



SUSTAINABLE ENERGY PLANNING
AALBORG UNIVERSITY



Smart energy-løsningers betydning og effekt på systemniveau

Energy System Analysis

Work Package 4

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WP4

- Analyze the dynamic relations of smart grid solutions for small customers
- Combine and integrate solutions on a system level (upscaling)
- Scenarios to visualize system-related consequences of different solution

- Use case studies (WP2)
- Energy System Analysis



Energy System Analysis

Based on case studies in Austria, Denmark and Norway

Results from combining markets, actors and technologies

Focusing on the main approaches

- Demand side management (DSM) and demand response (DR)
 - As possible result from Smart meters, efficiency measures, price tariffs
- Micro-generation (on consumer side)
 - PV power production, CHP heat and power, (heat pumps)
- Storage technologies
 - Battery storage (electric vehicles), heat storage



EnergyPLAN

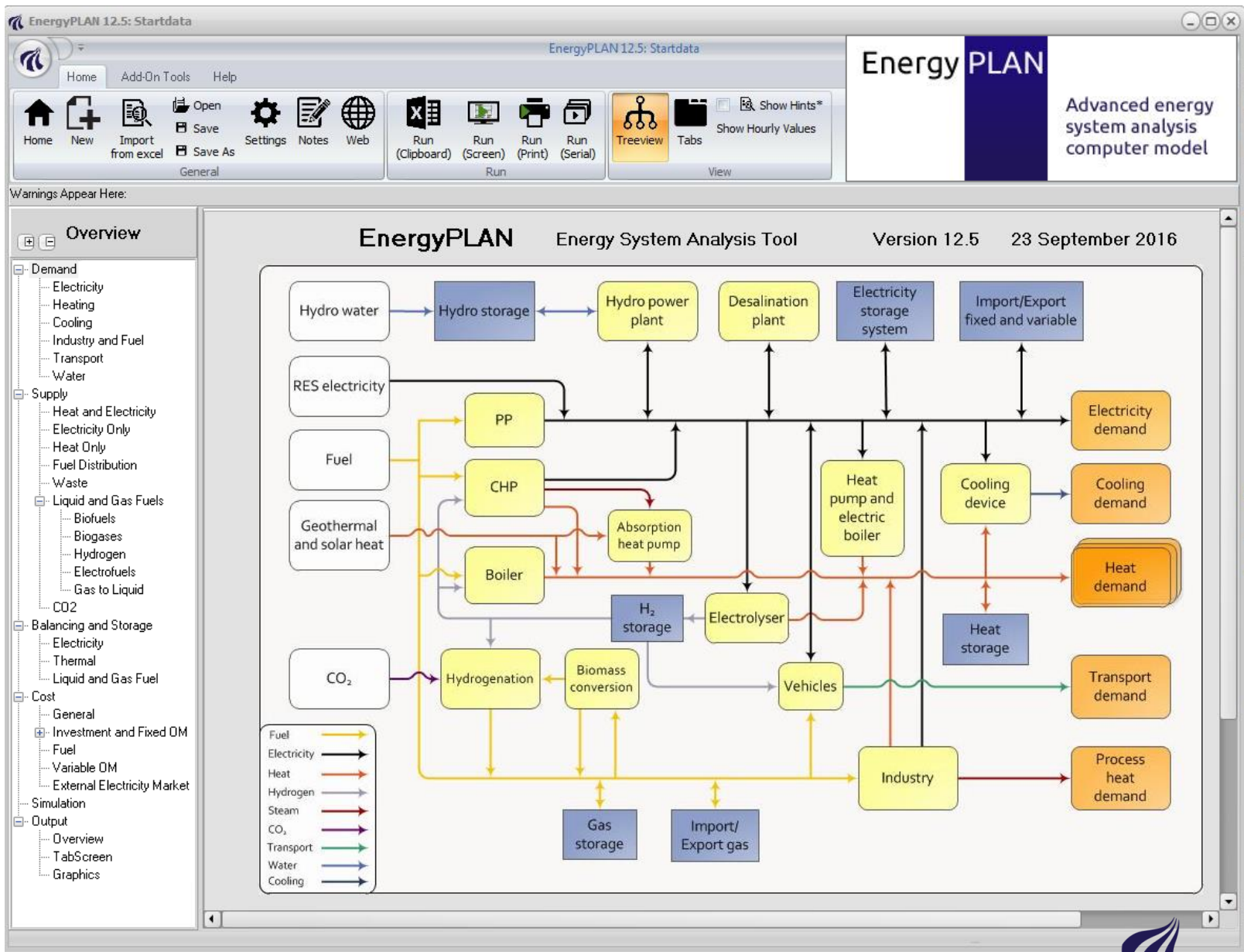
Main focus

- Simplified modelling of energy system
- Compare different technologies and regulation systems
- Ability to integrate and trade RES

Characteristics

- Holistic (encompassing all sectors, focus on connections)
- Aggregated (all technologies typically represented by one unit)
- Hourly on a yearly basis (leap year)
- Technical (or economic) optimisation





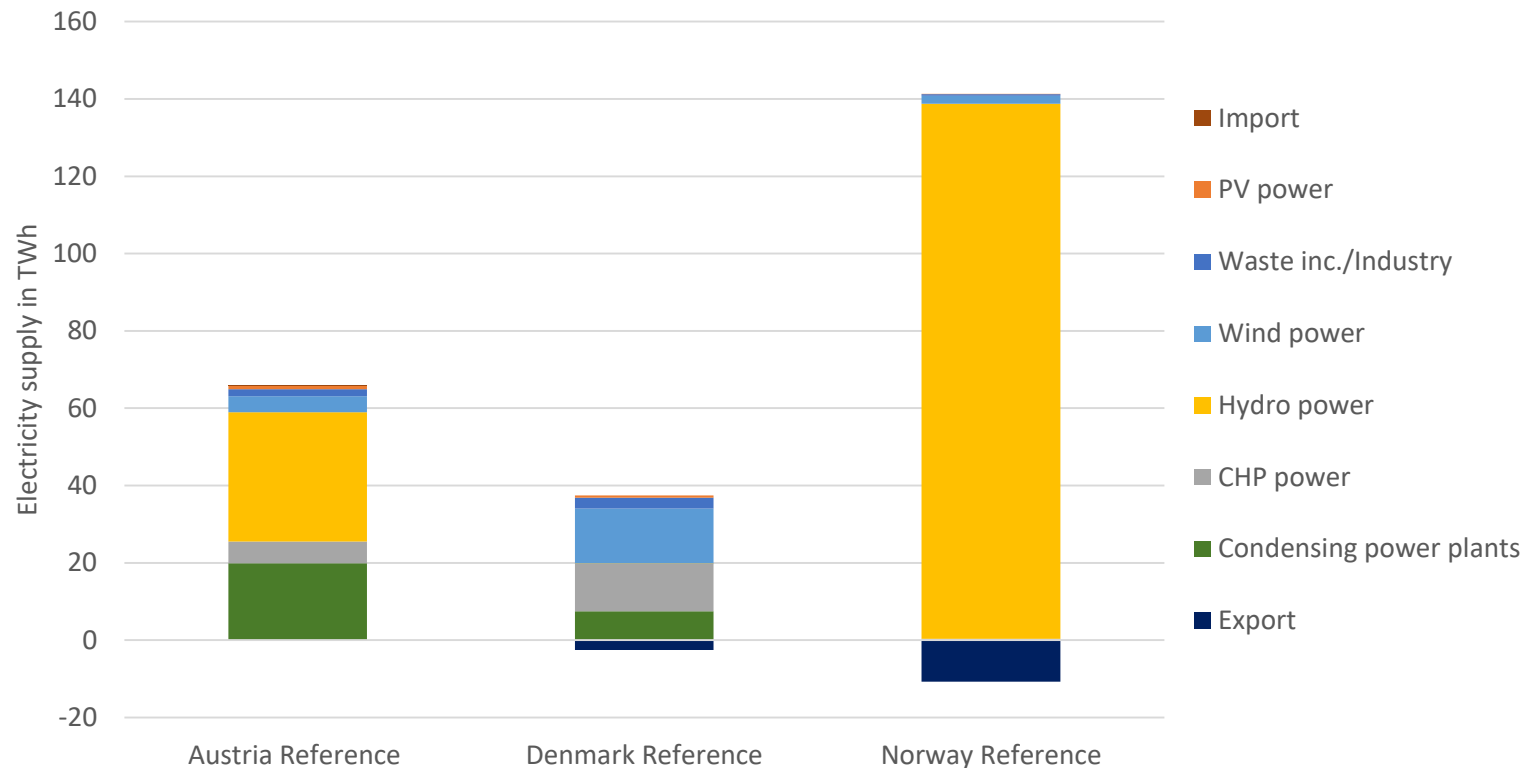
Energy System Analysis in EnergyPLAN

Hourly modelling of electricity, heating, transport demands and interconnections

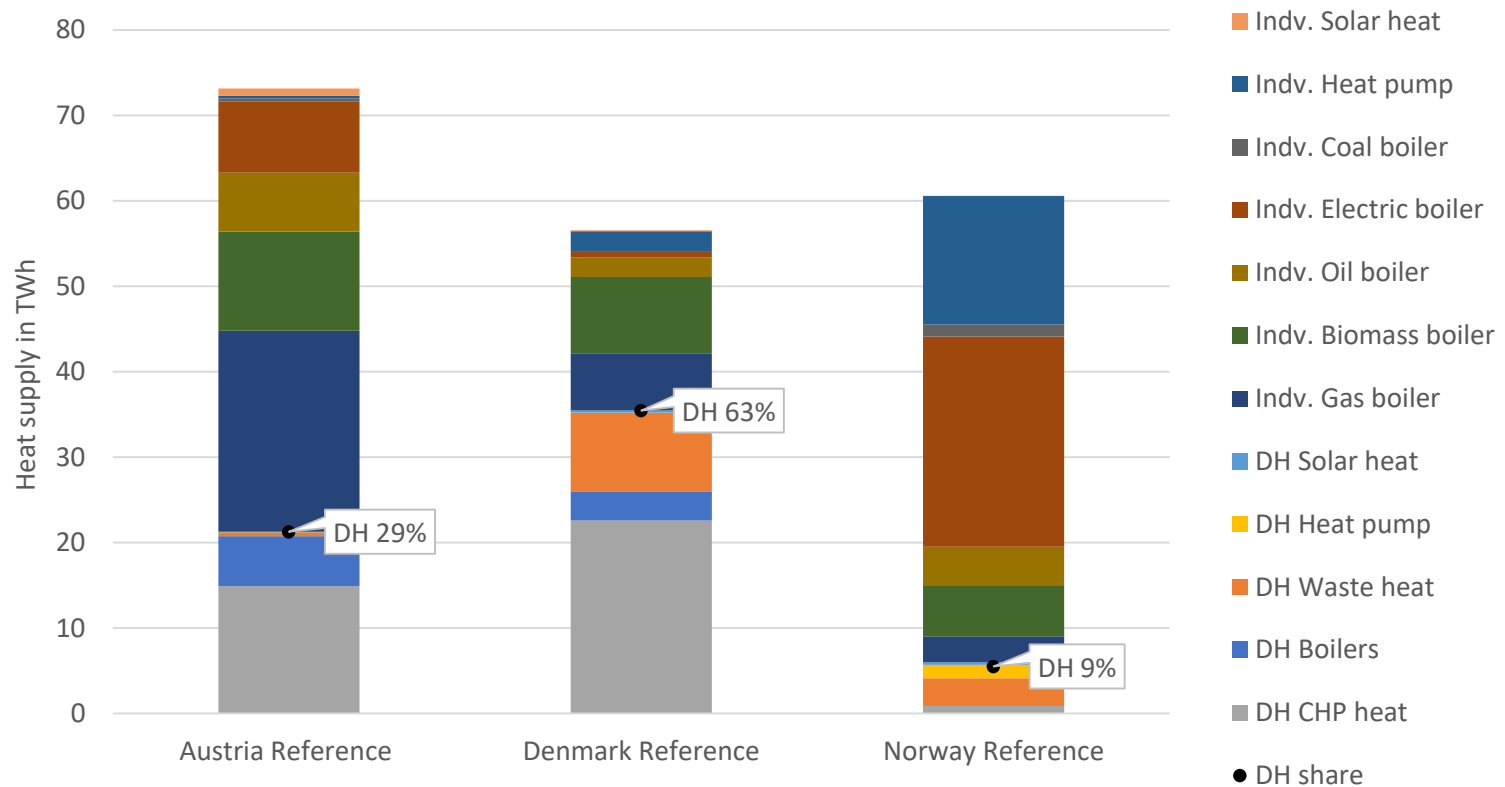
- Reference models of 2015
- Technical simulation to balance heat and electricity demands
- Focus on integration of RES
- Evaluation of case studies/technical constellations in different energy systems
- Evaluation of impacts on fuel demands, heat and electricity supply and CO₂-emissions



National Energy Systems - Electricity



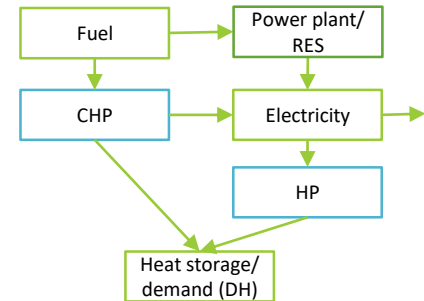
National Energy Systems - Heat



Energy System Analyses (ESA)

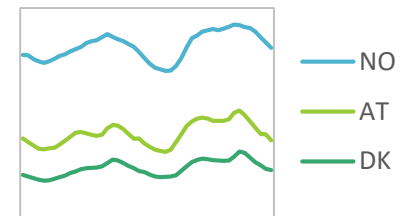
ESA1:

Micro-generation with PV and CHP/HP incl. heat storage (DH)



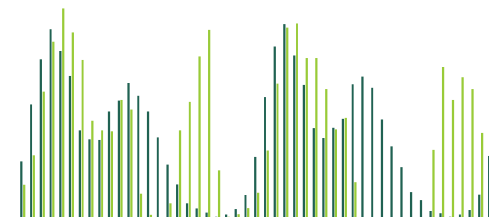
ESA2:

Demand side management through peak reduction/shift



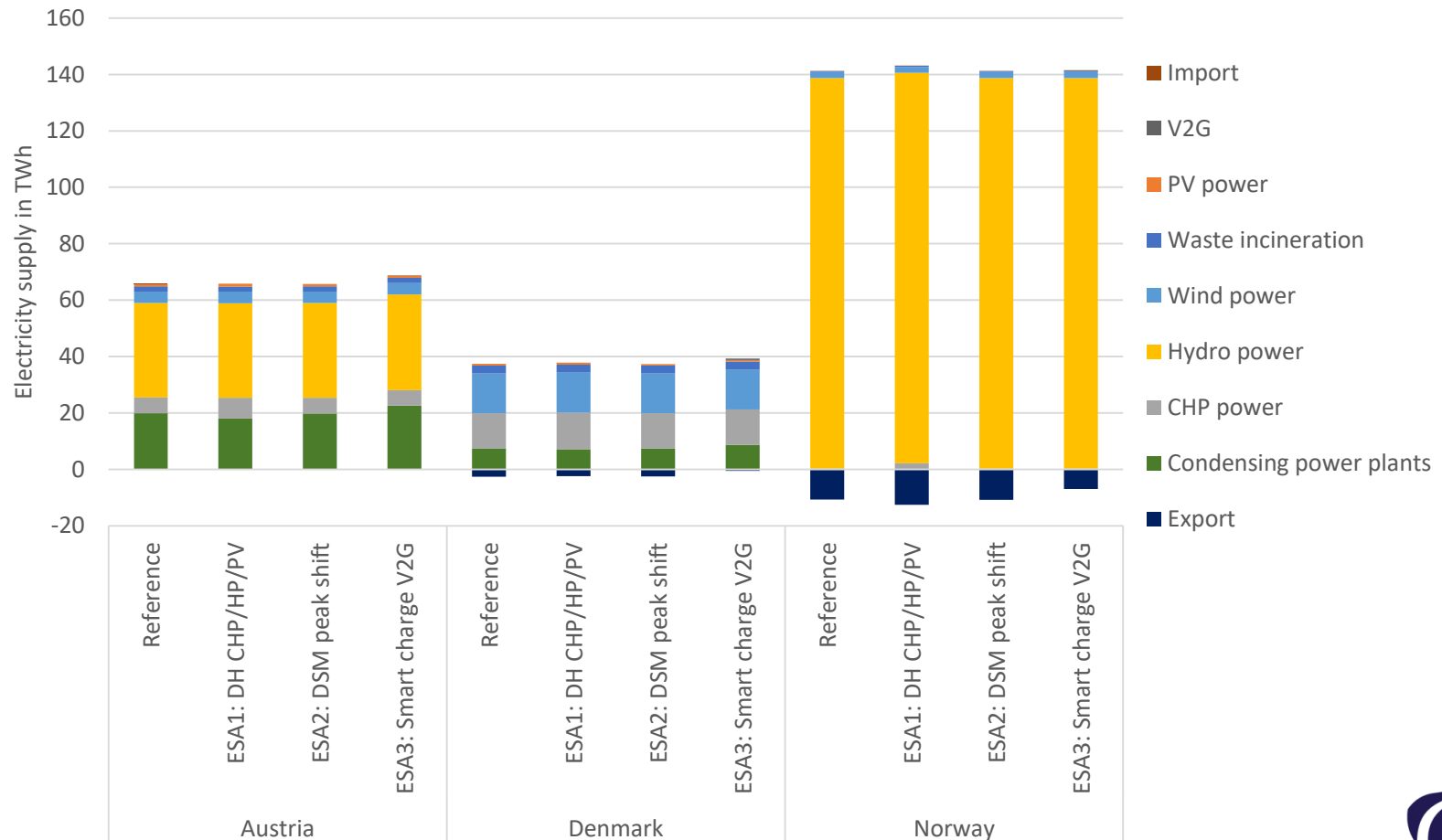
ESA3:

DR/storage through Electric Vehicles, charging and V2G



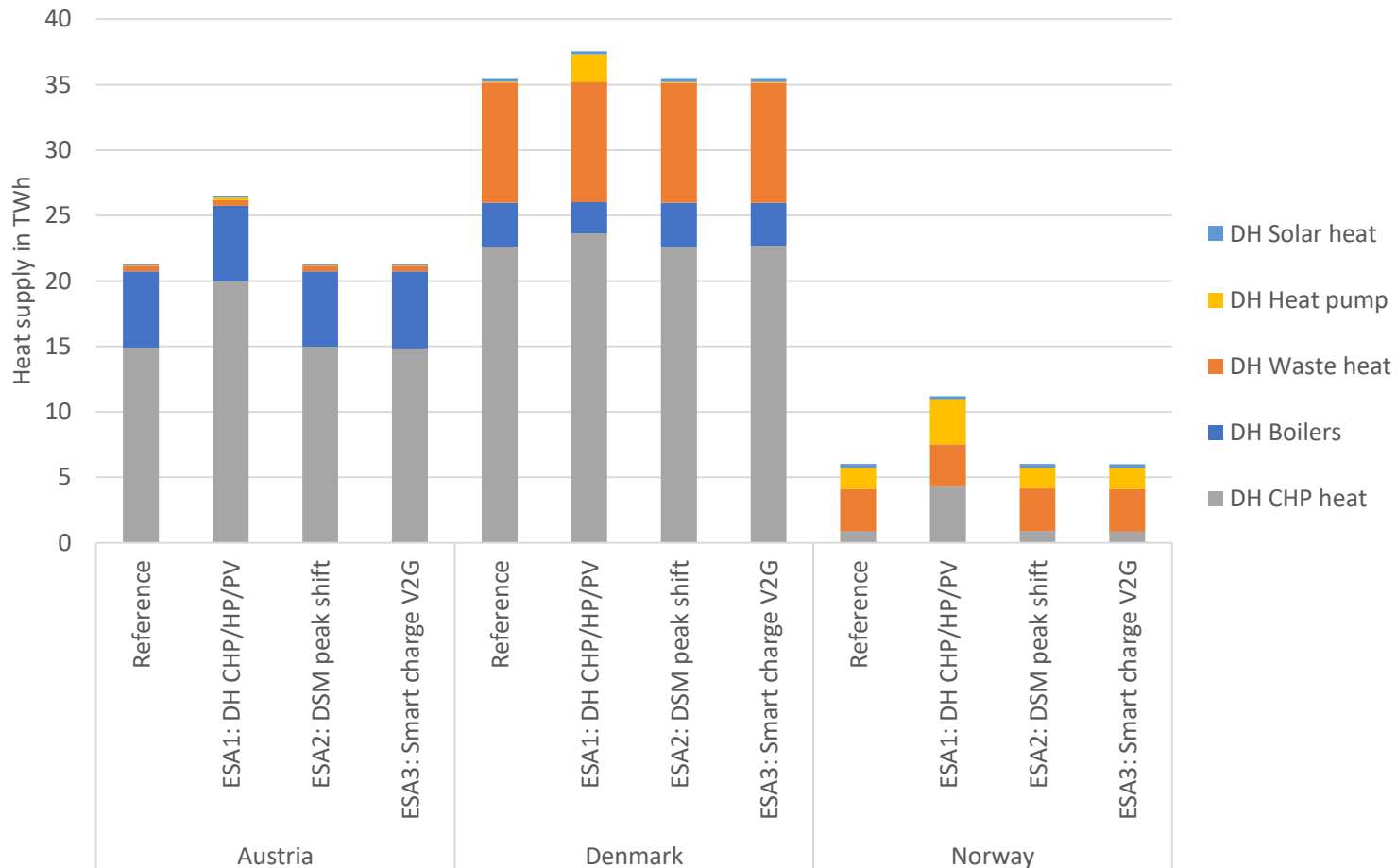
Energy System Analyses

Results on Electricity supply



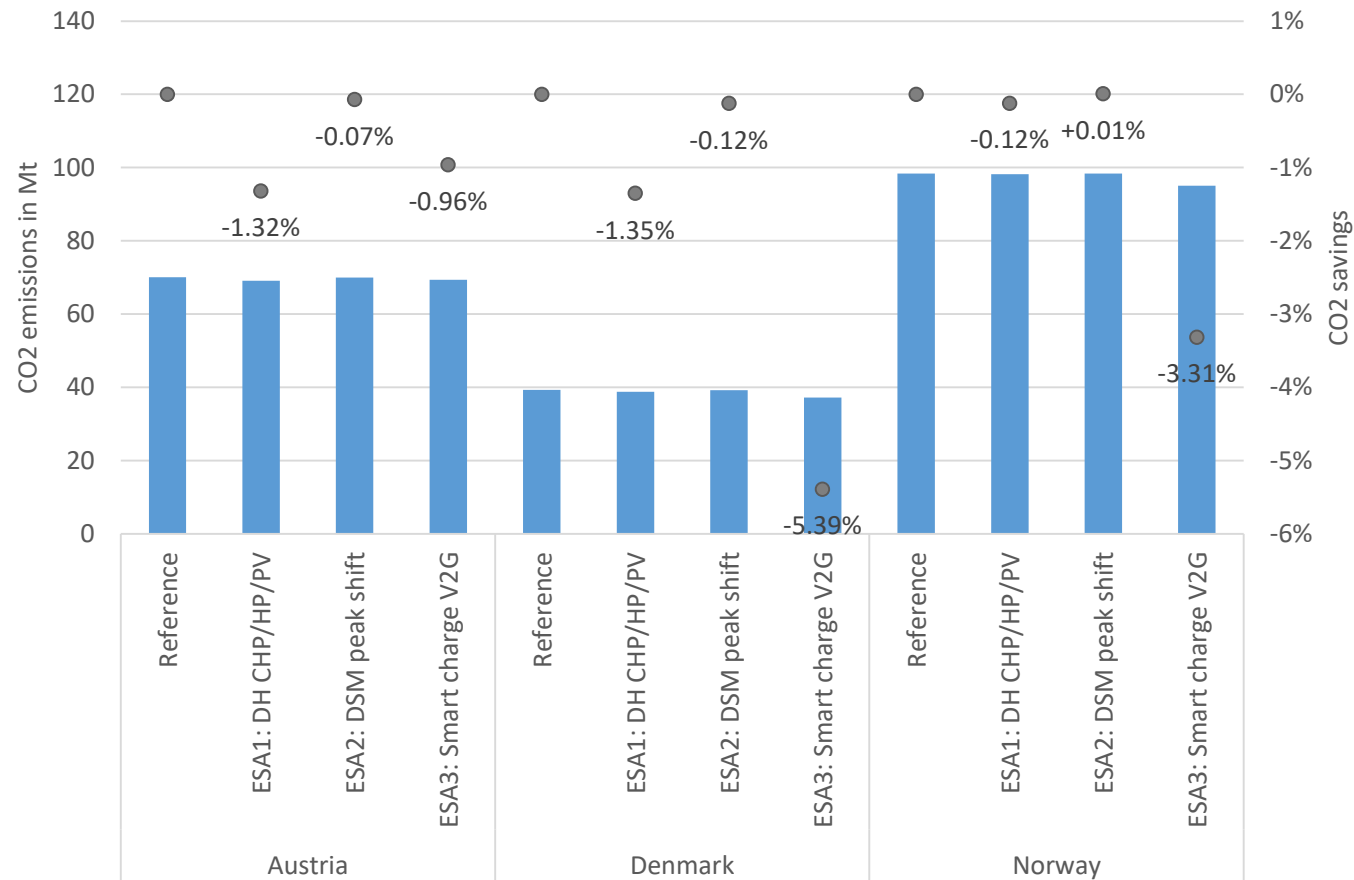
Energy System Analyses

Results on Heat (DH) supply



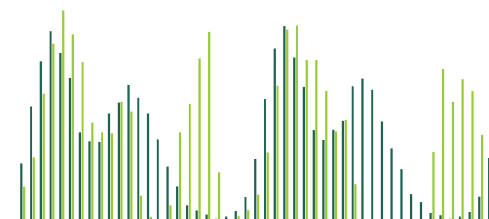
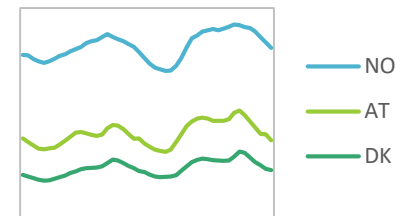
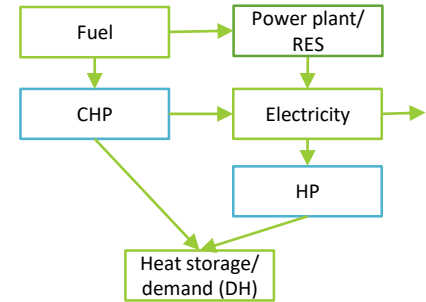
Energy System Analyses

Results on CO₂-emissions



Overall Results

	Austria	Denmark	Norway
ESA1: Sector integration 😊	PV, DH, CHP potential, PP reduction, highest CO ₂ savings 😊	PV, HP potential	PV, DH, HP potential, more export ⚡
ESA2: Moved demand	CHP increase, PP and boiler reduction 😊	CHP and PP decrease	CHP and export increase ⚡
⚡ ESA3: Increased demand	Hydro increase, minor V2G demand 😊	Export integration, V2G demand, highest CO ₂ savings 😊	Export integration, V2G demand, high CO ₂ savings 😊



Summary

- MATCH solutions effect not only electricity sector, but also heating sector (not just for ESA1)
 - Up-scaling solutions not always a good idea
 - Electrification of heat and transport require further RES capacity
 - Effects on electricity exchange (import/export) varies
 - CO₂ and fuel reductions
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- Careful planning and designing of future markets, actors and technologies
 - Consider the energy system(s) behind ‘smart grid solutions’





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Thank you for your attention!

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