Flowing Flexibility: Hydropower for a Green Transition

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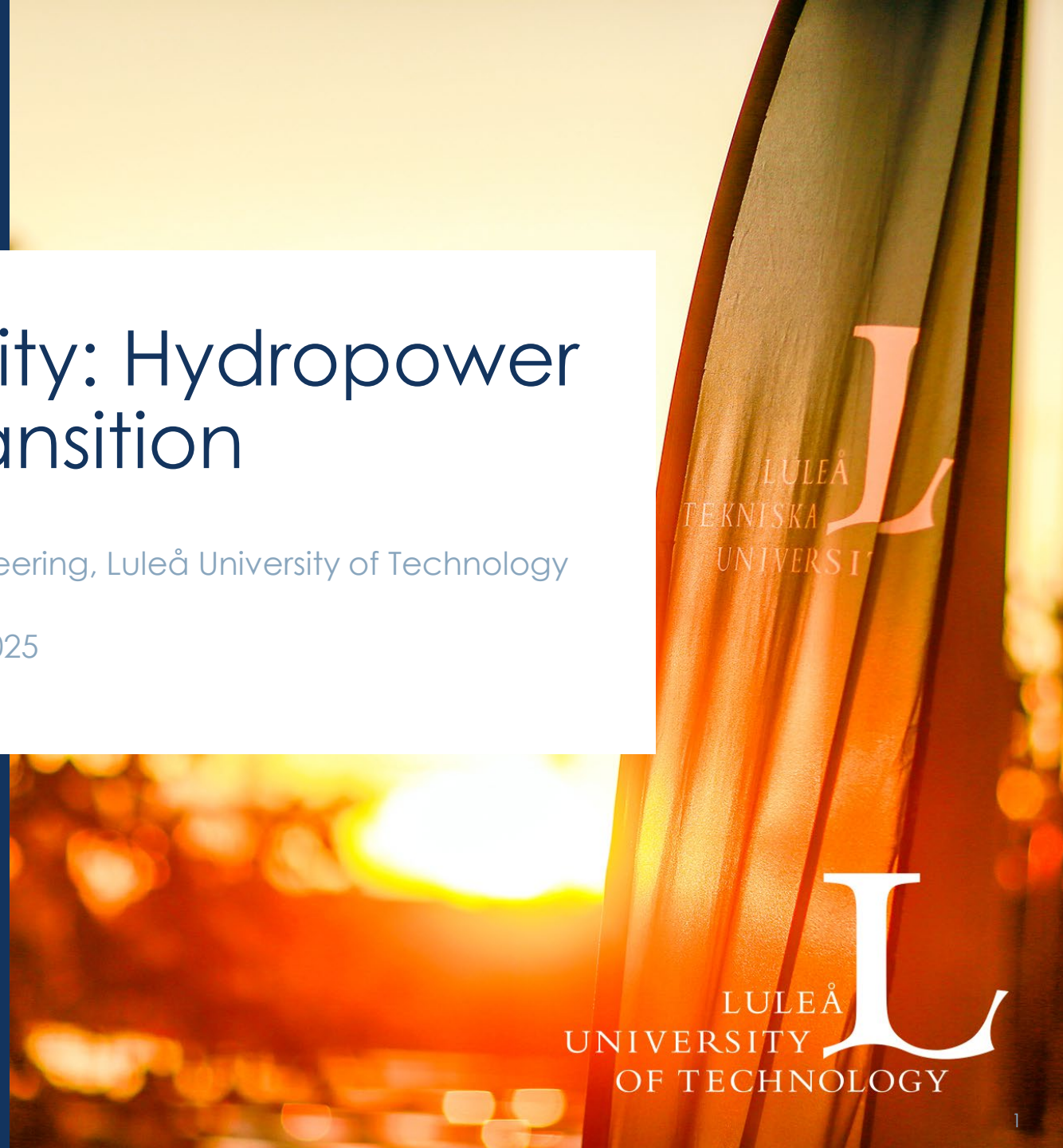
Hydropower R&D days, Uppsala, 2025



The project

AIM: To analyze what is required – in terms of flexibility from Swedish hydropower – to transfer to a fossil free energy system. Including assessing how changes in hydro power may impact what is cost-efficient solutions in other sectors.

This will be achieved by

1) **Develop a new electricity system module for TIMES-Sweden, with four price areas, high time resolution and various measures to increase hydropower's ability to contribute to flexibility in the future energy system.**
2) Identify a set of measures that are seen as central to a fossil-free electricity system and thus that Sweden can achieve our climate goals and meet the future increased electricity demand due to new green industrial establishments.
3) Develop better basis for environmental permit processes regarding the climate benefits of various measures in the electricity system.

Flowing Flexibility – Hydropower for a Green Transition

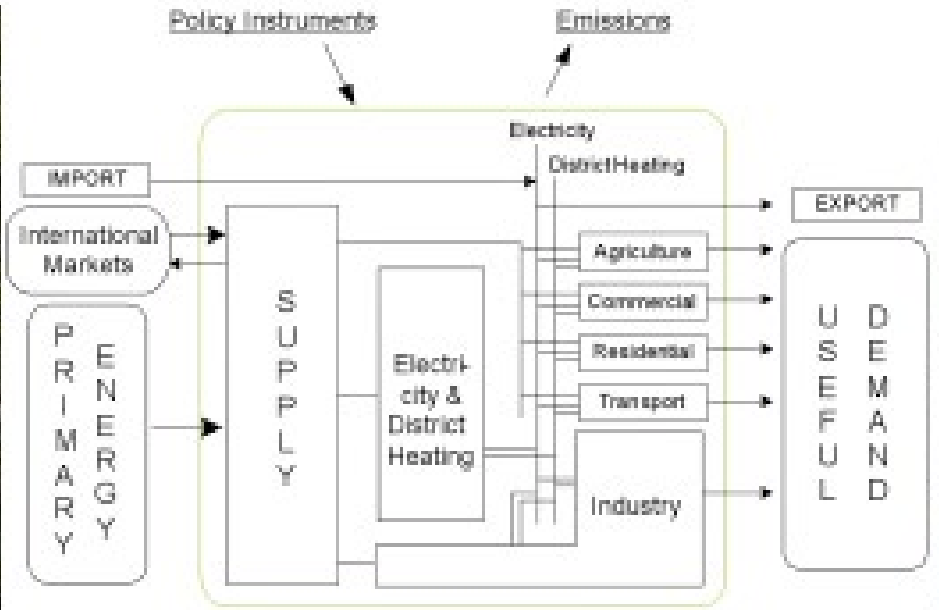
Flödande flexibilitet – Framtidens svenska vattenkraft i fas med den gröna omställningen”

- PhD project financed by the Swedish Energy Agency
- **PhD student: Tatiana Builes Hoyos, started in February 2025**
- Research subject: Energy Engineering, Applying system analysis & Long-term techno-economic Energy System Optimization Models

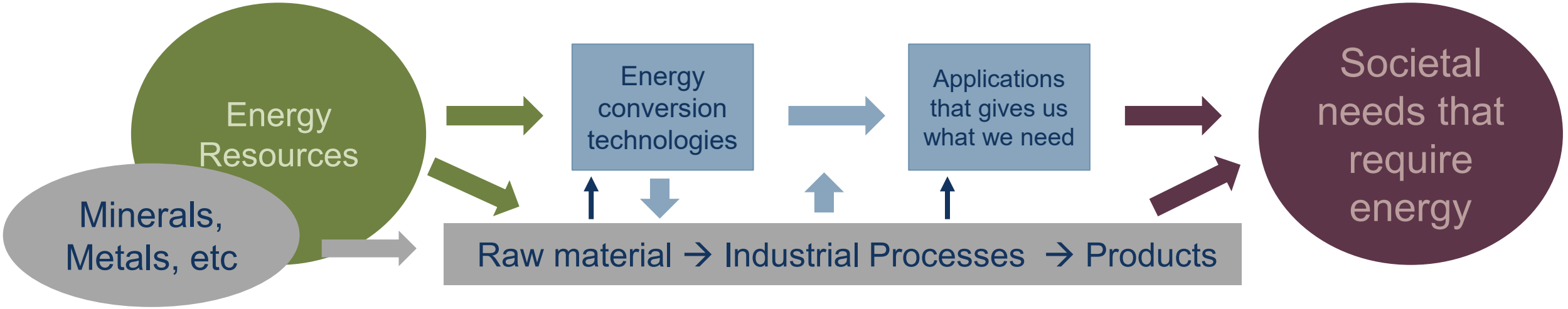
- Supervisor: Anna Krook-Riekkola, Associate Professor in Energy Engineering, LTU
- Collaborating with: Maria Pettersson, Professor in Environmental Law, LTU

How can we meet future societal needs that requires energy?

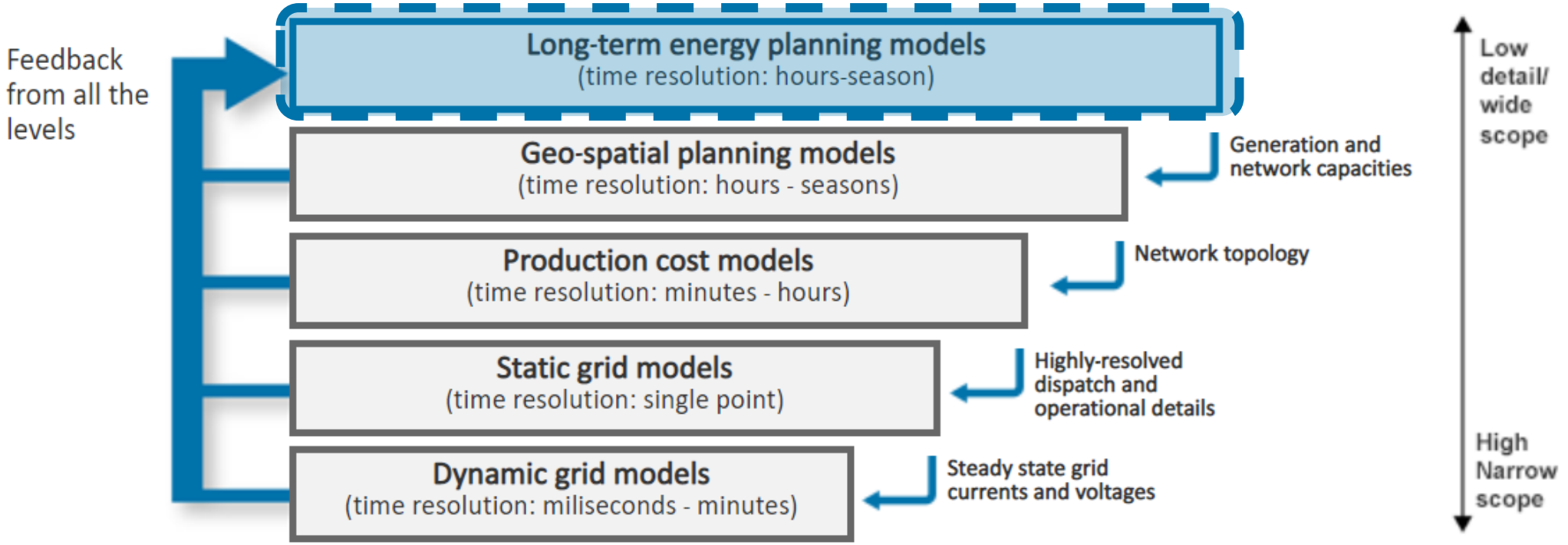
1. … and at the same time meet other goals we have set in our society …
2. … at the lowest cost …
3. … based on given resources …
4. … and on what happens with technological development, price trends, etc



ENERGY SYSTEM



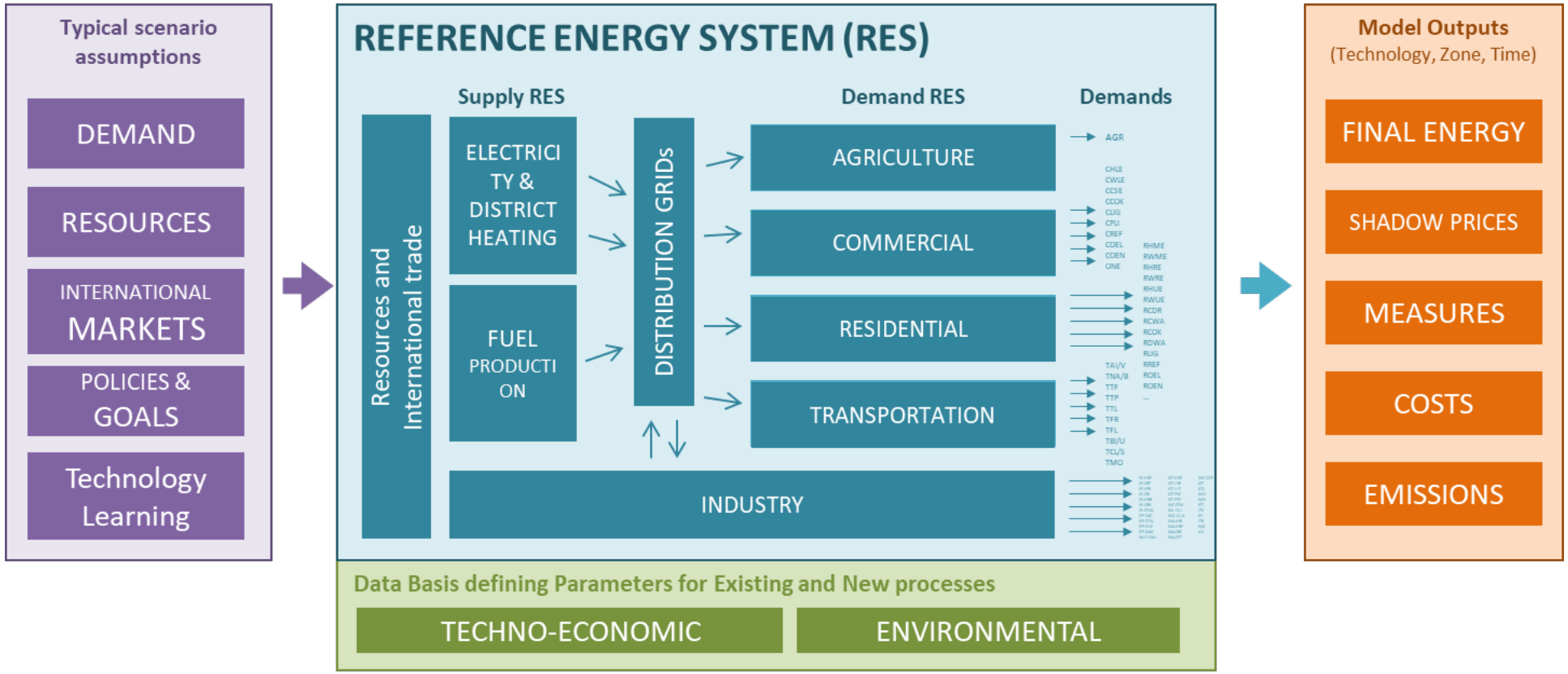
Approaching Energy Transition
Tools and analyses for energy system planning and interaction



PURPOSE: To support the transition to a sustainable energy system by testing different futures with respect to different sets of underlying assumptions

METHOD: Applied system analysis and models

MODEL: TIMES-Sweden



The model is based on the TIMES modelling platformed developed and maintained by **IEA-ESTAP**: https://iea-etsap.org/
Krook-Riekkola, A. (2015), Industry Sector & Fuel production: Sandberg, E. (2022), Transport sector: Forsberg, J. (2024)

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References

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Krook-Riekkola, A. (2015) National Energy System Modelling for Supporting Energy and Climate Policy Decision-making: The Case of Sweden, PhD thesis, Chalmers, Göteborg, Sverige.

Sandberg, E. (2022) National Energy System Modelling of Industry: Optimising the Transition Towards Carbon Neutrality, PhD thesis, Luleå University of Technology, Luleå, Sverige.

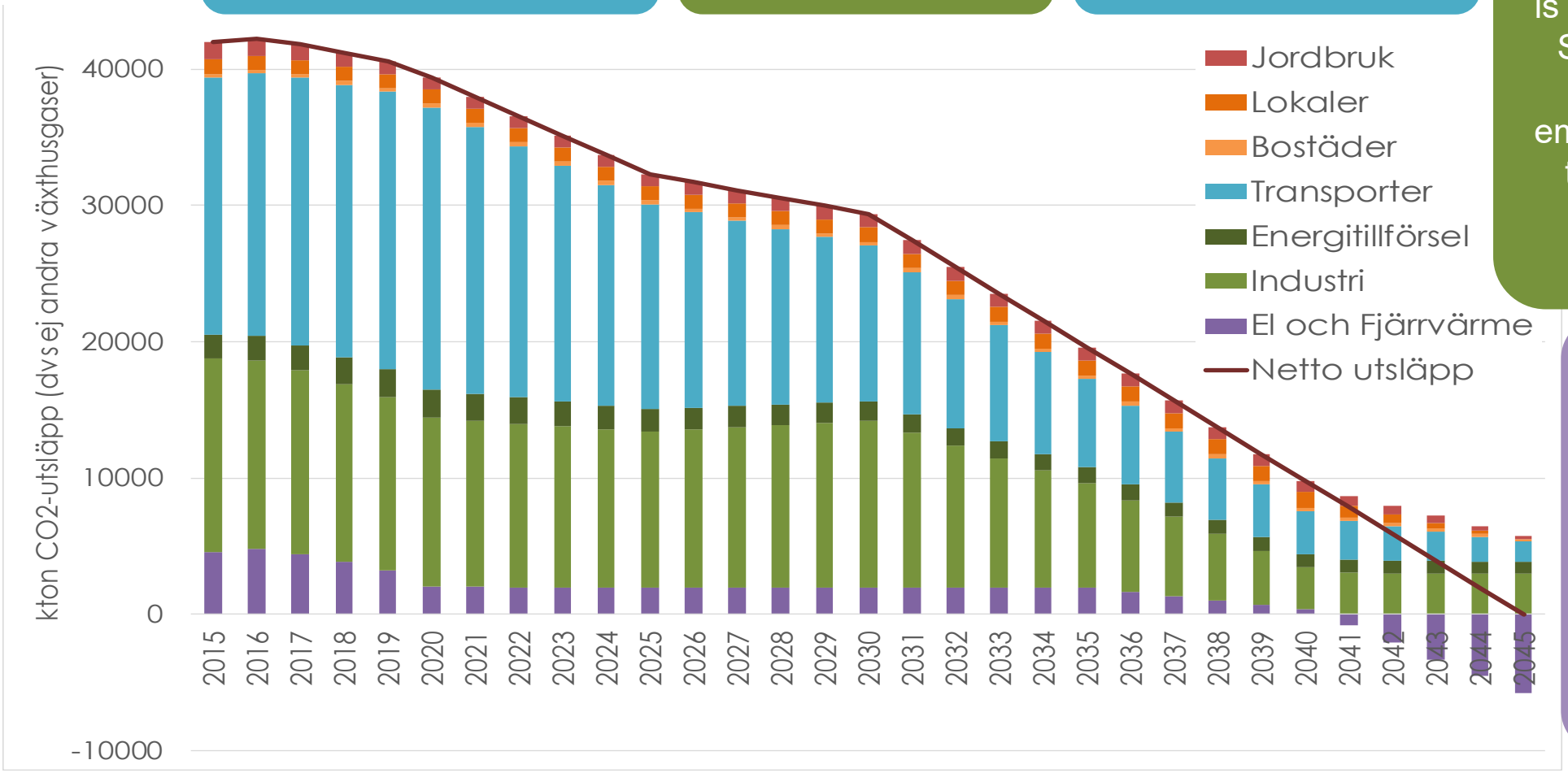
How can Sweden meet net-zero CO2-emissions by year 2045?
– *Results are illustrative and not the latest ones* –

2030: Cars in general does not use fossil fuels

2035: Iron&steel start the transition

2030-40: Heavy vehicles shift to fossil free alternatives

2045: Iron&steel is CO2-neutral. Still process related emissions from the cement industry



2045: BECCS to compensate for CO2-emissions really difficult to avoid