Danish Energy and Climate Scenarios

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Agenda

- The Danish Energy Agency and our scenarios
- Fossil free scenarios towards 2050
- Medium term scenarios for 2020-2035
- Future discussions and challenges

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The different outlooks

- **Short term**
  - Annual Energy and Climate Outlook
  - Frozen Policy approach for 2015-2025
- **Medium term**
  - Extension of BAU towards 2035
  - Evaluate policy options and intermediate targets
  - ”Work in progress”
- **Long term**
  - Fossil free scenarios for 2050
  - Tool for understanding and discussion

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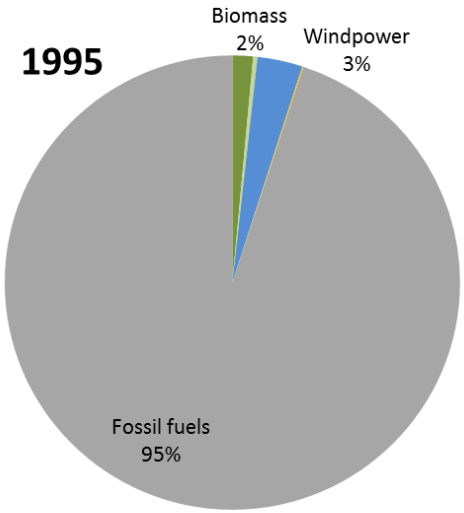
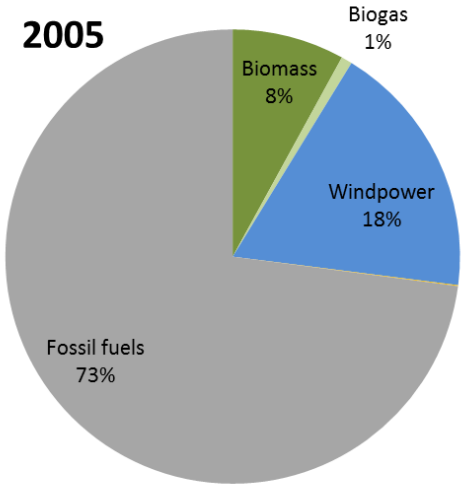
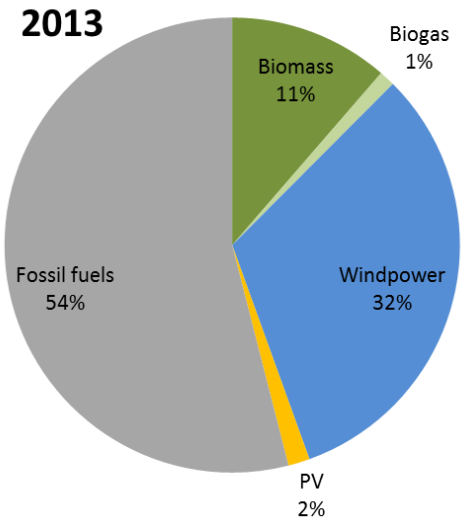
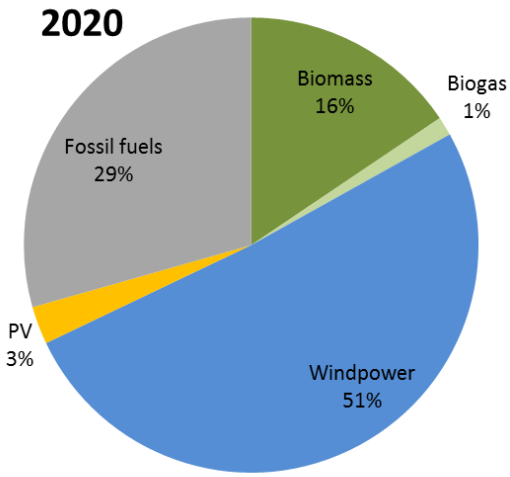
Electricity from RE
share of domestic supply

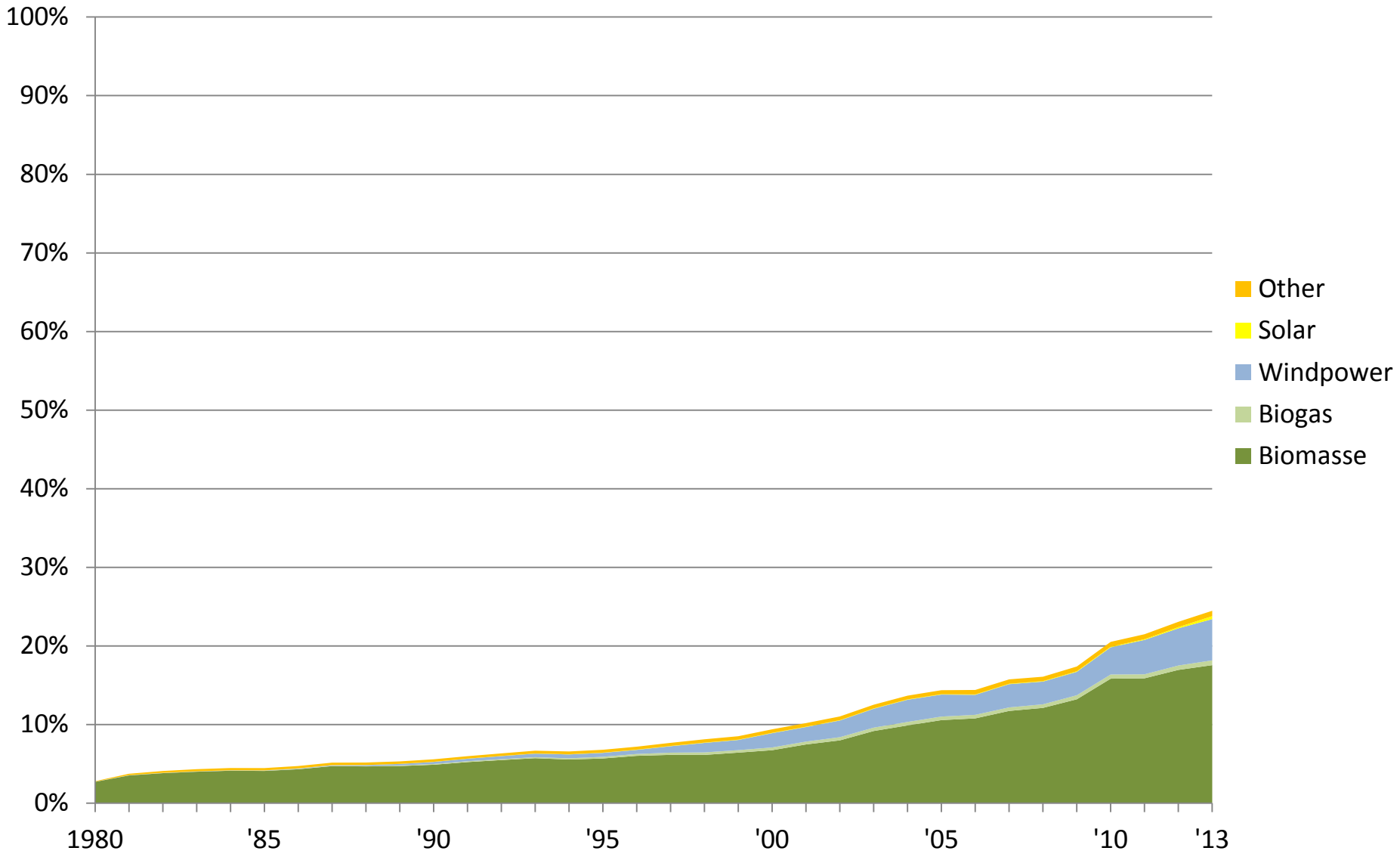








Renewable share of Total Primary Energy Supply (TPES)



Fossil-free Scenarios for a Danish Energy System

2020 – 2035 – 2050

http://www.ens.dk/sites/ens.dk/files/dokumenter/publikationer/downloads/energiscenarier_-_analyse_2014_web.pdf

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Political background

- A broad majority in the Parliament behind the development to 2020 (Agreement March 2012).
- Government target: Fossil-free electricity and heat production by 2035 (and no coal in power plants by 2030).
- Parliament supports ”100 % RE” in 2050 and EU 2050 target.
- Nuclear ban from 1985.

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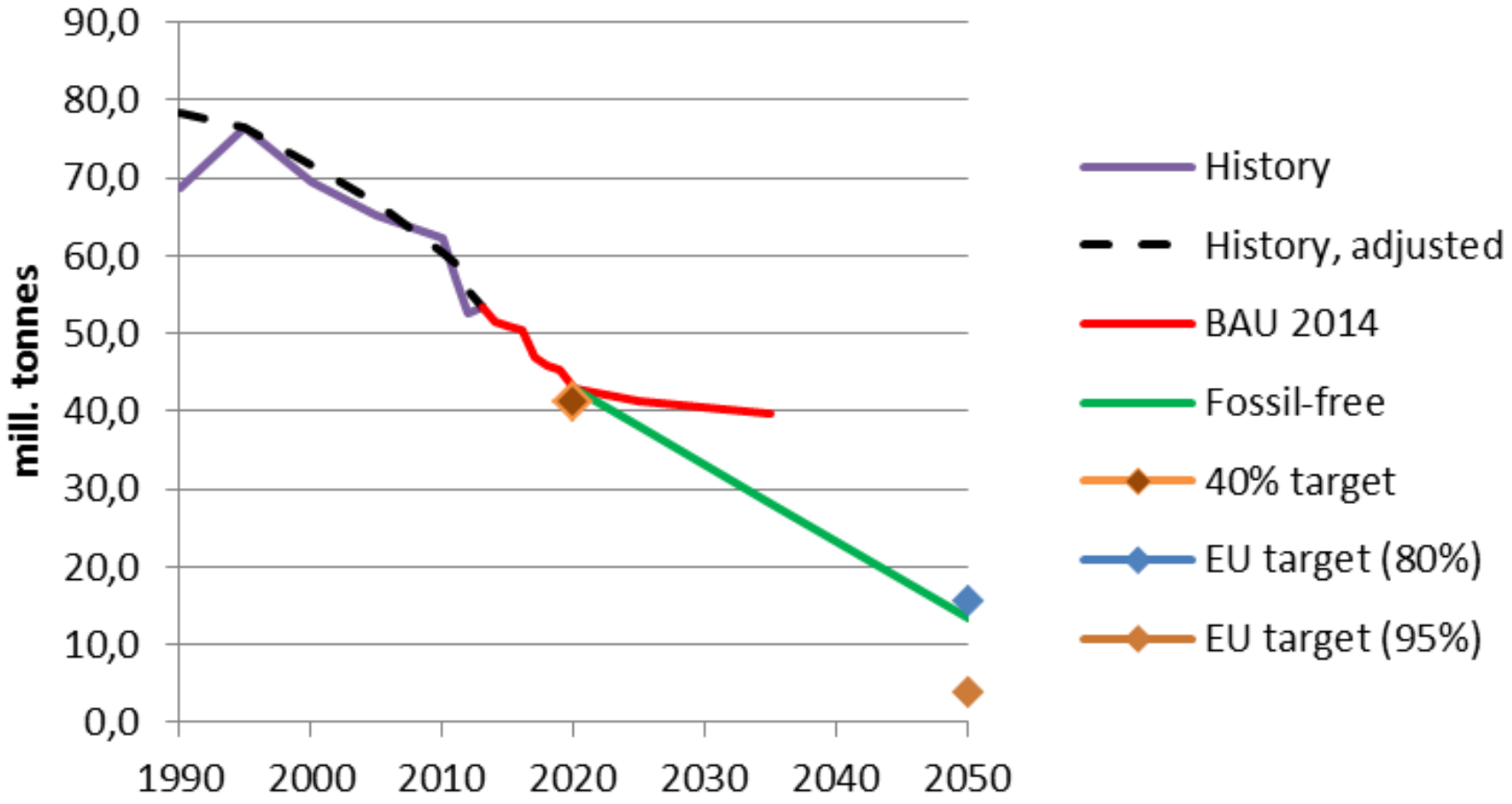
Danish GG emissions towards 2050



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Design criteria for 100 % RE

- Wind and solar abundant.
- Bio-energy limited.
- Total bio-energy is chosen as the primary design criterion.
- Energy savings and wind/PV will have to deliver the rest.

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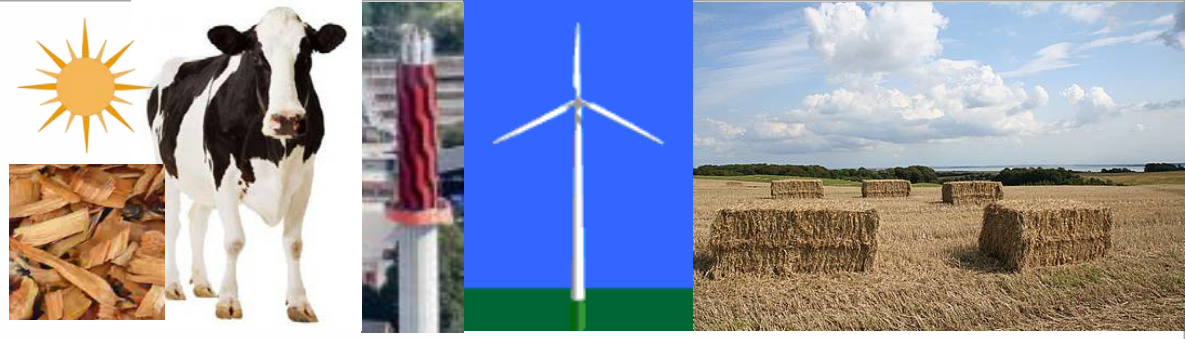
2050 scenarios



- **Wind**: Bioenergy ≈ Danish ressources.
- **Bio+**: Coal/oil/gas replaced by bioenergi.
- **Biomass**: A compromise.
- **Hydrogen**: Minimizes biomass.
- **Fossil**: For comparison (not BAU).

- *Large energy savings in all scenarios.*
- *Massive electrification in Wind and Hydrogen scenarios. Moderate in Biomass and Fossil Scenarios.*

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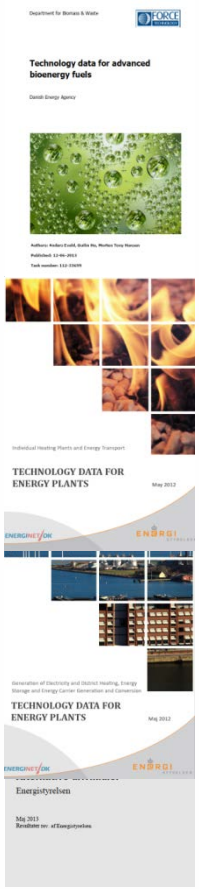
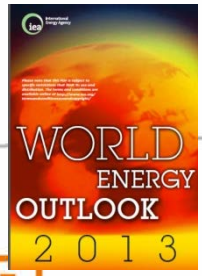
Methododology and assumptions

- Energy demand model (energy quality; economic growth + energy savings).
- EBM (bottom-up Energy Balance Model with hour simulations).
- Technology costs and efficiencies from 4 technology catalogues.
- Fuel/CO_2 prices: WEO (NP) + ETP (4º).



- Refineries in Denmark.
- Gas grid maintained (for green gas).
- Electricity storage: ”the market”.



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Entanglement of the future renewable energy system




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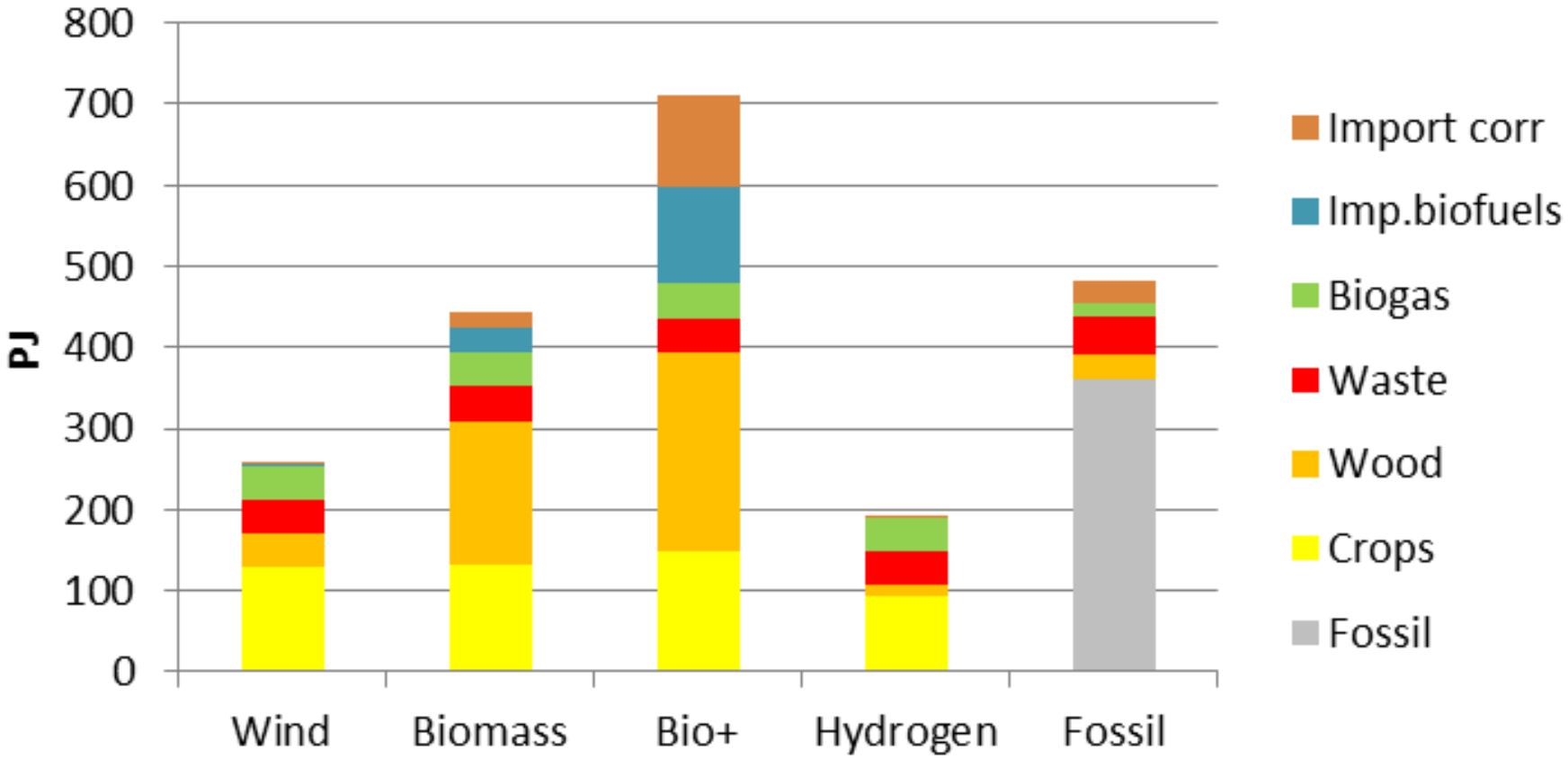
Fuel consumption 2050







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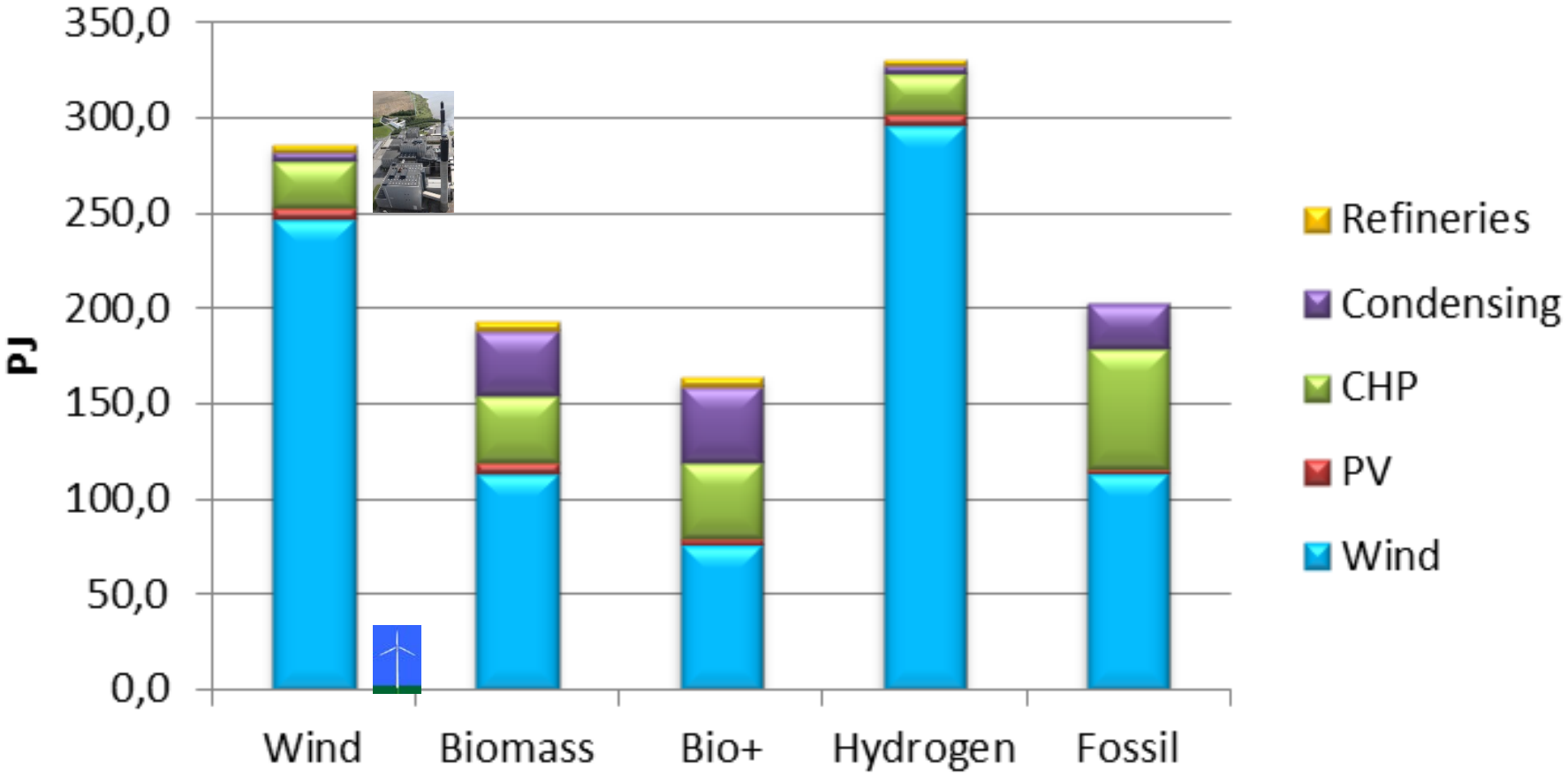
Electricity production 2050



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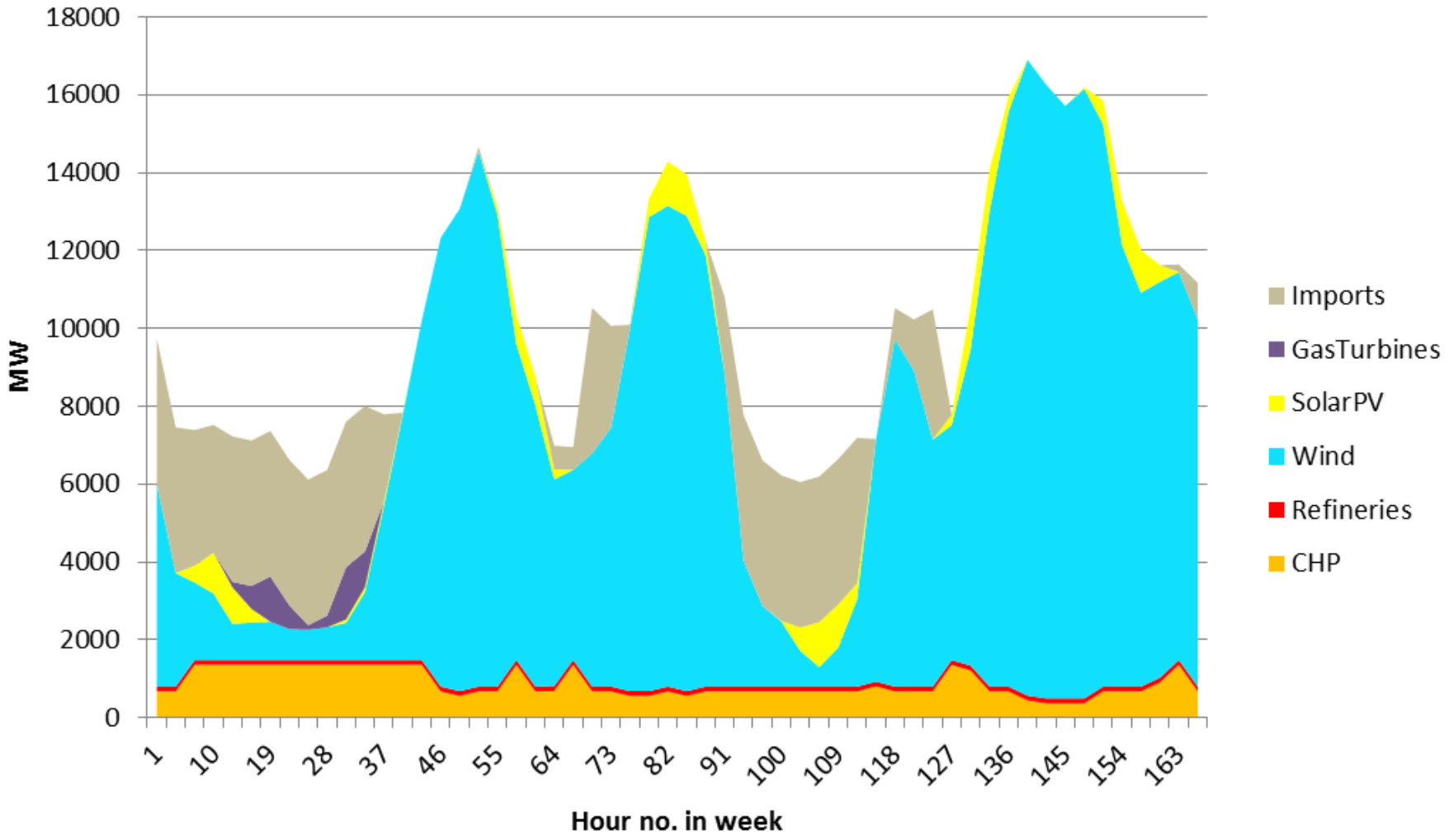
Electricity in week 13, 2050



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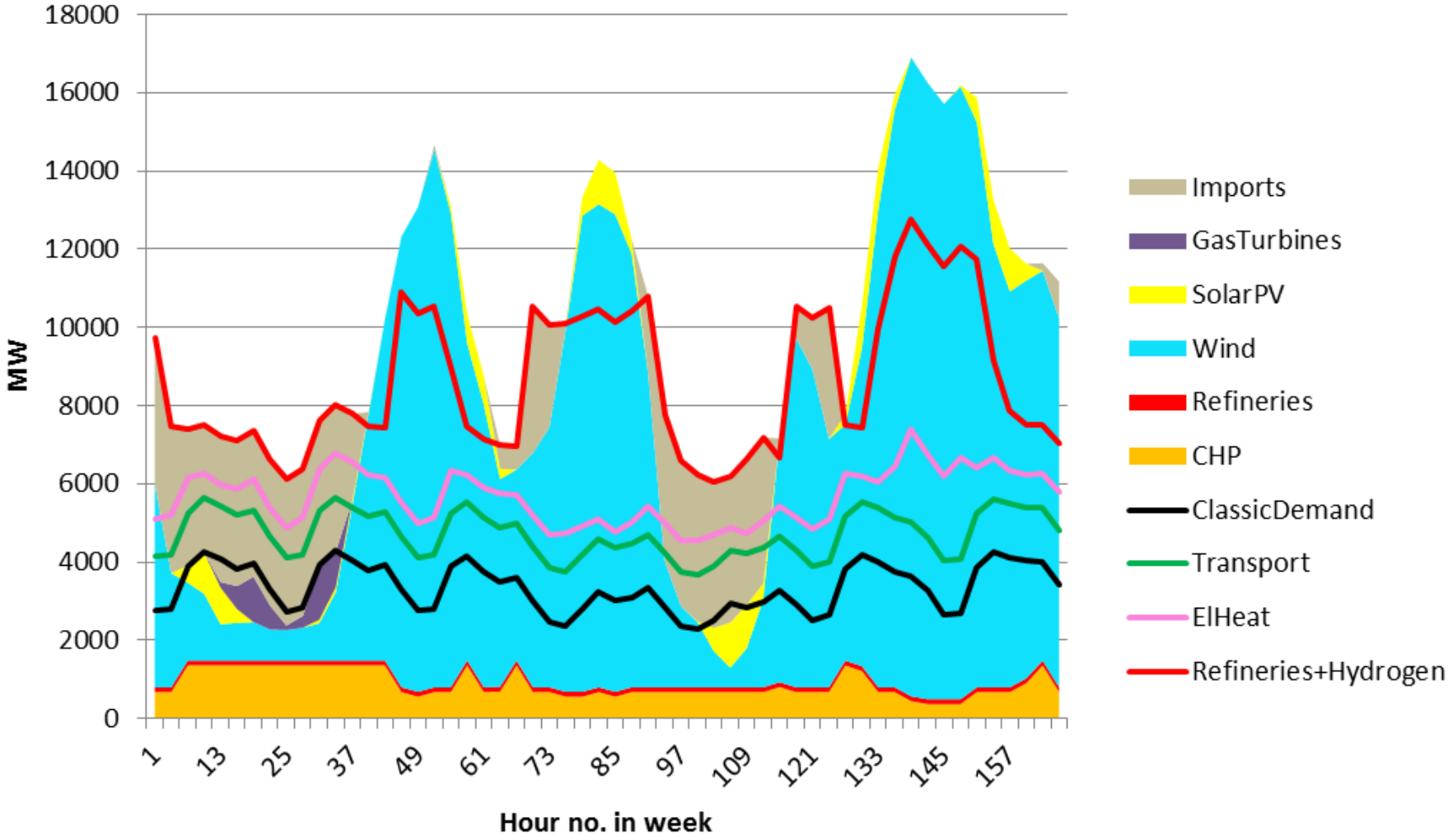

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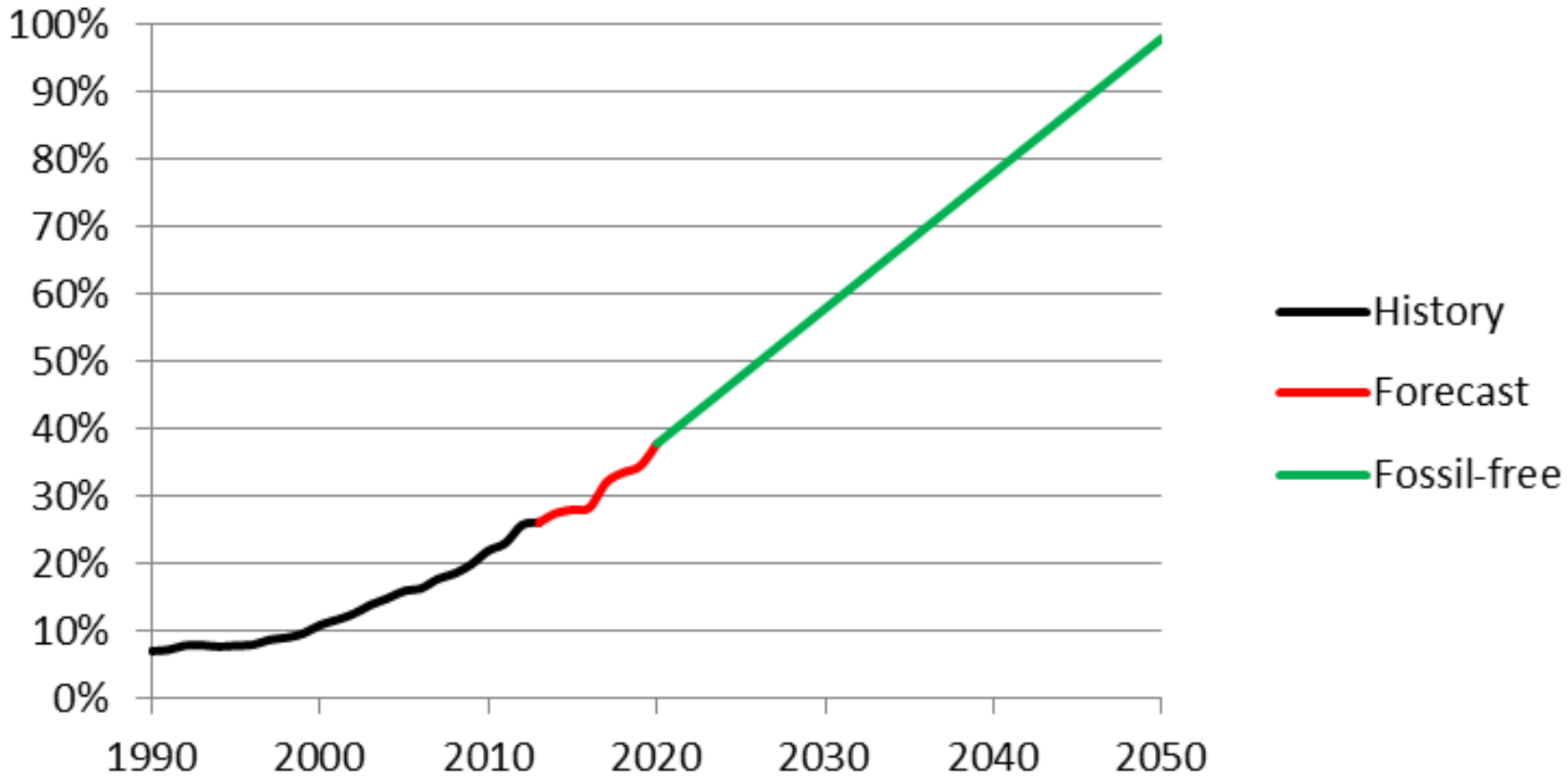
Towards ~100% RE in 2050



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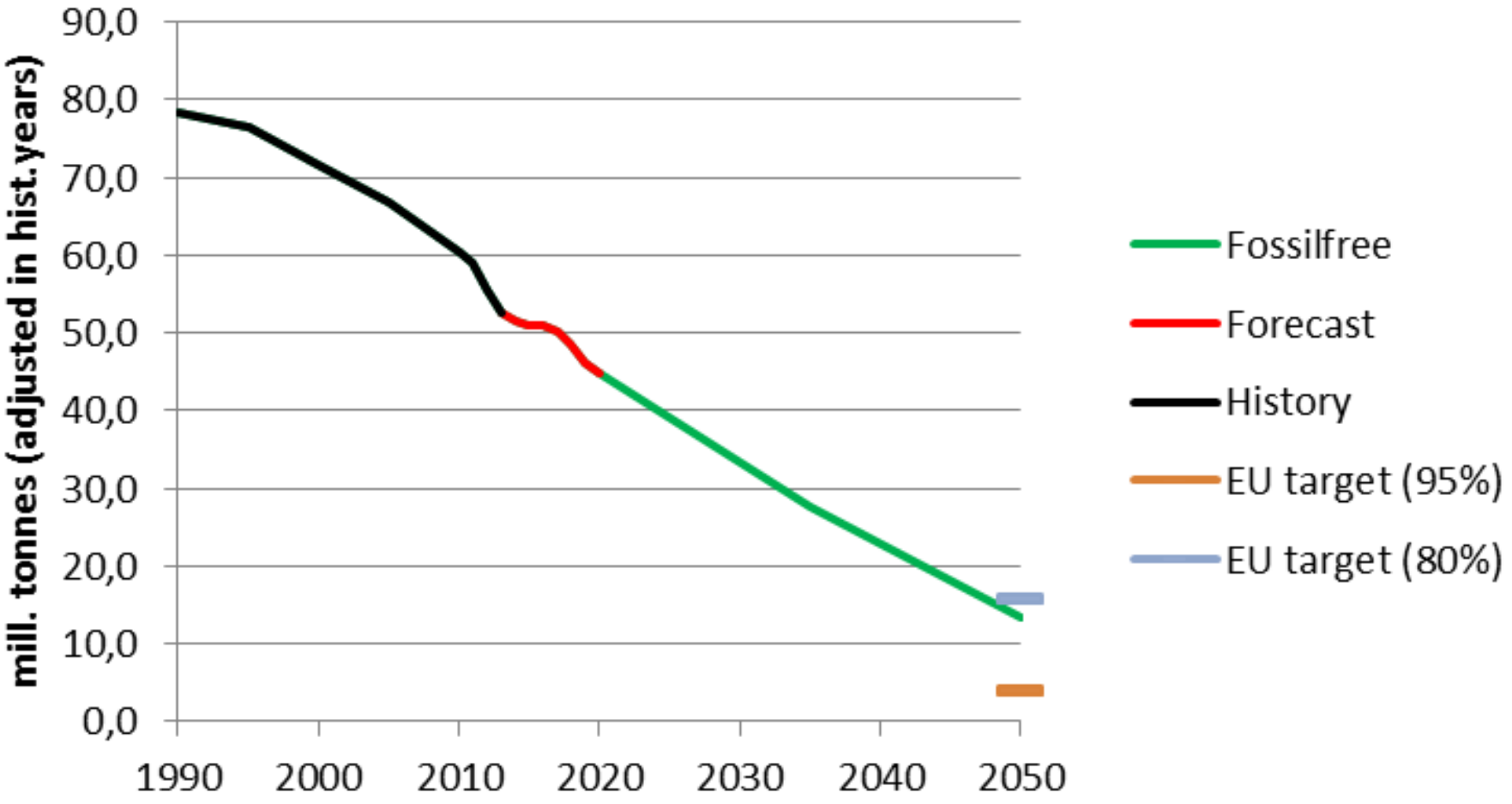
GG emissions towards 2050



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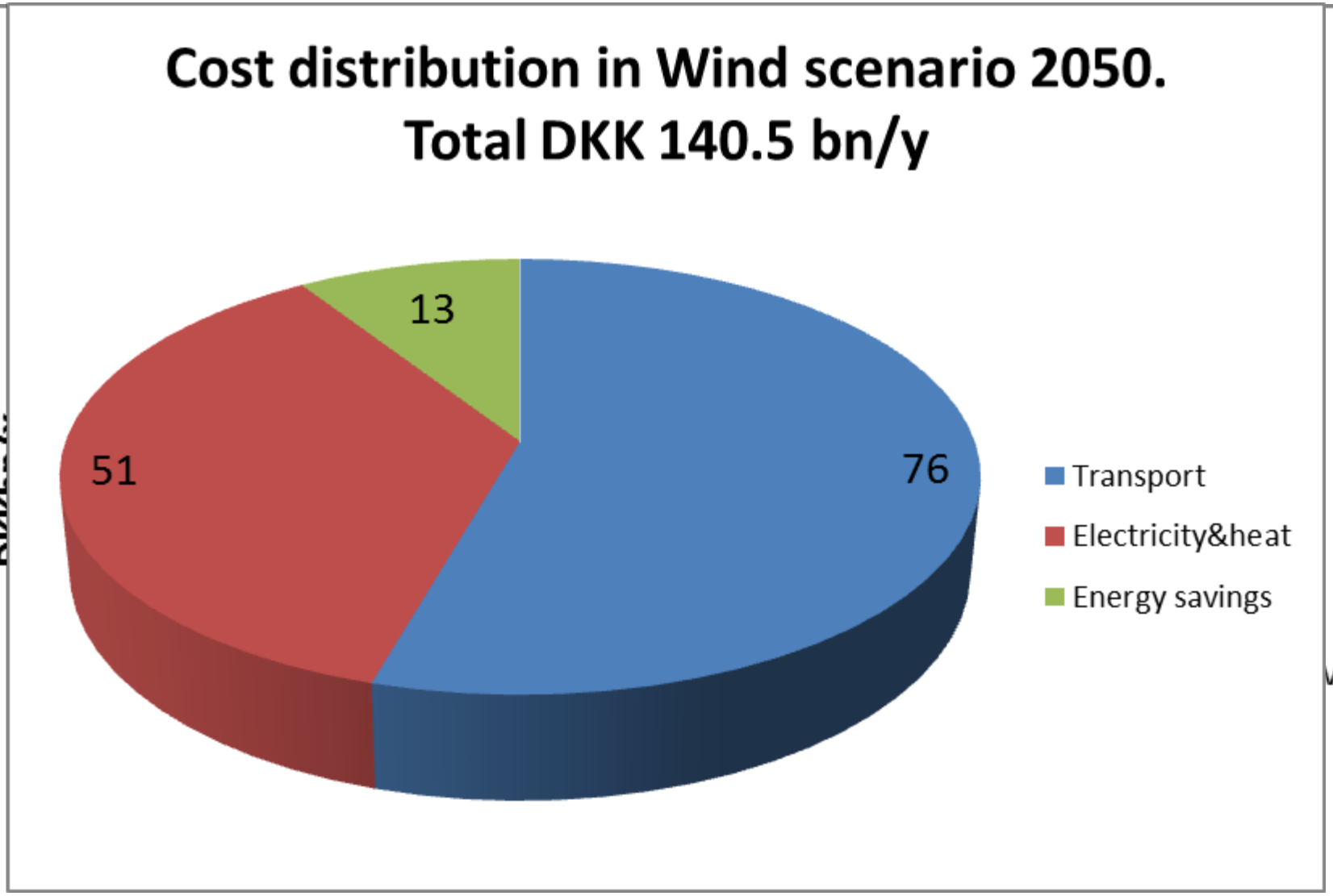
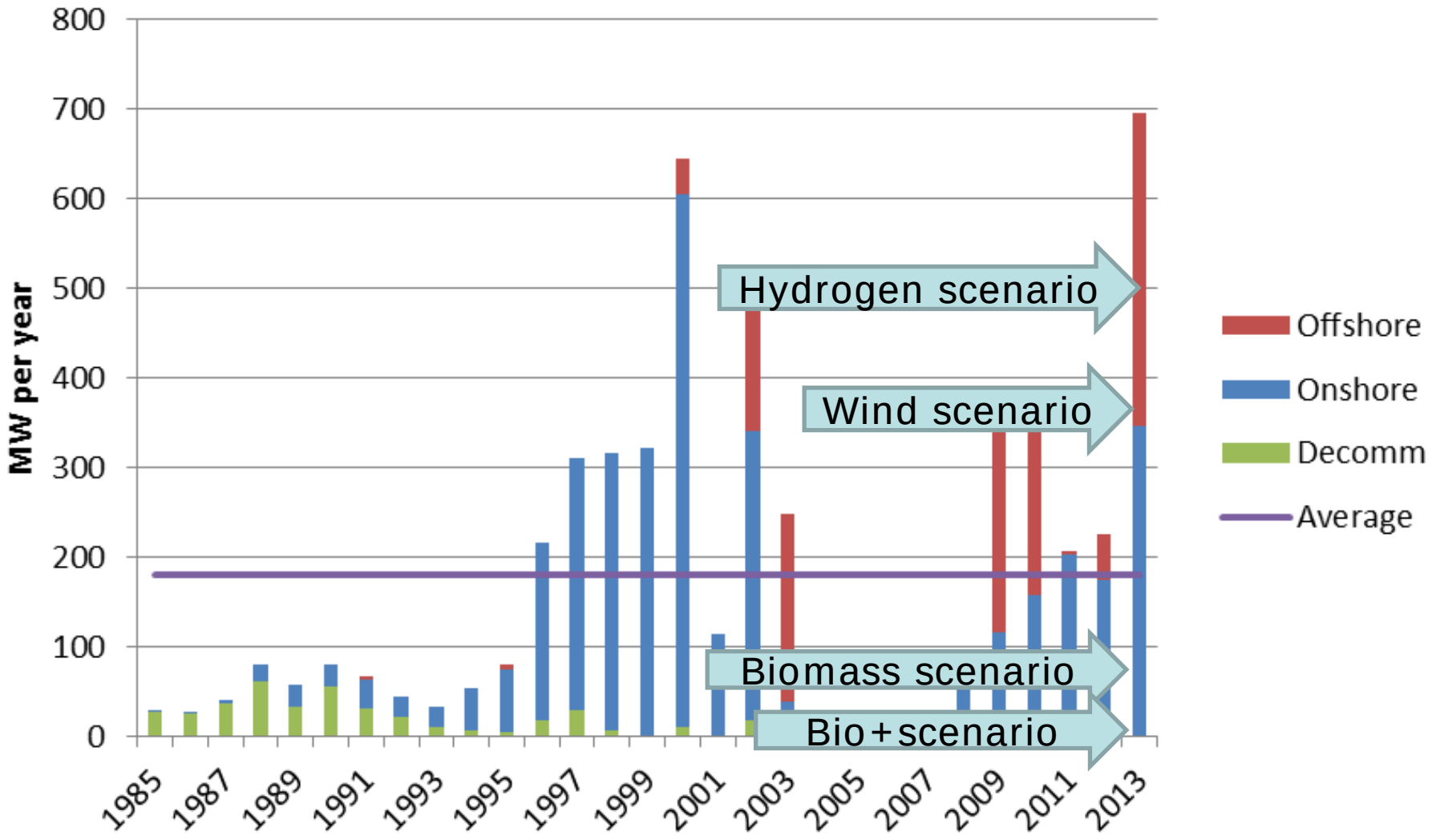

Cost distribution in Wind scenario 2050.
Total DKK 140.5 bn/y
13
51
76
Transport
Electricity&heat
Energy savings

Security of supply.

- **There appears to be a choice between two evils:**
- **A: Use a lot of bioenergy => import dependence and sustainability issues.**
- **B: Use very little bioenergy => Challenges electric security of supply. Solutions: Flexible demand + heat storage, reserve capacity, geographical + technological dispersion and electricity markets.**

Wind power installed in Denmark



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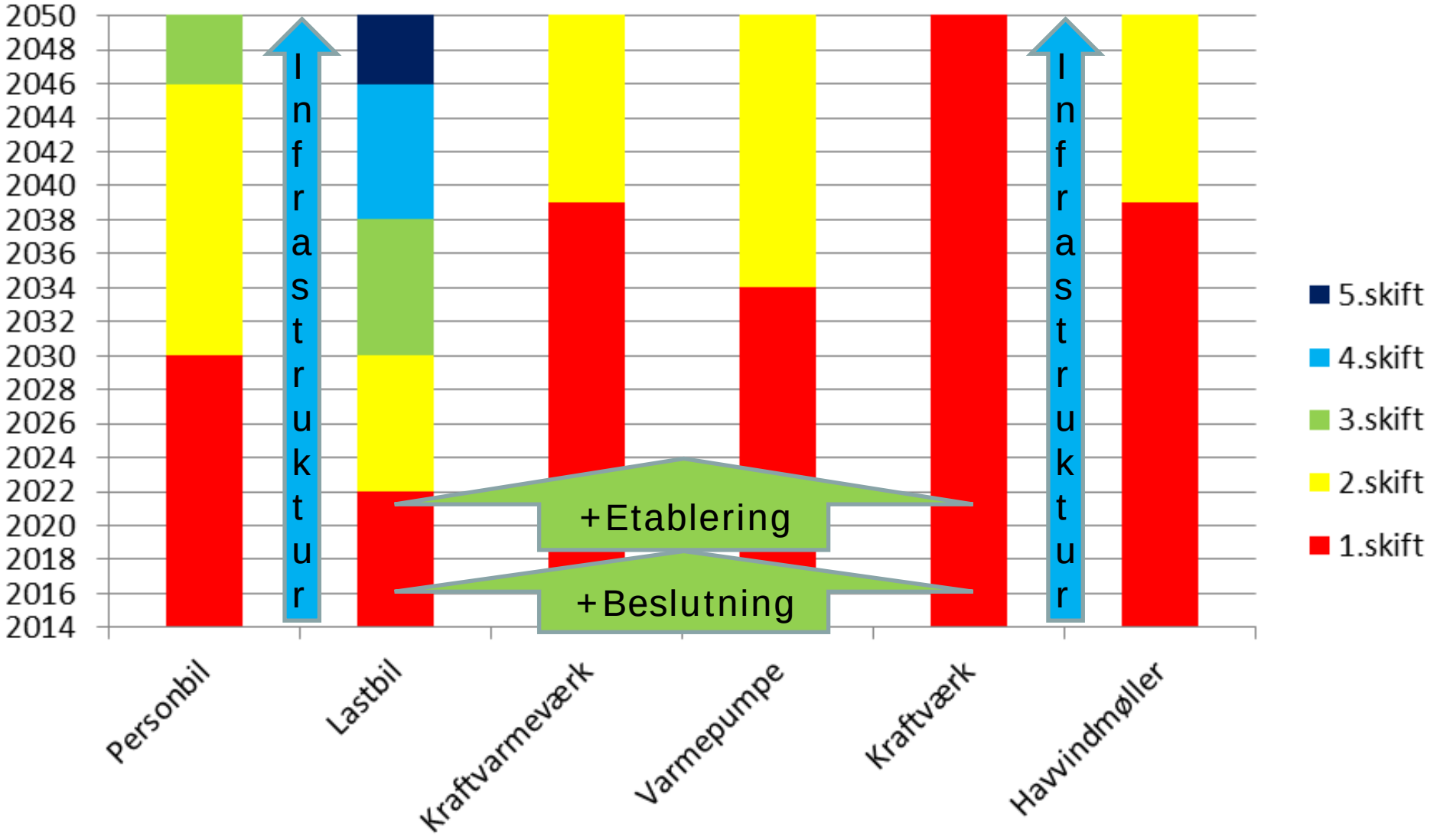
Udskiftningstempo frem mod 2050



Conclusions

- The transition must begin shortly after 2020.

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Medium term scenarios

- New political agreement for 2020-30 period
- Background for decisions moving towards 2050
- EU non-ETS targets for 2030

- Evaluate packages of measures/initiatives
- Published in 2016 + continous updates (hopefully)

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Examples

- Roll-out of heat pumps in households and DH production
- Phase-in of electric and gas driven vehicles in transport sector
- Increased bio energy production, biogas, energy crops
- Biorefining of grass -> fodder for animals + biofuels

Initial conclusions I

- Seems possible, but difficult to reach 2030 targets

- Focus needs to be wider than just electricity and DH production
- Transport and agriculture need to ”deliver” decrease in emissions
- Solutions can be found by integrating sectors, e.g. biomass from agriculture

Initial conclusions II

- Generally in line with 2050 scenarios

- Biomass vs electrification is key
- Several constraints regarding ”timing” – e.g. stock of vehicles, tender processes, etc.
- Processes need to start from 2020 onward

Challenges and questions

- Biomass – sustainability and emissions?
- National biomass vs imports
- Gas infrastructure
- ”Electrification” of transport and heating sectors

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Thank you for your attention

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