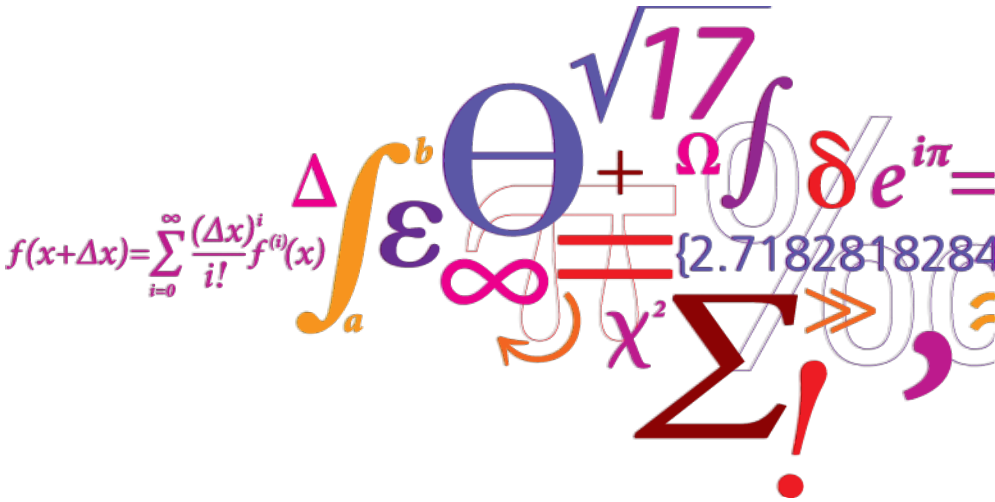
Development of transport scenarios for Denmark

An iterative and participatory perspective

Zurich – 72th Semi-annual ETSAP meeting
12th December, 2017



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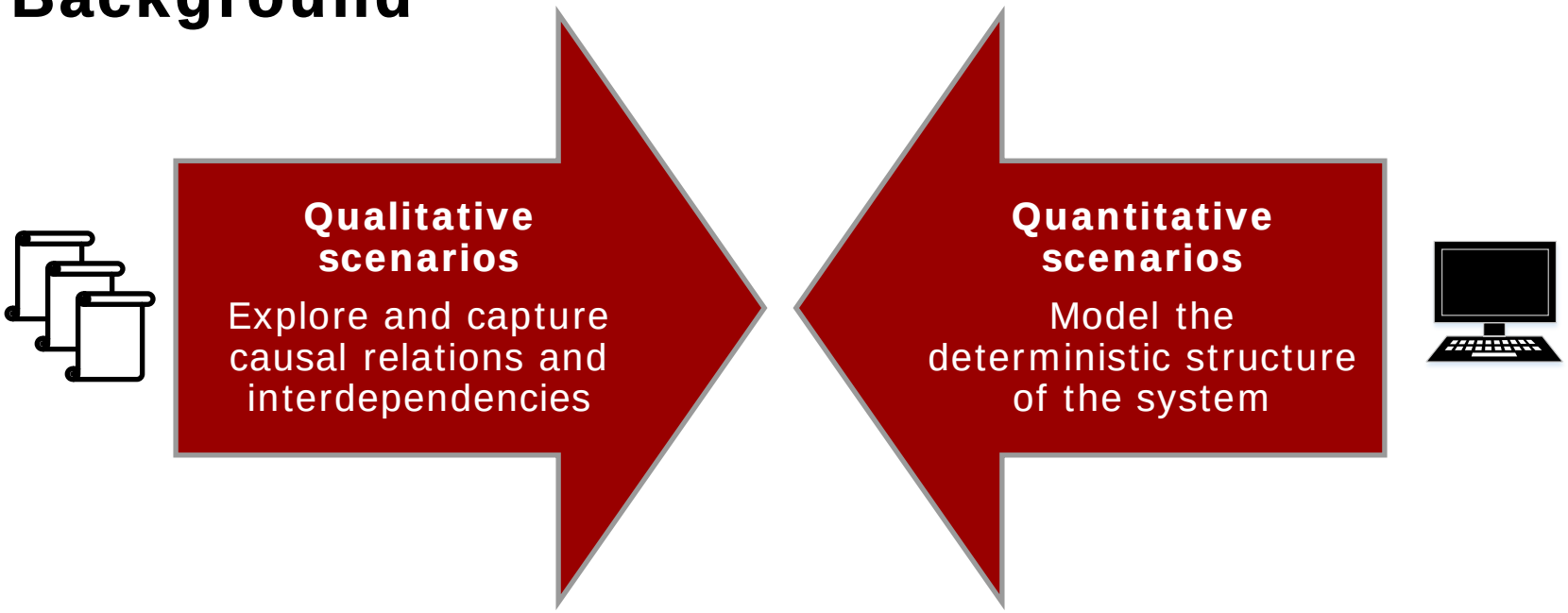
Background



- ✚ Mutual validation of two perspectives
- ✚ Enlarge model structure to integrate new parameters

- ▬ Difficulty in attributing quantitative estimates to uncertain drivers
- ▬ Implicit information in qualitative scenario discourse
- ▬ Scope and capabilities of modelling tools

Case study

Case: Transport scenarios for Denmark - Analysing 100% RE pathways

Research questions

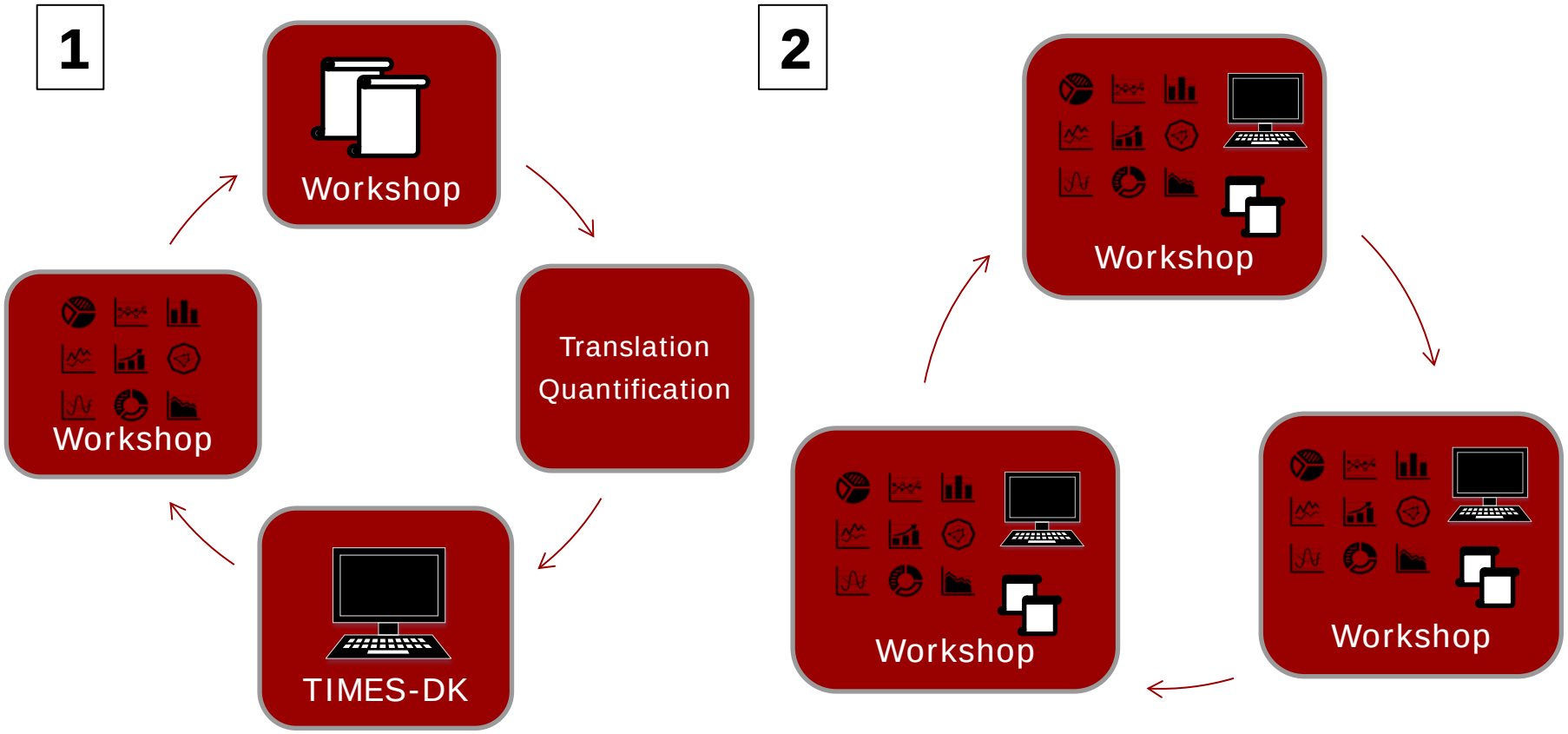
Methodology

- How can we bridge qualitative and quantitative tools for the creation of scenarios in TIMES-DK?
- What do we gain from this dialogue? How can it be improved?

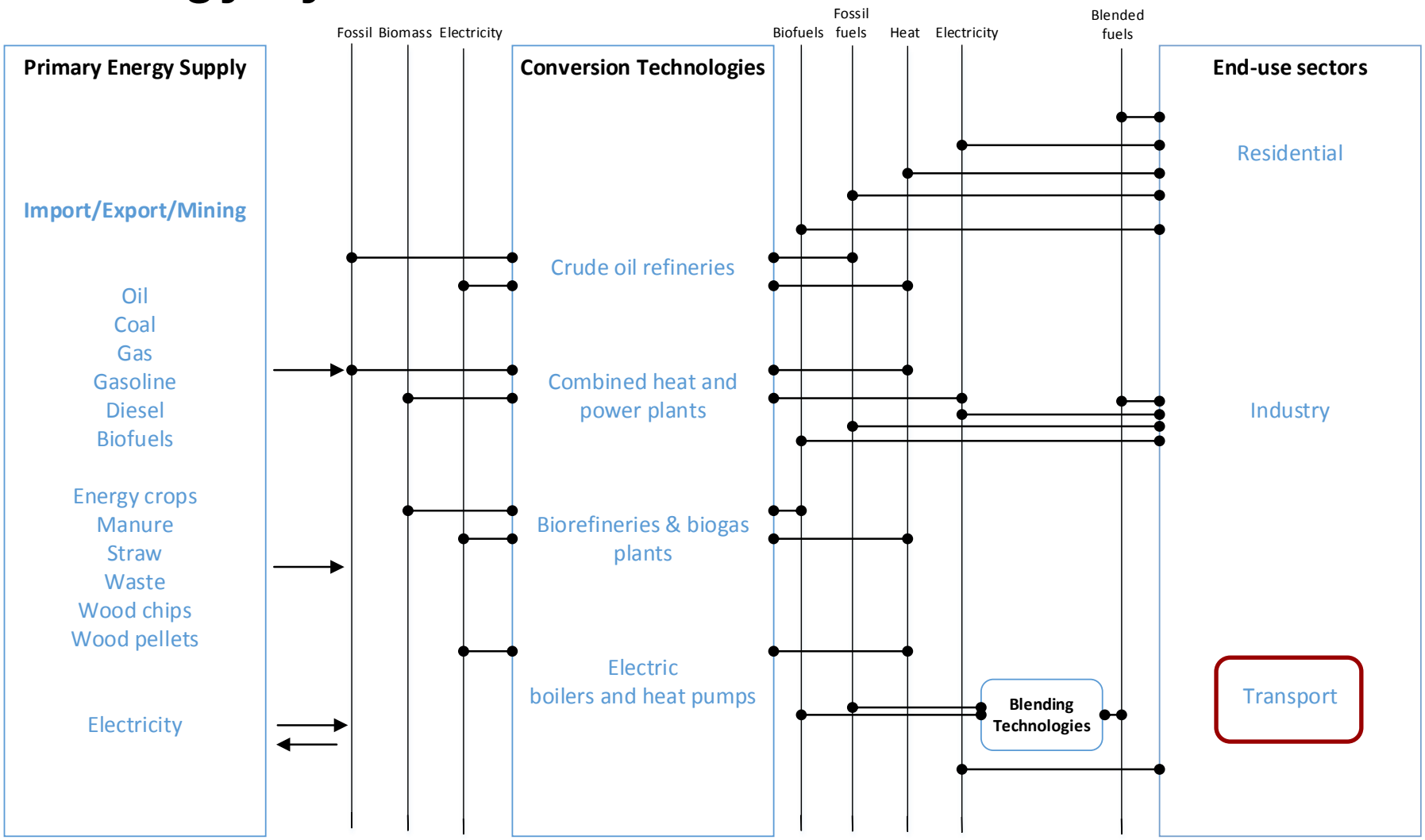
Transport and energy system

- What are robust and sustainable pathways for the future energy and transport system in Denmark?
- Which policy measures can support the recommended pathways?

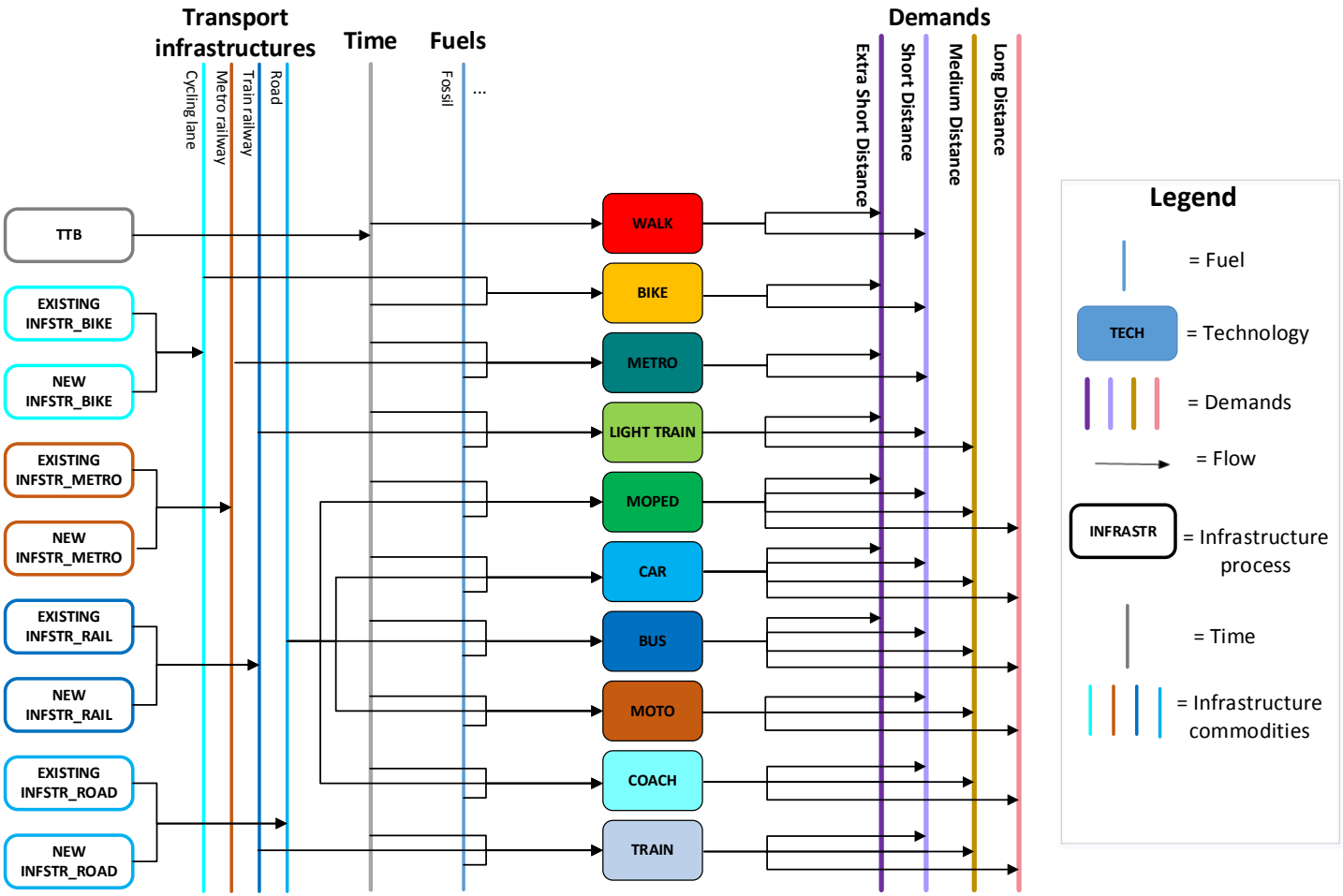
Framework for scenario development



Energy system model TIMES-DK



Structure of transport sector

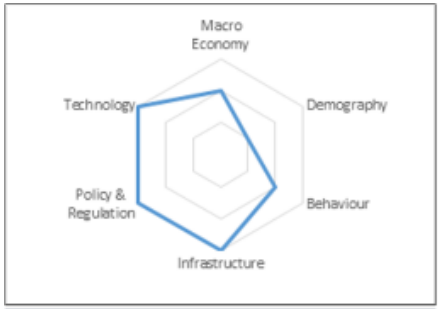


Tattini et al. (2018)

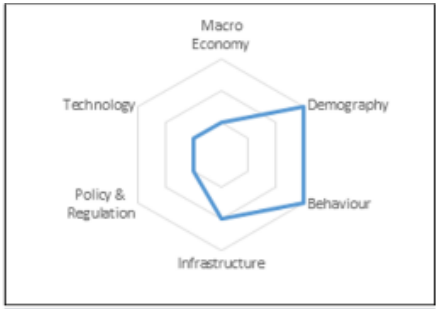
Qualitative scenarios

		Project members		Stakeholders	
		High relevance	High uncertainty	High relevance	High uncertainty
Infrastructure	Infrastructure	●●●●	●●	●●●●●●	●●●
	Accessibility of public transportation	●●●●●●●●	●●●	●●	
	Biking and parking at train stations				
Policy & Regulation	Taxation	●●●●	●●	●●●●●●●●●●●●	●●●●●●●
	Local air pollution	●●●●●	●●		
	Personal targets	●●●●	●●●●		
	CO2 targets	●●●	●●	●●●●●	
	Change of tax system			●●●●	●●●
	Climate change urgency				●●●●●●●
	Tax revenue				●
	Congestion			●	●
	Green cities (pollution)			●	●
Demography	Urbanisation	●●●●●●●●	●	●●●●●●●	●●●●
	Population density	●●●	●	●●	
	Aging		●●●		●●
	Family patterns			●	●●●
	Urbanization - self-driving cars effect				
Macro economy	Economy	●●	●●●●●●	●●●●●●●●●	●●●●●●●●
	Freight demand	●●	●●●●●●		
	Energy prices	●●	●●●●●●	●●●●●●●●●	●●●●●●●●●
	Car manufacturer business models				
Behaviour	Tourism	●●	●●●●●●		●●●●
	Life style changes	●●●●●●●●	●●●●●●●●●●●●	●●●●	●●●●
	Green behaviour	●●	●●●●●●		
	Work flexibility	●	●●●●●●●●●●	●	●
	Sharing economy	●●●●	●●●●●●●●		●●●●●●●●
	Opening hours of institutions			●	
	E-trading				
	Basic feeling of freedom				
	Free time				
Technology	Autonomous vehicles	●●●●●●●	●●●●●●●●●●●	●●	●●●●
	Electric transport	●●●●	●●	●●●●●●●●●●	●
	Cost of vehicles	●●●●●●	●●	●●●●	●●●
	Travelplan - total app for all modes			●	
	Hydrogen and gas vehicles, electric bikes			●●	●●●
	Biofuels potential			●	●●●
	Intelligent road, inductive charging				
	3D print				●
	Drone transport				●●●
Urban planning	SUMP: behaviour/demography, urban planning			●●●●●	●●●●●●
	New urbanisation (city centre and outskirts)				

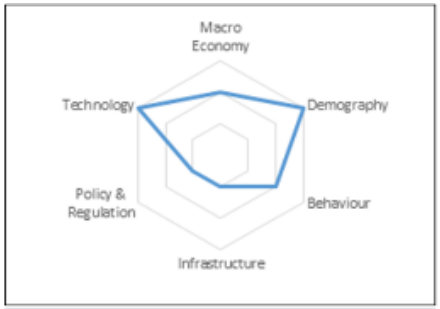
Qualitative scenarios



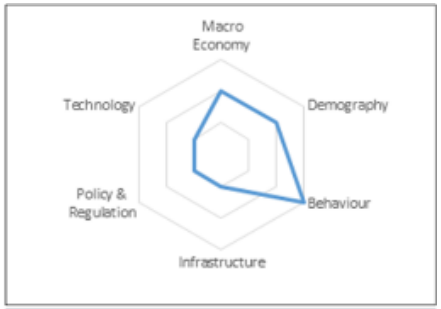
High-Tech & High-reg



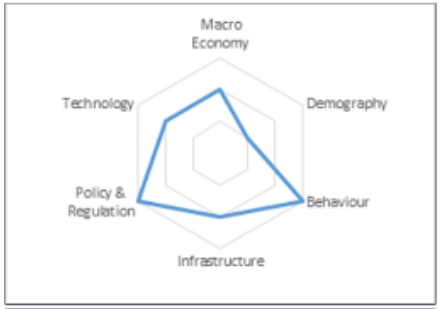
Urban Hippie



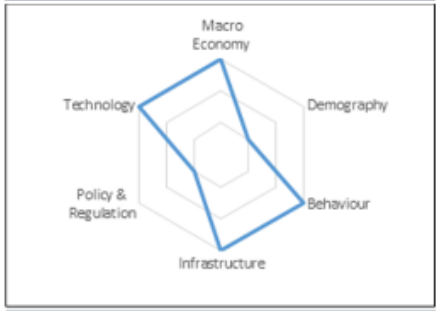
Urban Electrification



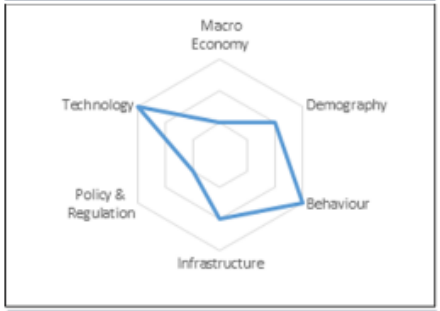
Green Individuals Alone



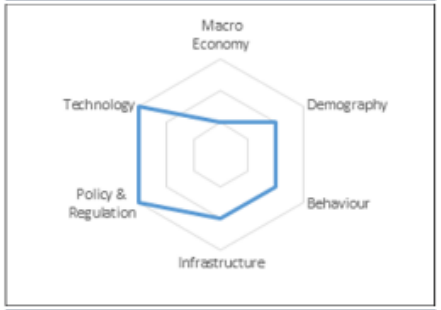
Policy and Consumer Driven



No leadership – market delivers



Last minute Action (2030)



Last minute Action (2050)

TIMES-DK scenario interface

Global assumptions

Driver	Options	Reference
	Value Choice	
Fossil fuels price trajectory	Medium	IEA (2016); Energistyrelsen (2017)
Discount rate	10	
CO2 price	High	Energistyrelsen (2017)

Policy targets

Driver	Options						Reference
	Active/Inactive	Value Choice	Unit	Year	Limit	Sector	
Phase-out of fossil fuels	☐			2050		Apply to all sectors	Energistyrelsen (2015)
				2035		Heat & Power	
				2030		Residential	
				2050		Transport	
				2040		Industry	
CO2 target	☐	80	%	2025	Max	Apply to all sectors	EEA (2015)
		50	%	2025	Max	Residential	
		100	%	2050	Max	Residential	
		30	%	2030	Max	Heat & Power	
		70	%	2050	Max	Heat & Power	
		20	%	2030	Max	Industry	
		40	%	2050	Max	Industry	
		20	%	2030	Max	Transport	
		80	%	2050	Max	Transport	
Renewable energy target	☐	50	%	2035	Max	Apply to all sectors	EC (2016)
		80	%	2040	Max	Apply to all sectors	
		50	%	2035	Max	Residential	
		60	%	2035	Max	Industry	
		80	%	2050	Max	Transport	
Share 1G biofuels	☑	7	%	2020	Max	Transport	EC (2016)
	☑	3.8	%	2030	Max	Transport	EC (2016)

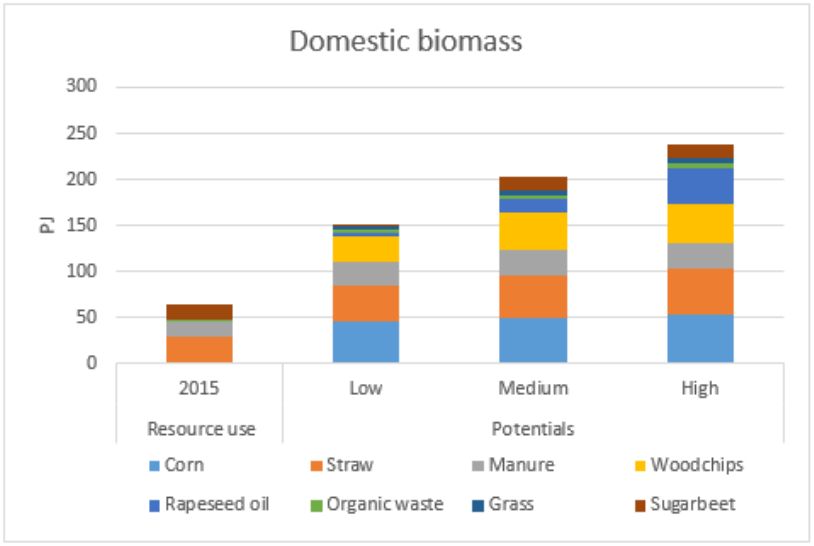
Phase-out of fossil fuels in Denmark:
- In all sectors for a target year
- In each sector in specific years

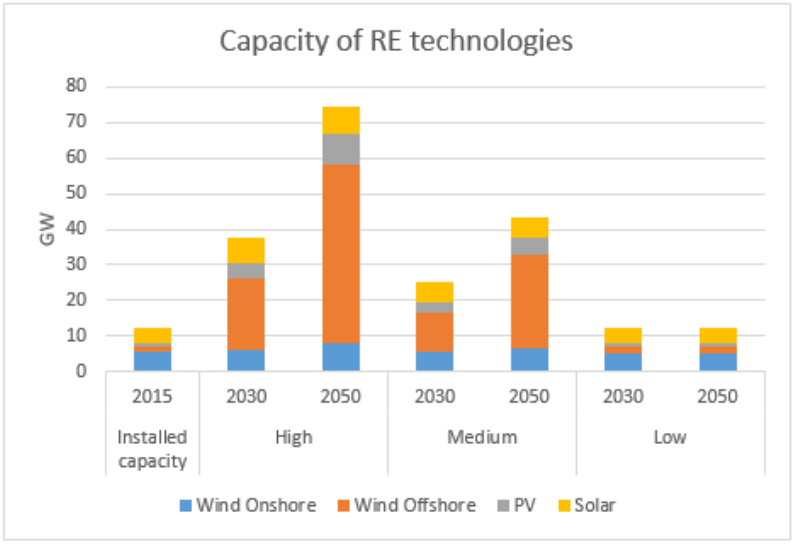
TIMES-DK scenario interface

Resources assumptions

Driver	Options					Reference
	Active/Inactive	Value Choice	Unit	Year	Limit	
Biomass domestic potential		High	PJ	2050	Max	Energistyrelsen (2015); Astrup et al. (2011)
Bioenergy imports		Yes	PJ	2050		
Biofuels imports		Yes	PJ	2050		
Wind onshore capacity					Max	IEA (2016); Energinet (2015)
Wind offshore capacity					Max	IEA (2016); Energinet (2015)
Solar thermal capacity					Max	IEA (2016); Energinet (2015)
PV capacity					Max	IEA (2016); Energinet (2015)

Set the capacity of onshore wind in specific year(s):
- High = 8.05 GW (2050)
- Medium = 6.63 GW (2050)
- Low = 5.21 GW (2050)



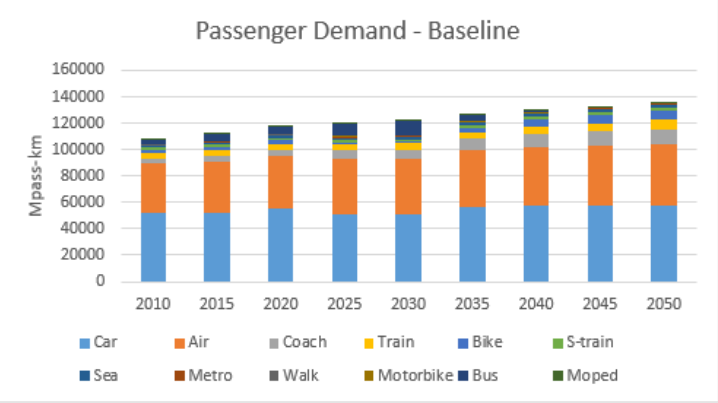


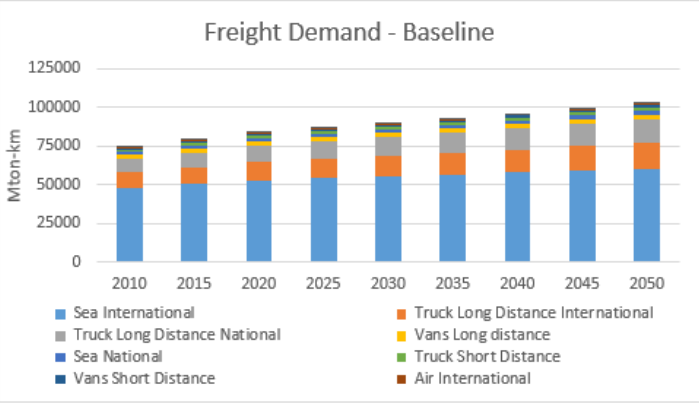
TIMES-DK scenario interface

Transport Technology assumptions

Driver	Options					Reference
	Active/Inactive	Value Choice	Unit	Year	Limit	
Vehicles efficiency	☐	0	%	2020		AlternativDrivmiddel Model (Energistyrelsen)
Bike infrastructure	☐			2035		Own assumption
Railways infrastructure		90	km/h	2025		Christiansen & Skougaard (2015)
Public transport infrastructure						Christiansen & Skougaard (2015)
EV public charging development						EU (2014)
CNG/CBG stations development						Statistics Denmark (2017)
Car occupancy		1.5	person/vehicle	2020		EEA (2010)
Car occupancy		1.5	person/vehicle	2030		EEA (2010)
Teleworking	☐					Christiansen & Skougaard (2015)
Share of e-bikes	☐	5	%	2030	Min	Own assumption
Biofuel blending limits		Medium				Various sources
Autonomous cars	☑	0	%	2030	Max	Own assumption
ICE ban						
On all ICE cars	☐			2030		Own assumption
Only on fossil ICE cars	☐			2030		Own assumption
Increase tax on fossil fuels		0	%	2025		Own assumption
Decrease tax on electricity		0	%	2030		SKAT (2017a)
Vehicle Registration Tax	☐			2025		SKAT (2017a)

Adjust investments in EV charging infrastructure:
- High = 15 vehicles per charger in 2030.
- Low = 30 vehicles per charger in 2030.





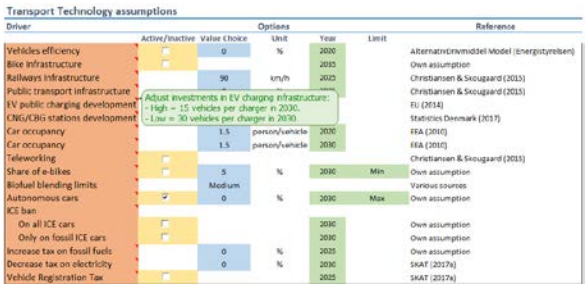
Scenario workshops

Citizens, stakeholders and researchers involved in the creation of transport-focused scenarios for Denmark

Discussion of driving forces and uncertain parameters

Design of scenarios through TIMES-DK interface

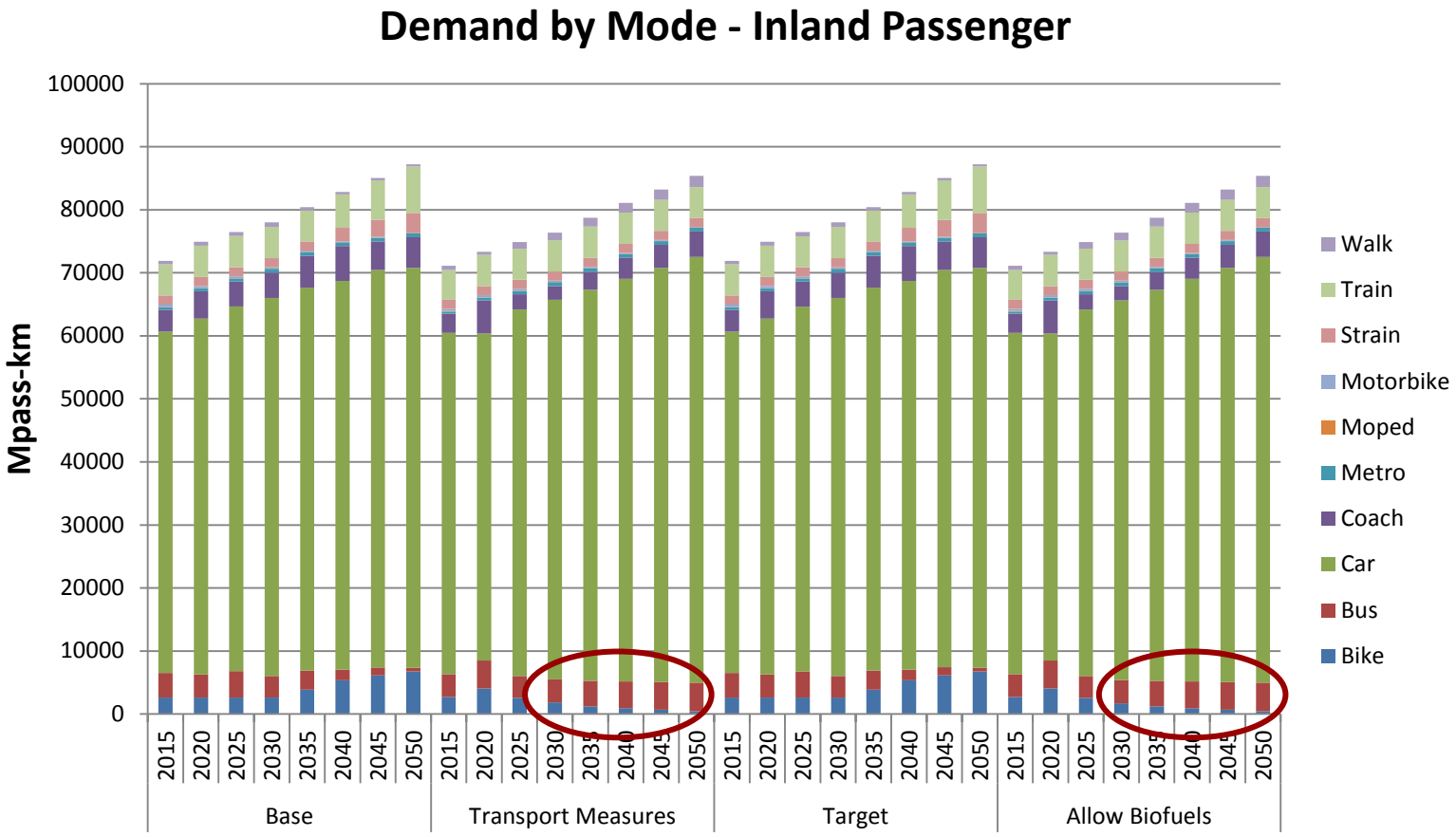
Assessment and comparison of scenario results



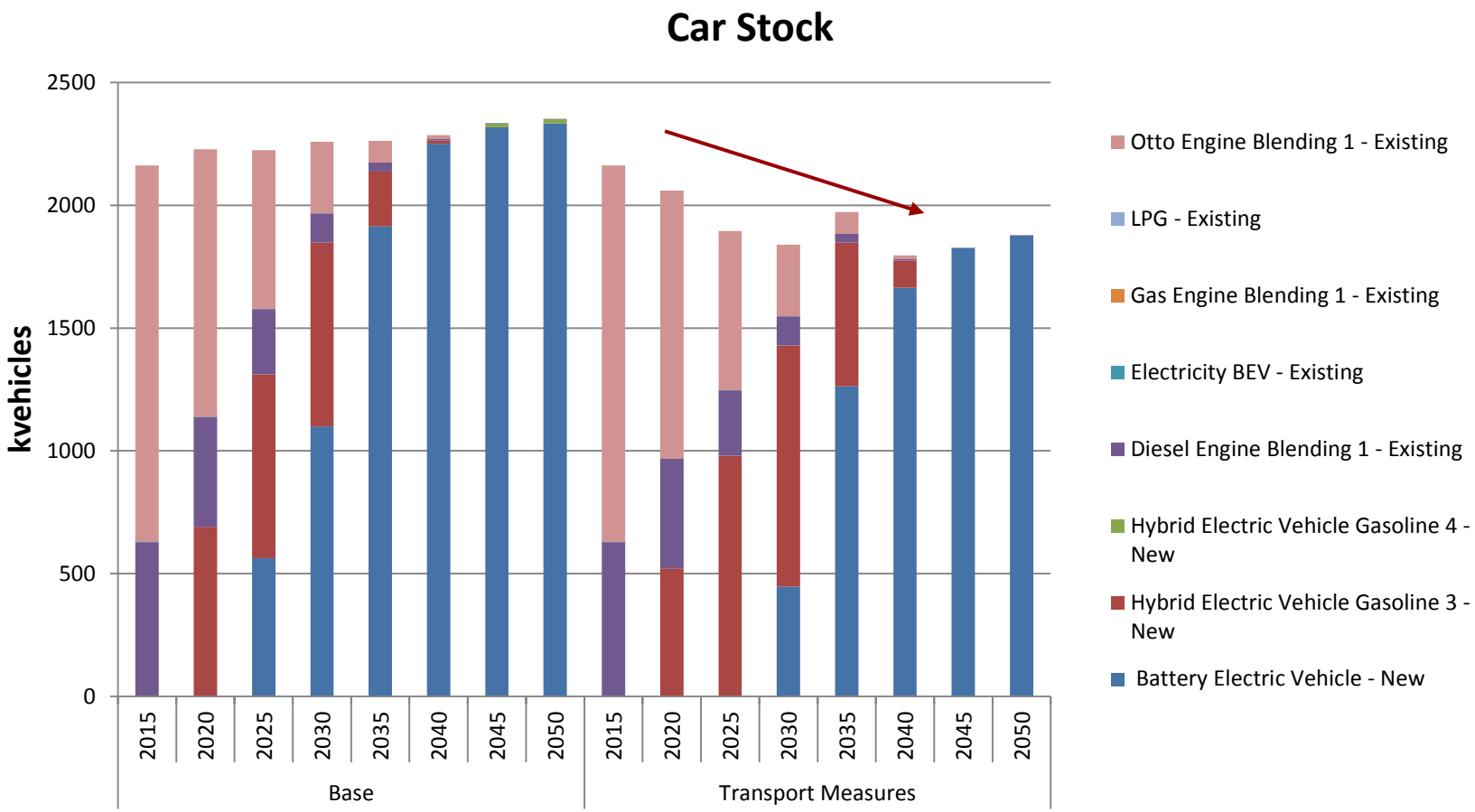
Scenario workshops

Scenario	Main Assumptions
Base	• No emission caps • No RE% targets after 2020 • No restrictions on power and biomass imports • Baseline taxation scheme for all sectors
Transport Measures	• Phase-out of fossil fuels in transport by 2035 (excluding maritime); other sectors by 2030/2035 • Imports of biomass not allowed from 2020 • Improved bike & public transport infrastructure • Increased car occupancy levels • Feebate scheme supporting alternative vehicles
Target	Same as Base, except phase-out of fossil fuels in transport by 2035, other sectors by 2030/2035.
Allow Biofuels	Same as Transport Measures, except biomass imports are allowed.

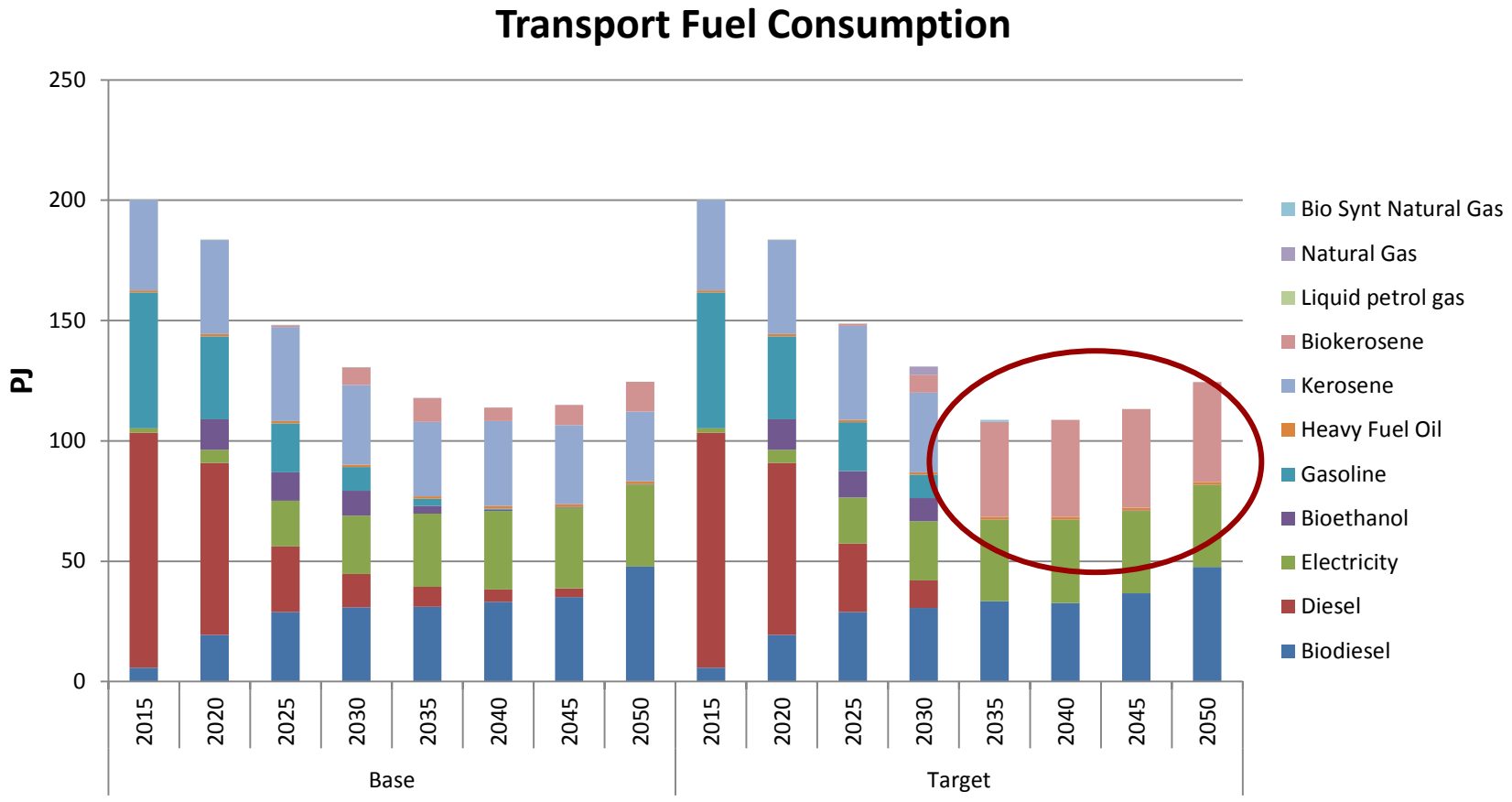
Scenario results



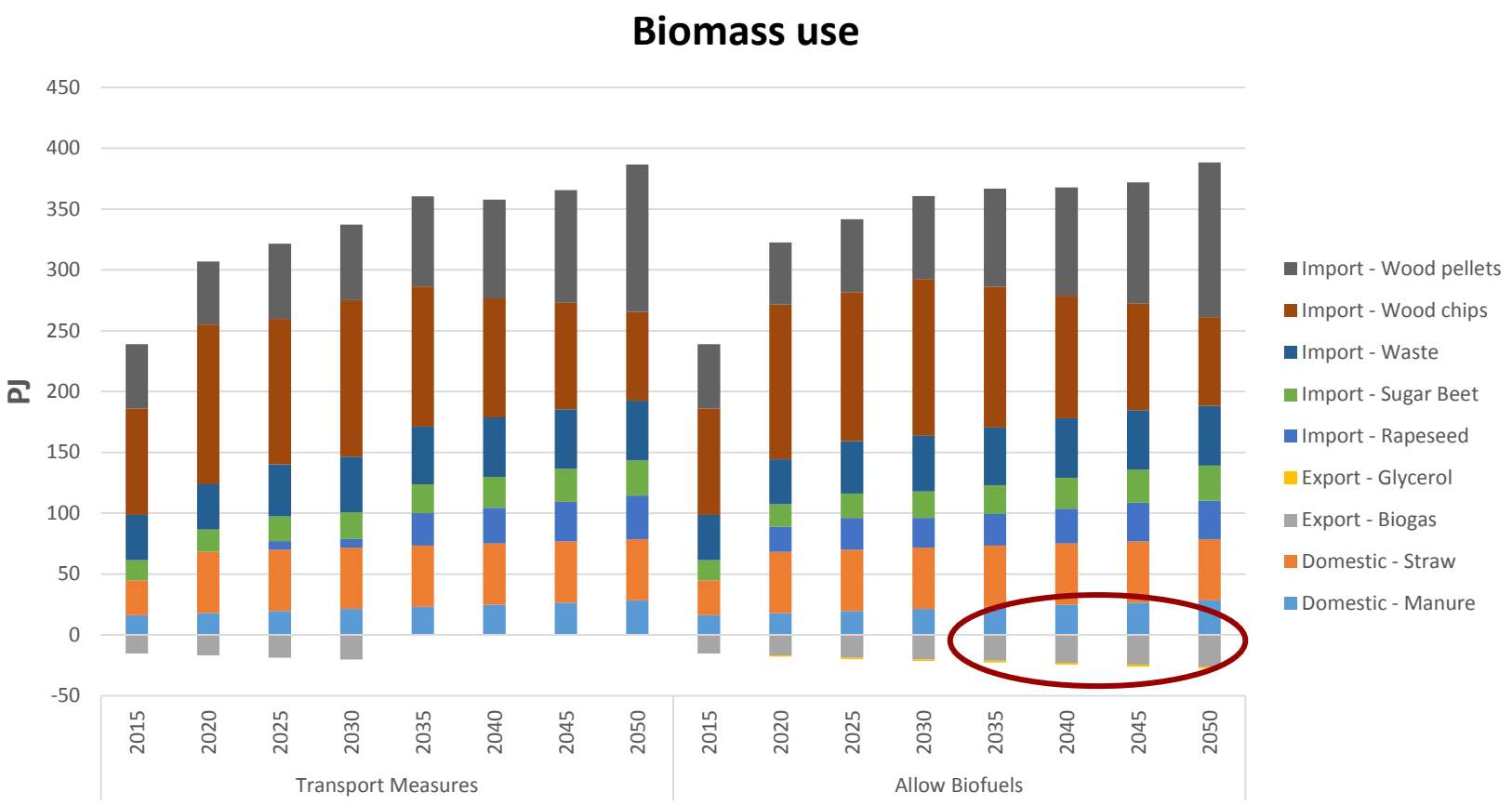
Scenario results



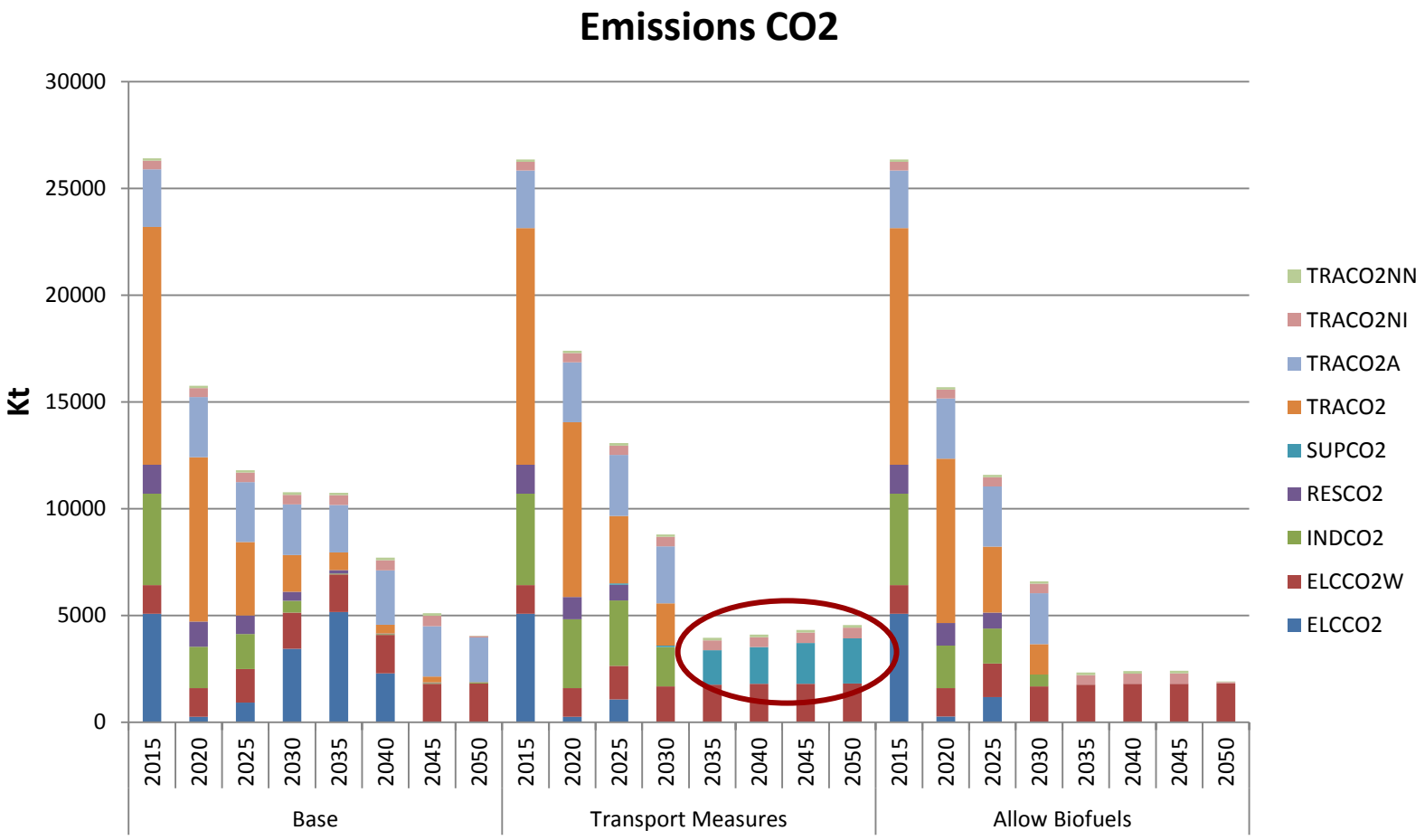
Scenario results



Scenario results



Scenario results



Learning opportunities

- The method provides space for:
  - Discussion and debate over relevant drivers
  - Common evaluation of pathways
  - Understanding of cause-effect relationships
  - Validation of assumptions

- Different development trajectories and policies can be tested: importance of participation and interaction in the scenario creation

Challenges and further work

- Simplification or modification of scenario interface: adjust tool to group needs
- Time constraints: faster result generation
- Provide further guidance on drivers' impacts: sensitivity analyses, screening of results…

Thank you for your attention!

Comments, doubts, suggestions?

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