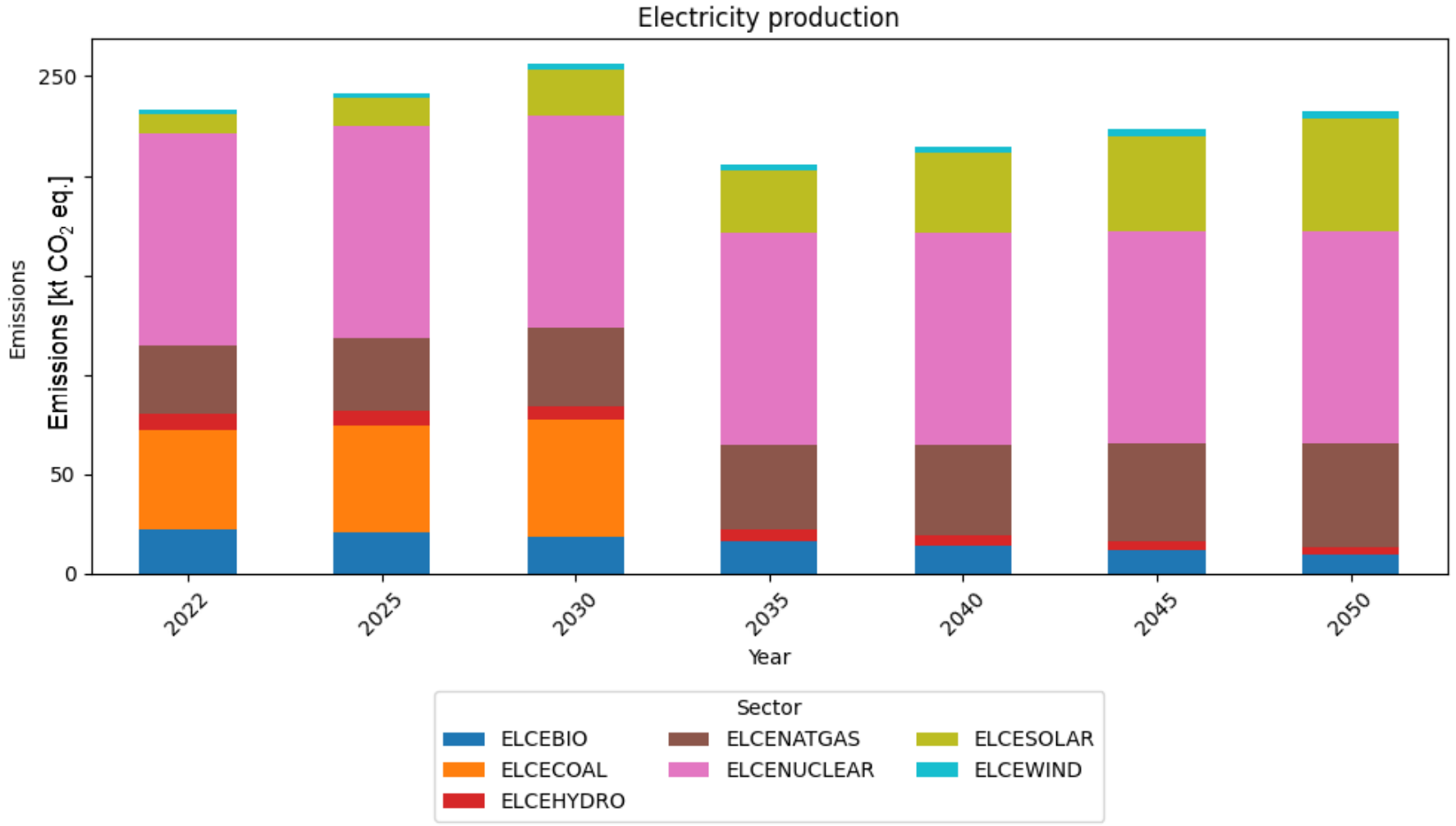
Developing TIMES model at CHMI

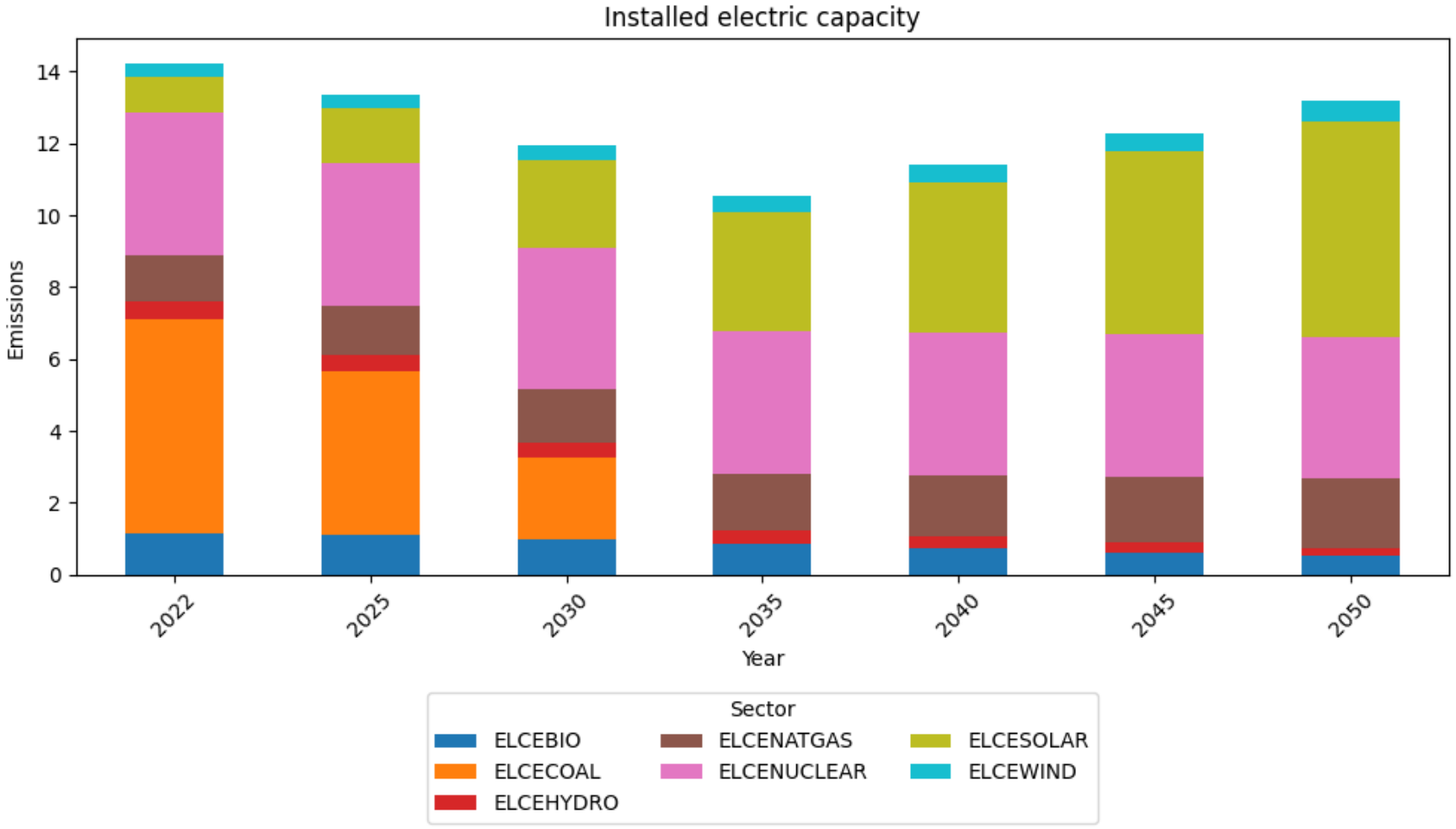
- CHMI is currently developing a TIMES model with a focus on regional-level energy planning and emissions forecasting.
- CHMI starts with a single-region model and a small number of technologies.
- **Challenges & Next Steps:**
    - Expanding the model scope beyond the pilot region.
    - Incorporating additional technologies to improve sectoral representation.
    - Ensuring consistency with national and EU policies.
- Preliminary results are promising, and we aim to achieve a fully operational model in the next phase of development.

CHMI model outputs



Projection of production of ELC in CZE

Our model outputs



Projection of installed capacity of ELC in CZE

Conclusion

- The TIMES model has proven to be a valuable tool for improving the accuracy and reliability of GHG and pollutants emissions projections in the energy sector. By integrating economic, technological, and policy-driven factors, it allows for a more comprehensive analysis of future energy pathways.

- Our collaboration with CUEC under the ARAMIS project has strengthened our modeling capabilities, and ongoing efforts to develop an in-house TIMES model will further enhance national and regional planning.

- CHMI will refine its methodologies, incorporate a greater number of technologies, and ensure consistency with national and EU policies. These advancements will contribute to better-informed decision-making and a more sustainable energy future for the Czech Republic.

Thank you for your attention !

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