



THE NORTHERNMOST UNIVERSITY
of Technology in Scandinavia

Modelling Climate Policy Recommendations for Sweden

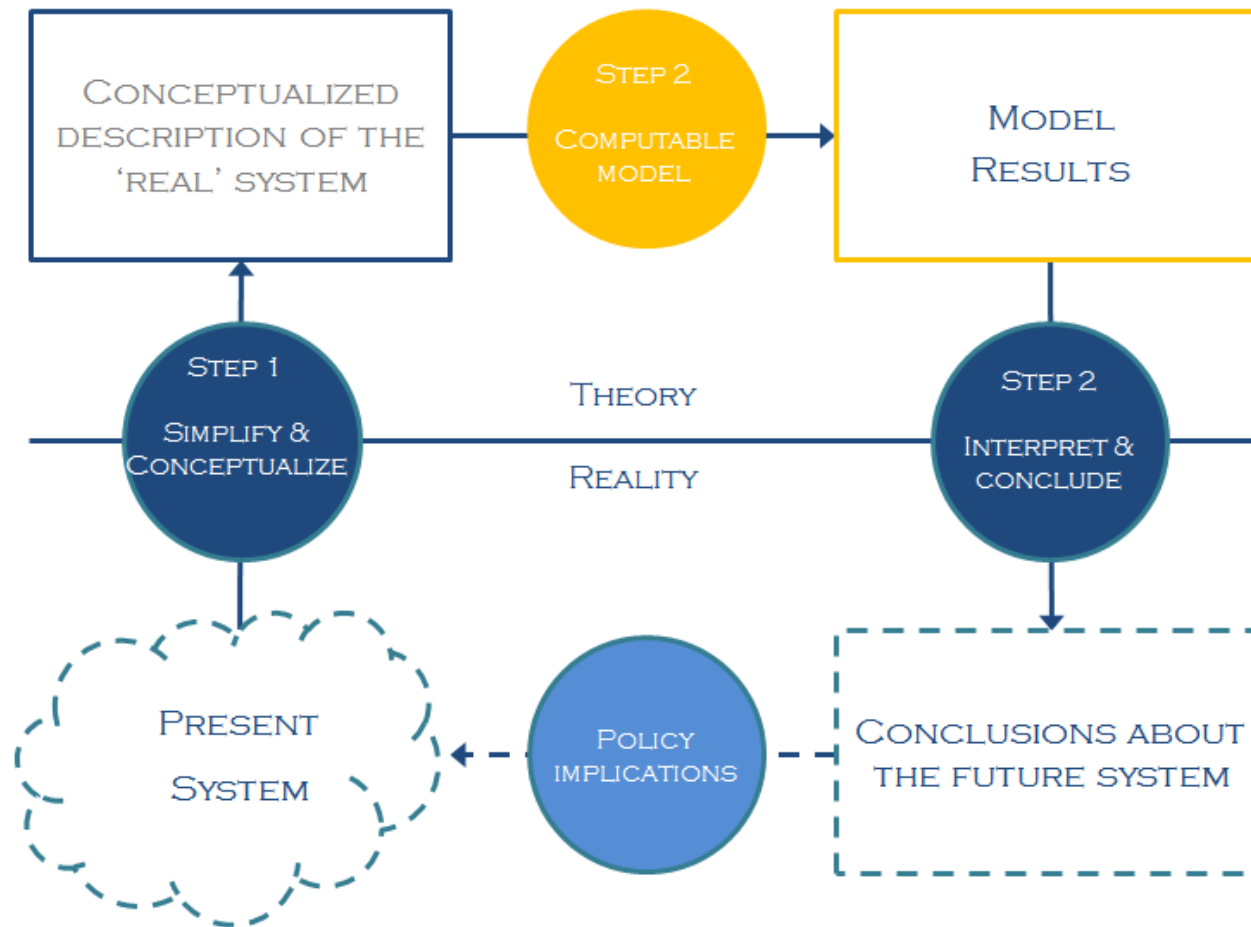
Workshop on Short term vs long term energy planning, UCL, April 28th 2016

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OF TECHNOLOGY

Energy system modelling process



From: Krook-Riekkola (2015). Inspired by Clas-Otto Wene, professor emeritus, Energy System Technology unit (Chalmers), Churchman (1968) and Tosato (2009)

My objective with this workshop

- 1) Which kind of **insights from the energy system model** 'should' be **communicated** to the decision makers (in order for them make sustainable decisions)?
 - Indicators (e.g. EUR/CO₂, cost/GDP): Decision makers asks for it, but what does it actually say?
 - 'Stories' on how the target could be met (often become huge).
 - ?

- 2) How to improve the (TIMES) modelling work with respect to **uncertainties** of the future?

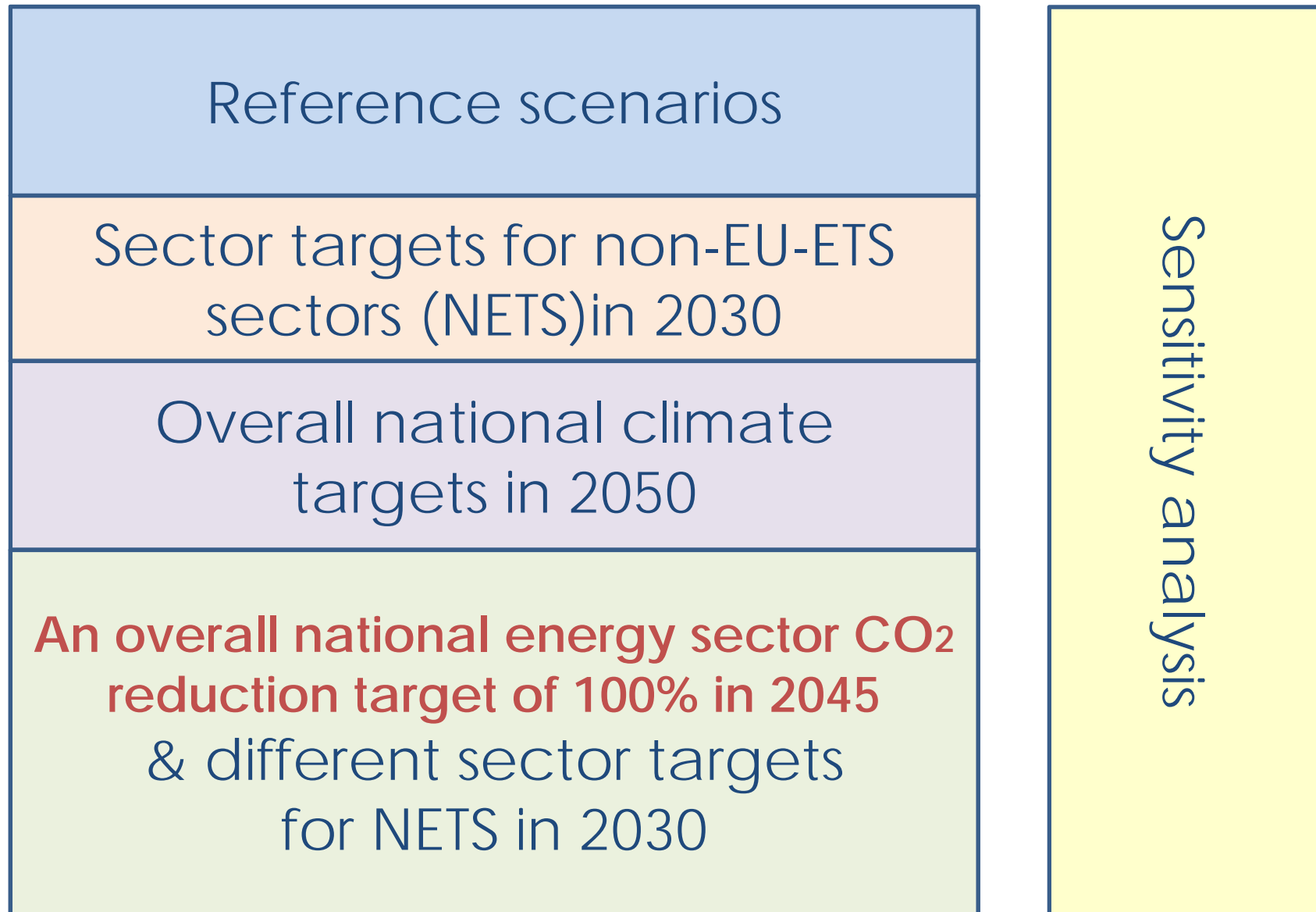
Assessing Climate target for Sweden Using TIMES-Sweden

- Sector targets in year 2030
- Overall target in year 2050

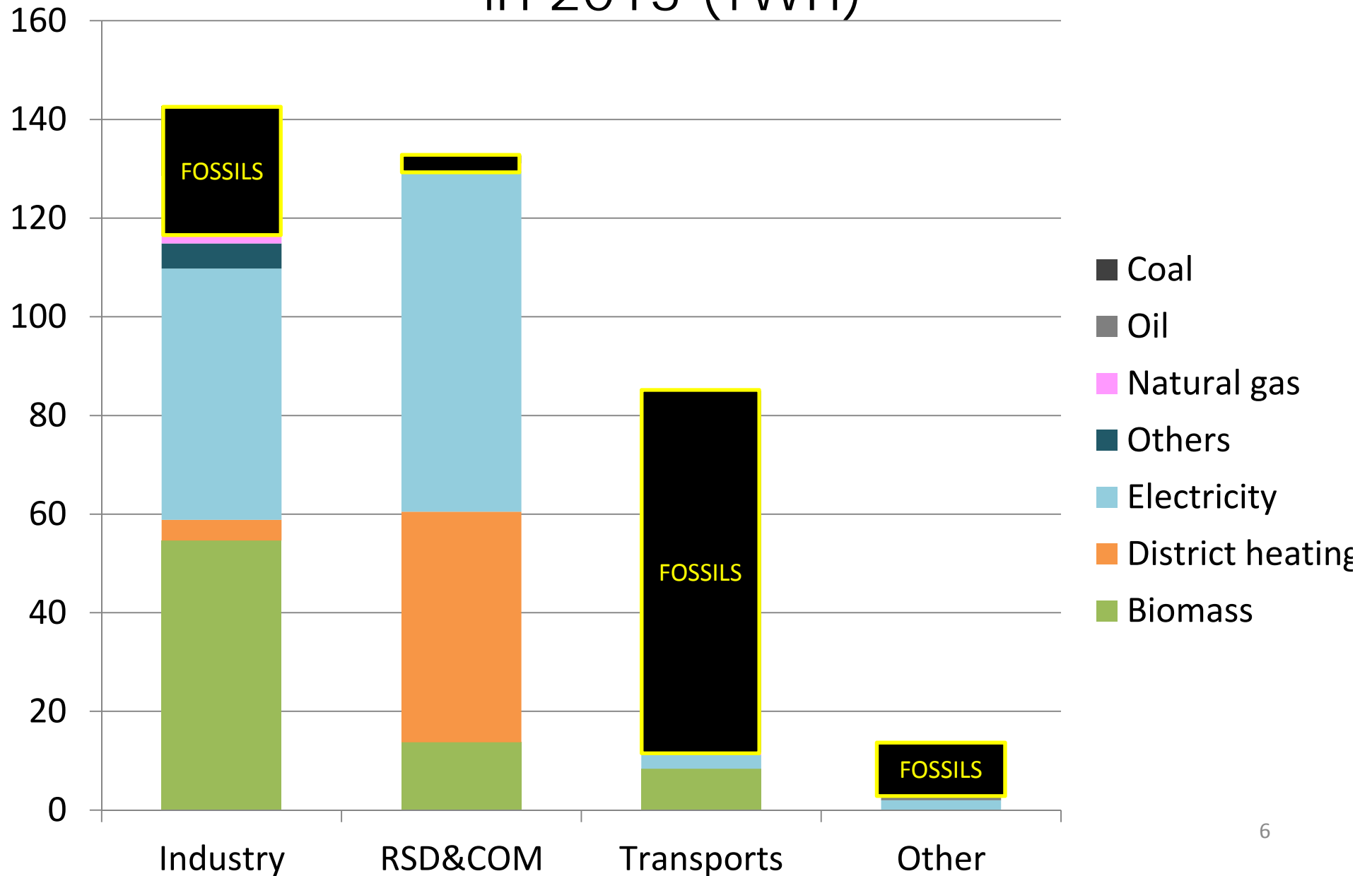
TIMES-Sweden: An energy system optimization model of the Swedish Energy system, including both supply and demand sectors, including transportation.

Base-year calibrated according to energy and transportation statistics, existing policy instruments etc.

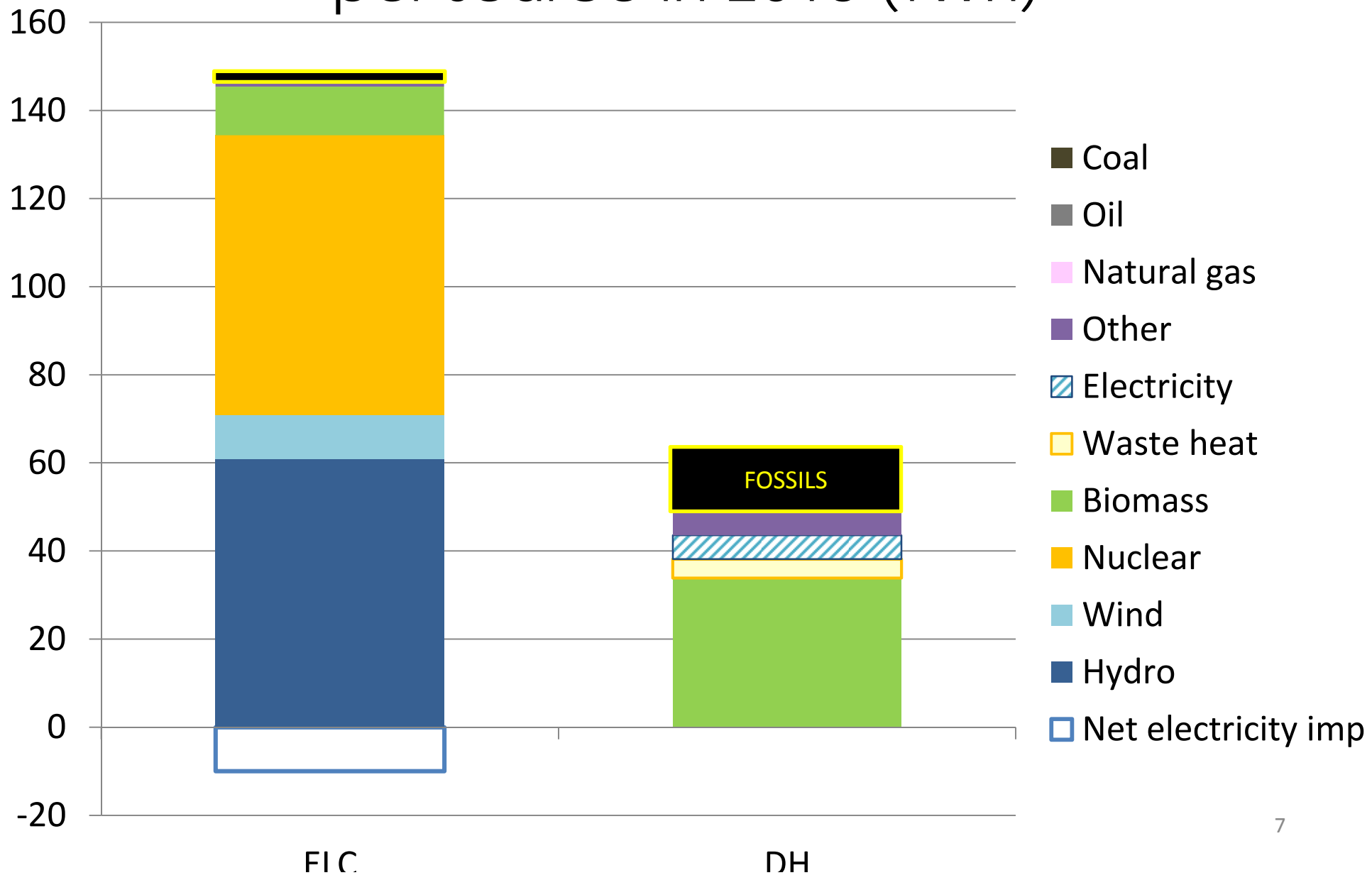
Scenario analysis with TIMES-Sweden



Final Energy "Consumption" in 2013 (TWh)



Net electricity & District heating production per source in 2013 (TWh)



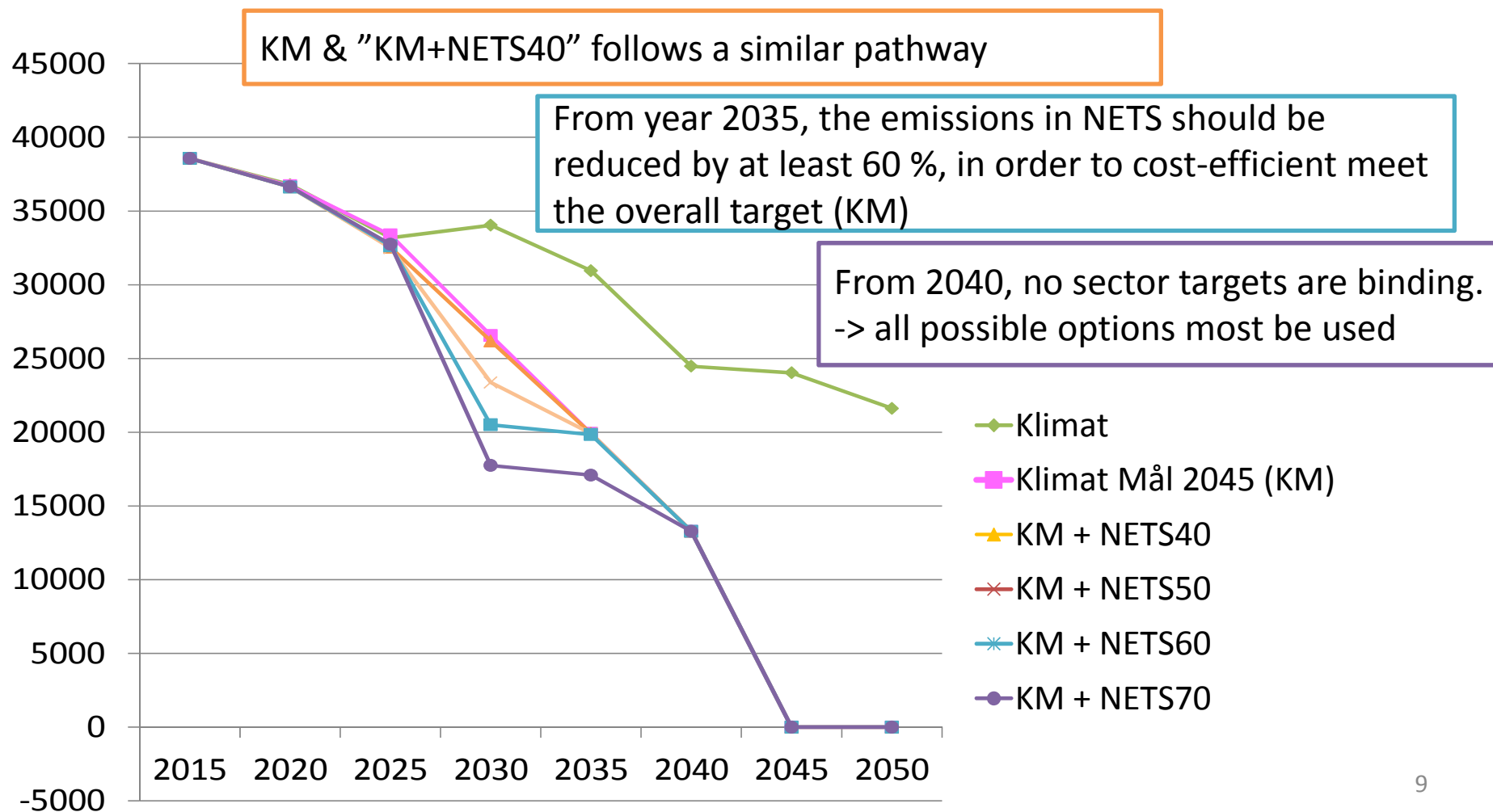
Some results

Total CO₂ emissions

Klimat: Reference scenario with EU-ETS climate scenario

Klimat mål (KM): A national 100% reduction target from 2045

Sector targets: KM+NETSxx (xx% reduction from 2030)



Main conclusions

- **Biomass** is crucial in order to meet low carbon pathways in a low cost manner. (☺ Sweden is rich in biomass sources both forestry and energy crop possibilities ☺).
- Challenge I: **Road-based goods** transportation (very few alternatives to fossil fuels). Some goods can be changes to alternative transportation (railway, 'electrified high-ways', ships and improved logistics). THUS, **biofuels** becomes very important! In the same time, the compatibility of biofuels depends to a large degree on the price of oil, THUS, it is important with targeted policies!
- Challenge II: To make shore that the **technology progress** assumed in the model take place.

Big uncertainties – that impact the results

- ✓ Bio-CCS and CCS in the industry (Pulp&paper, Iron&steel and Cement)
 - > Impact if the target can be meet or not.
- ✓ Future transport demand
 - > Impact he cost of meeting the target.
- ✓ Cost development of electric vehicle
 - > Impact he cost of meeting the target and how much biomass that is needed.
- ✓ Price development of oil products (impact biofuels)
 - > Impact he climate reduction pathway, and thereby the accumulated amount of CO₂.

Thanks for the attention

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