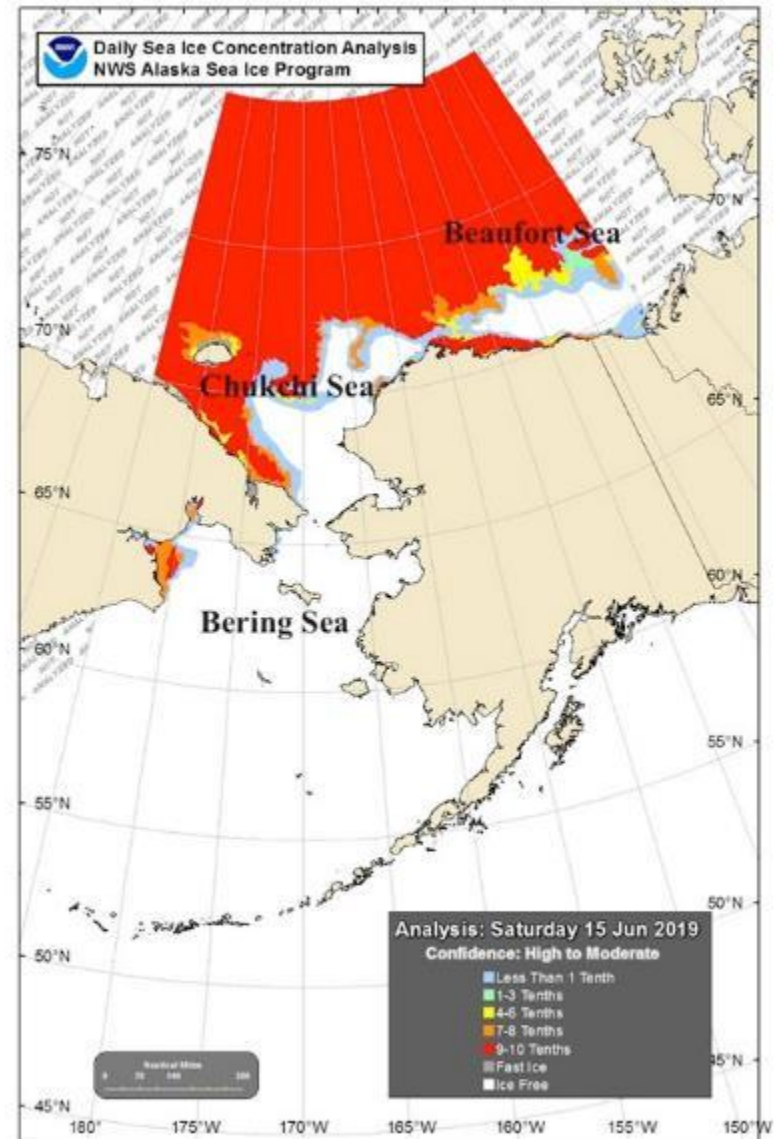
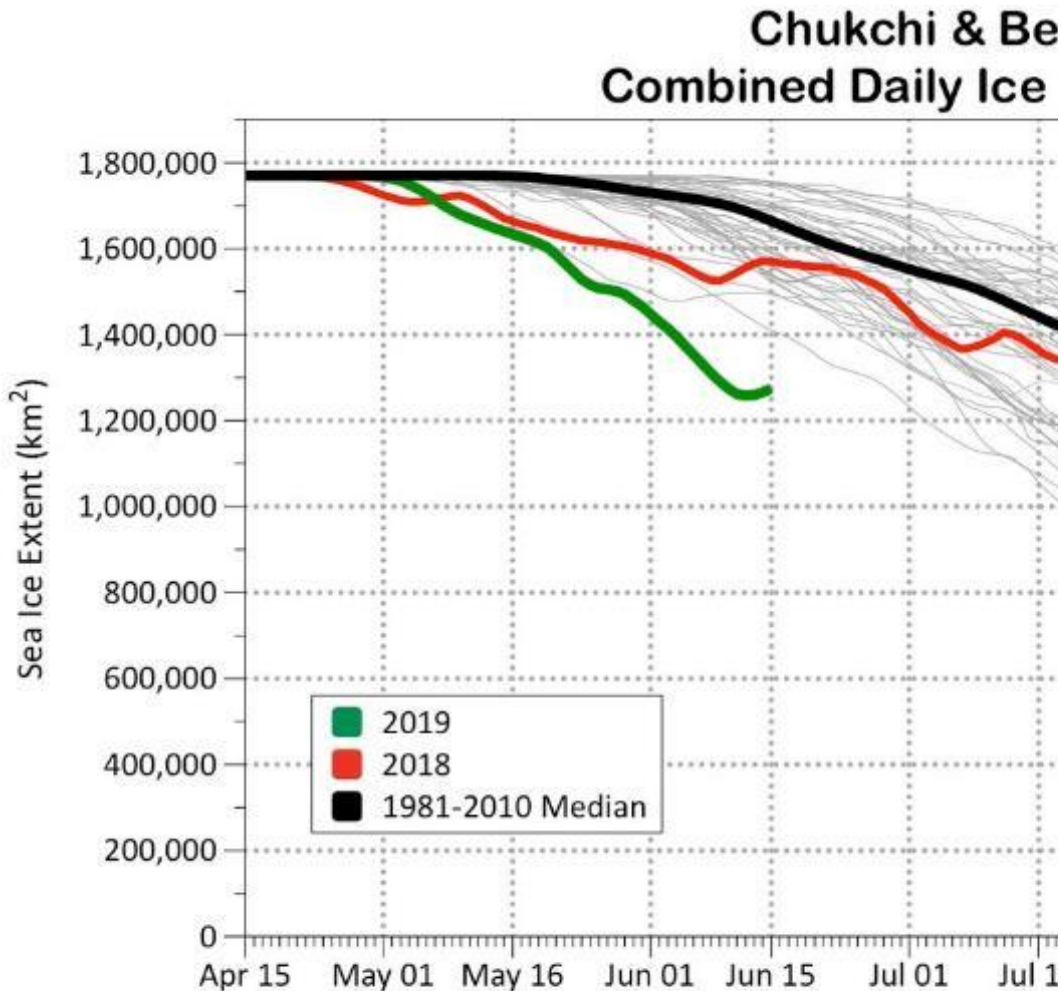




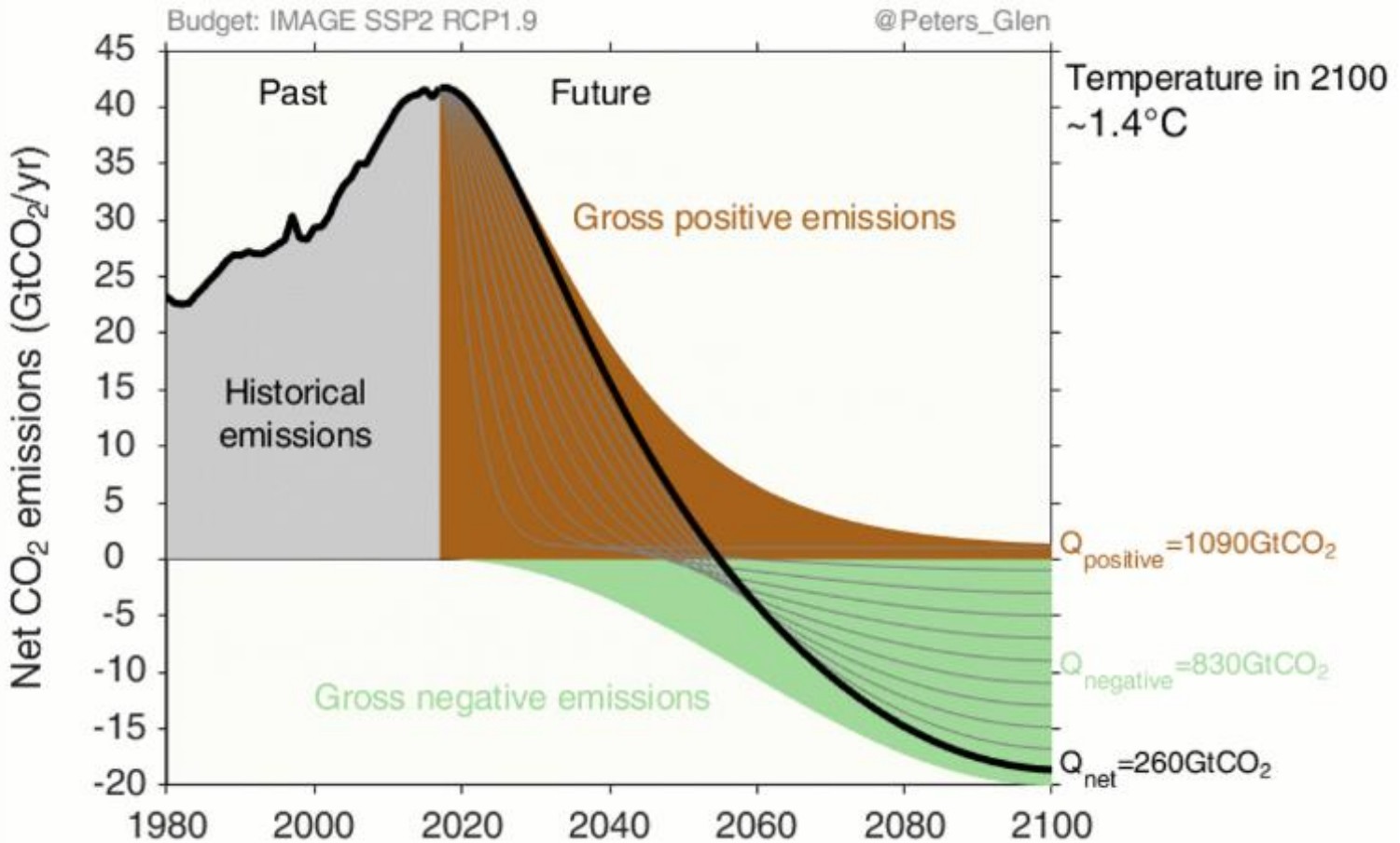
dr. ir. Machteld van den Broek

Role of CCS to save humanity+

Impact of 1 °C all around us



Why CO₂ capture and storage



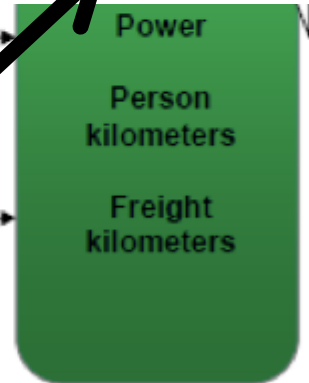
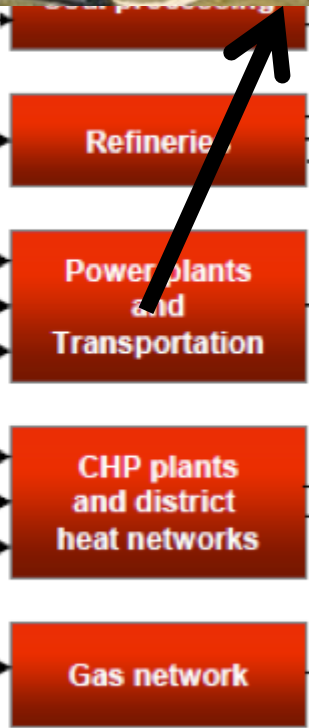
W

contribute?



Cost and emission

Resources, Resource availability



Demands



Energy

Final energy

Demand services



Grey → hydrogen

300 ton H₂ per day

Blue hydrogen: capture
9 kg CO₂ /kg H₂



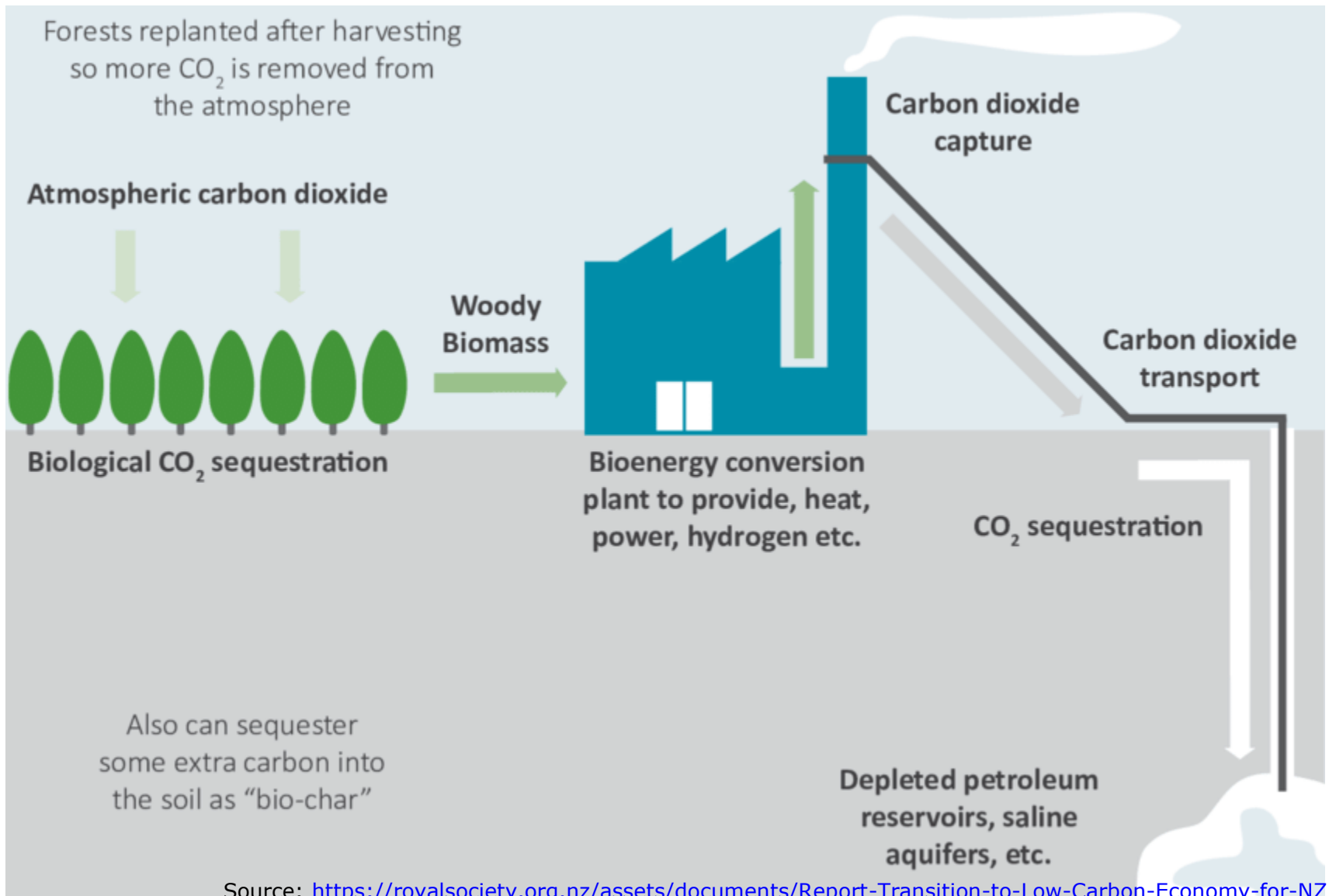
Source: <https://www.youtube.com/watch?v=ItXORzCCLPQ>

Green hydrogen

0.5 ton H₂ per day



CCS for negative emissions



CCS for negative emissions

900 tonnes/year

Performance (future):
0.3 MWh electricity/tonne CO₂
6 GJ heat/tonne CO₂

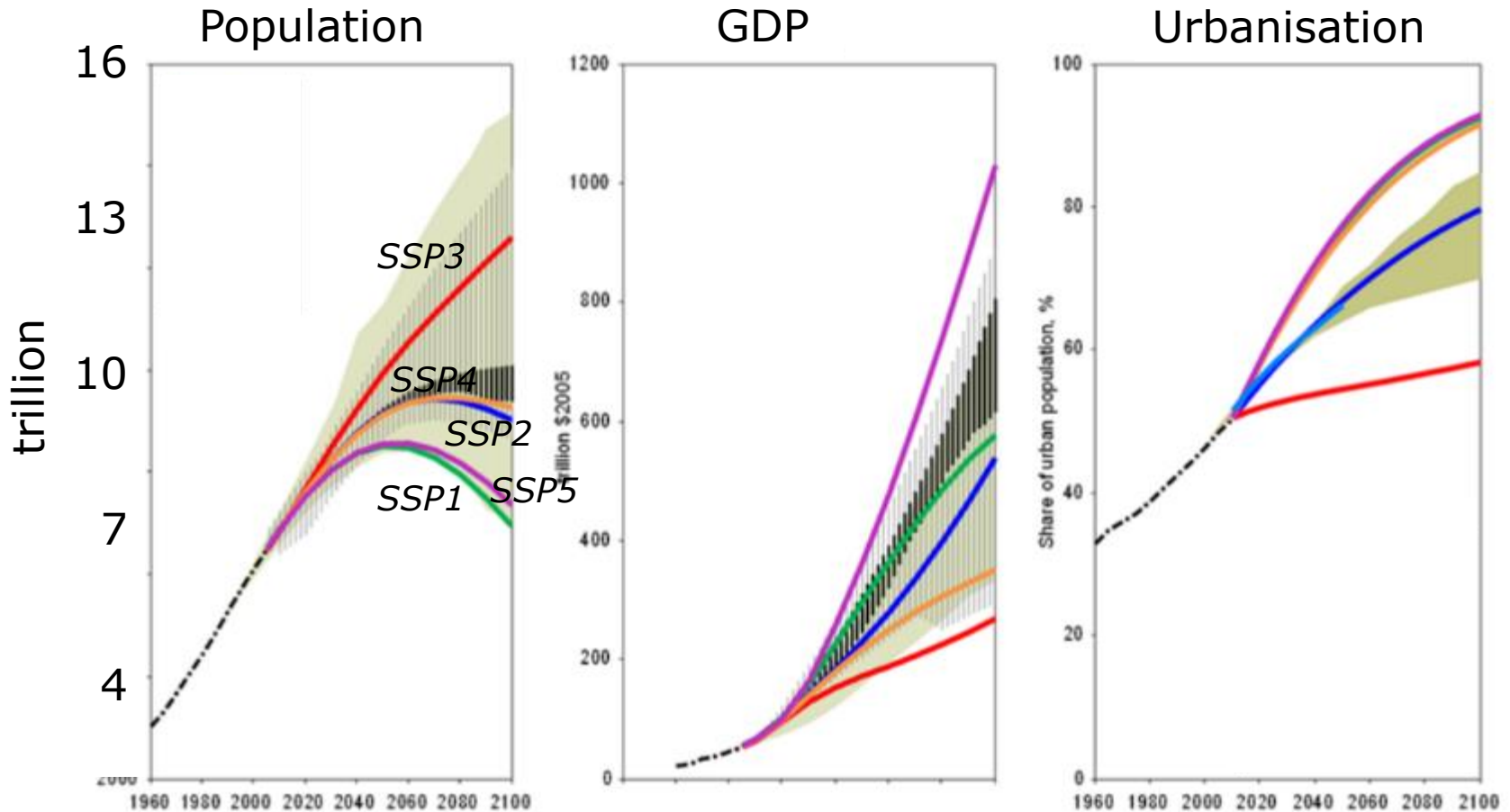


Role CCS + focus Dutch government

	Coal	Biomass	Natural gas	Blue H ₂ from NG	Electrolysis H ₂ (electrification)
Electricity t/MWh (410)	85	-925	40 (Allam 0)	60	x
Transport g/km (200)	Gasify + FT	Several processes	Gasify + FT	20	340 → 0 (115 → 0)
Industry t/MWh (220)	steel	-450	30	40	850 → 0
Built env. t/MWh (220)	x	x	x	40	850 → 0 (110-160 → 0)

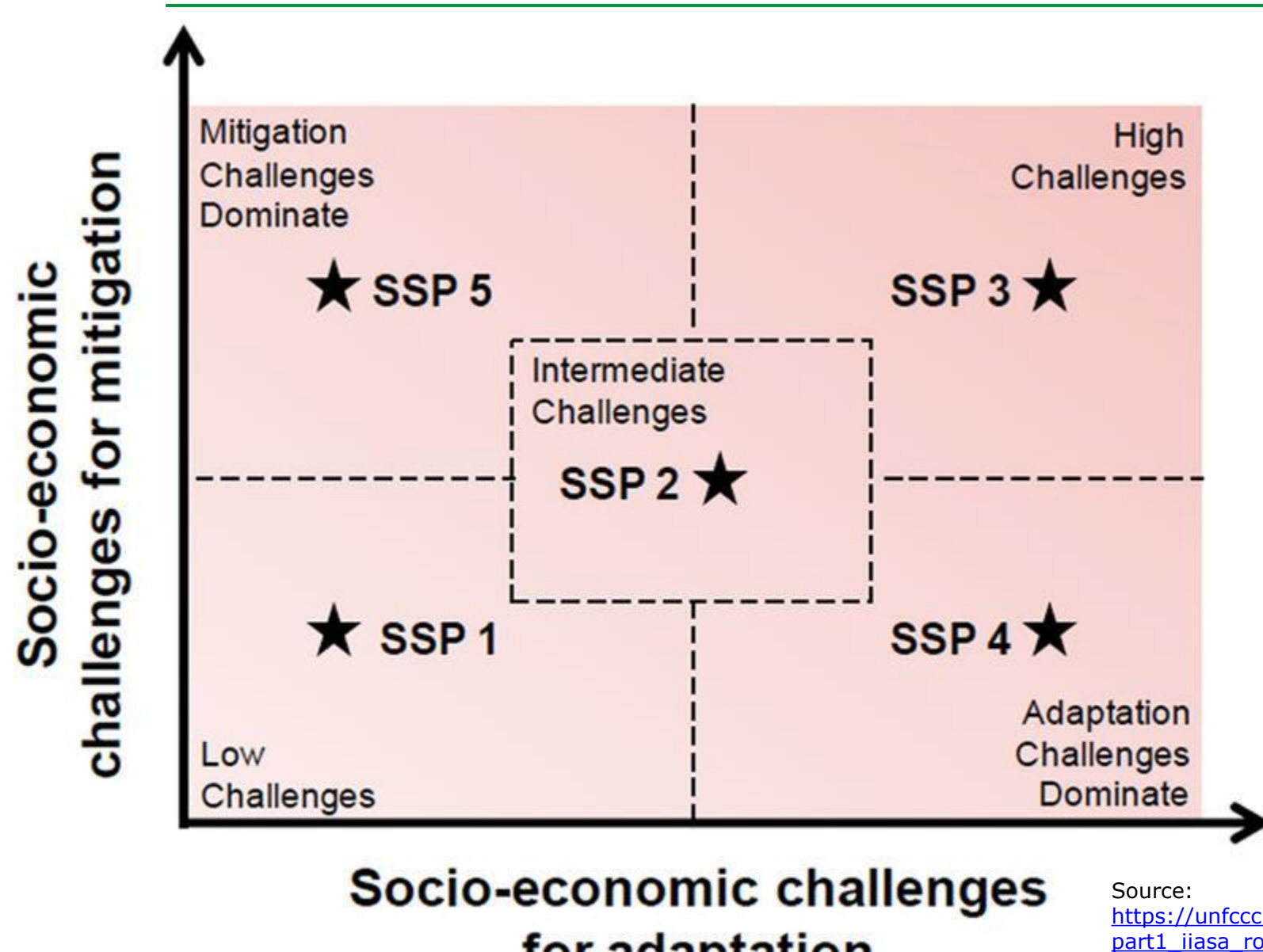
Direct Air Capture

Shared Socio-economic Pathways (SSPs)



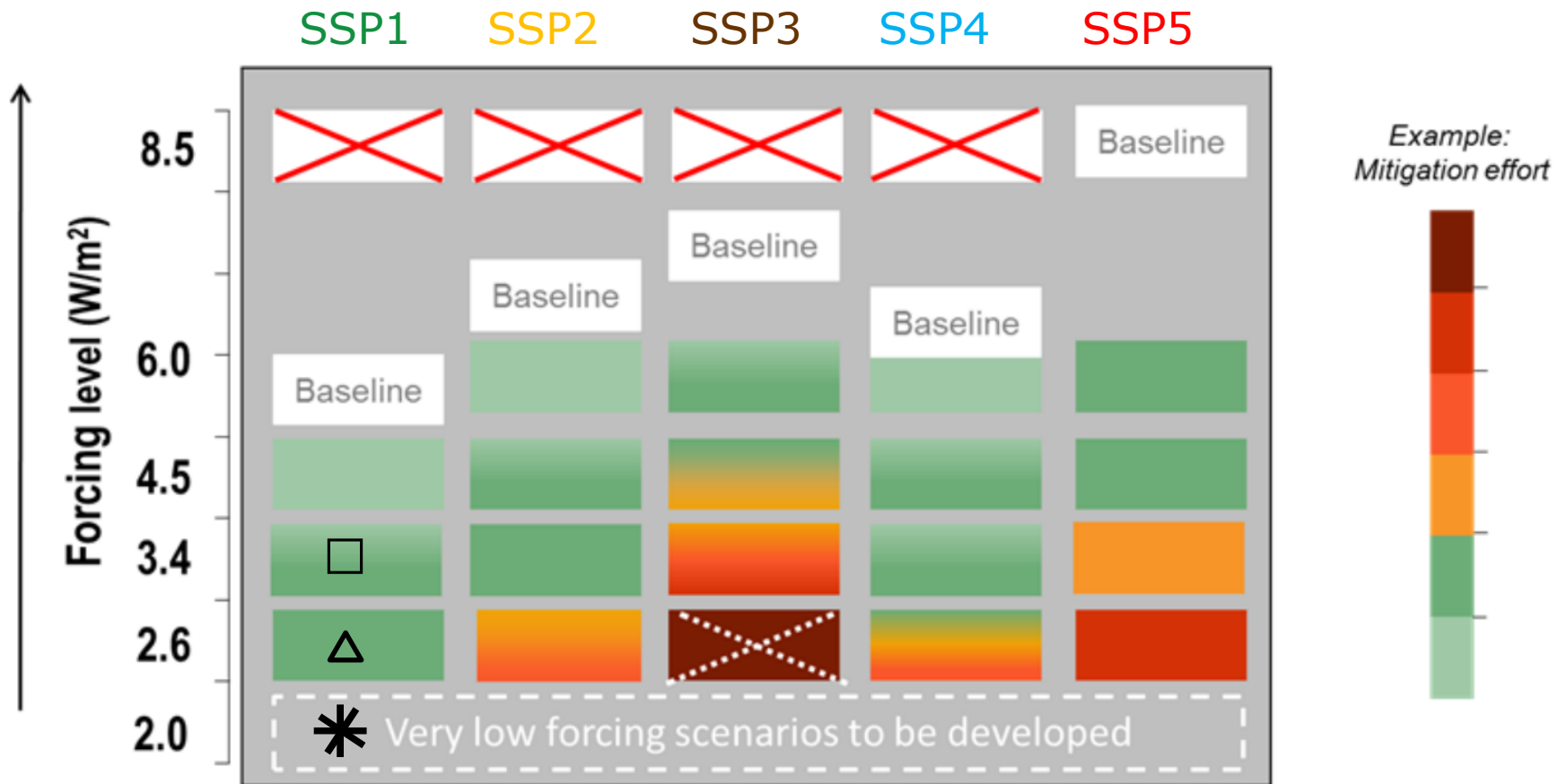
Population: KC&Lutz, 2016; economic growth: Dellink et al., 2016;
urbanization: Jiang & O'Neill, 2016;
https://unfccc.int/sites/default/files/part1_iiasa_rogelj_ssp_poster.pdf

Shared Socio-economic Pathways (SSPs)

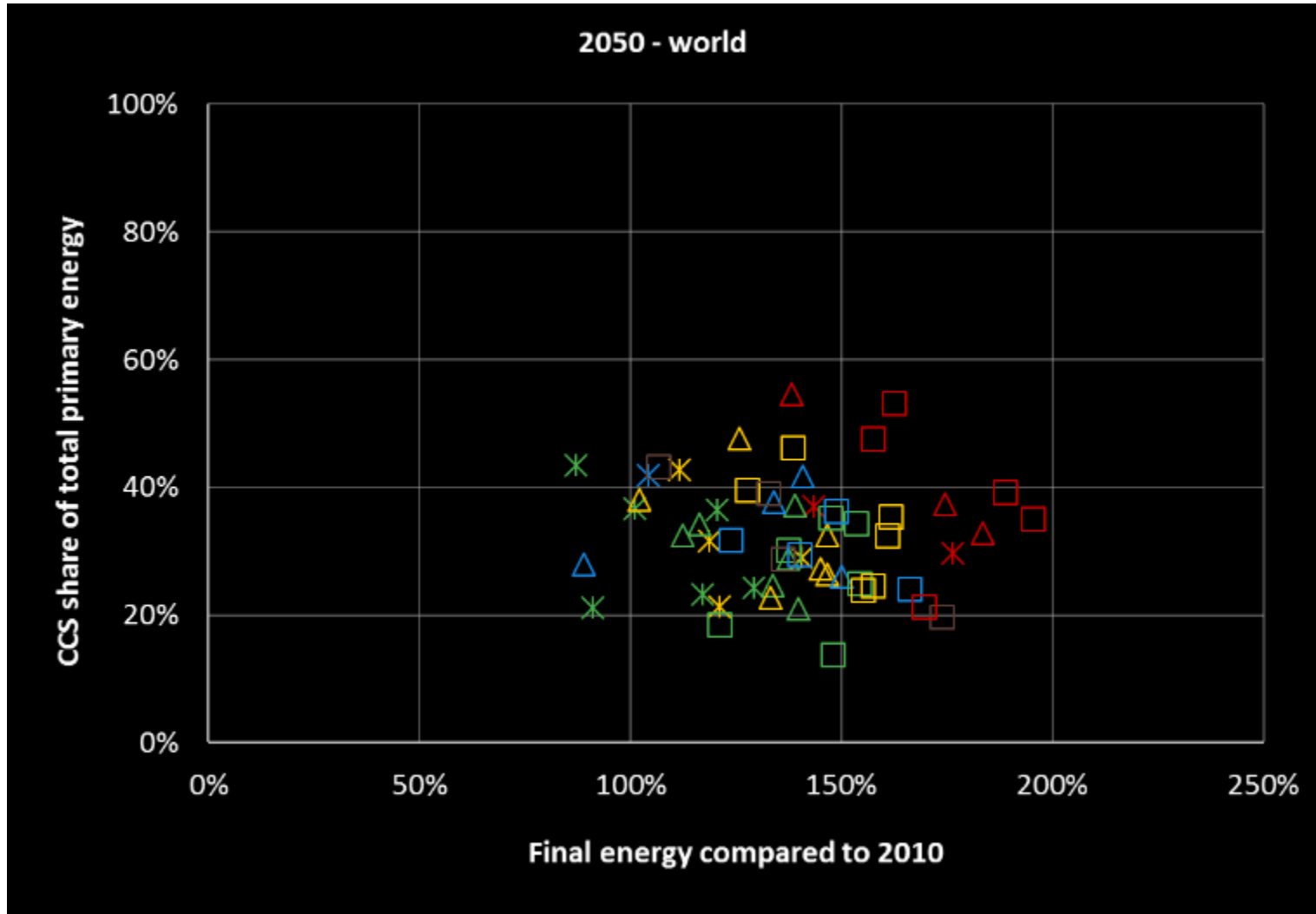


Source:
https://unfccc.int/sites/default/files/part1_iiasa_rogelj_ssp_poster.pdf

Shared Socio-economic Pathways (SSPs)

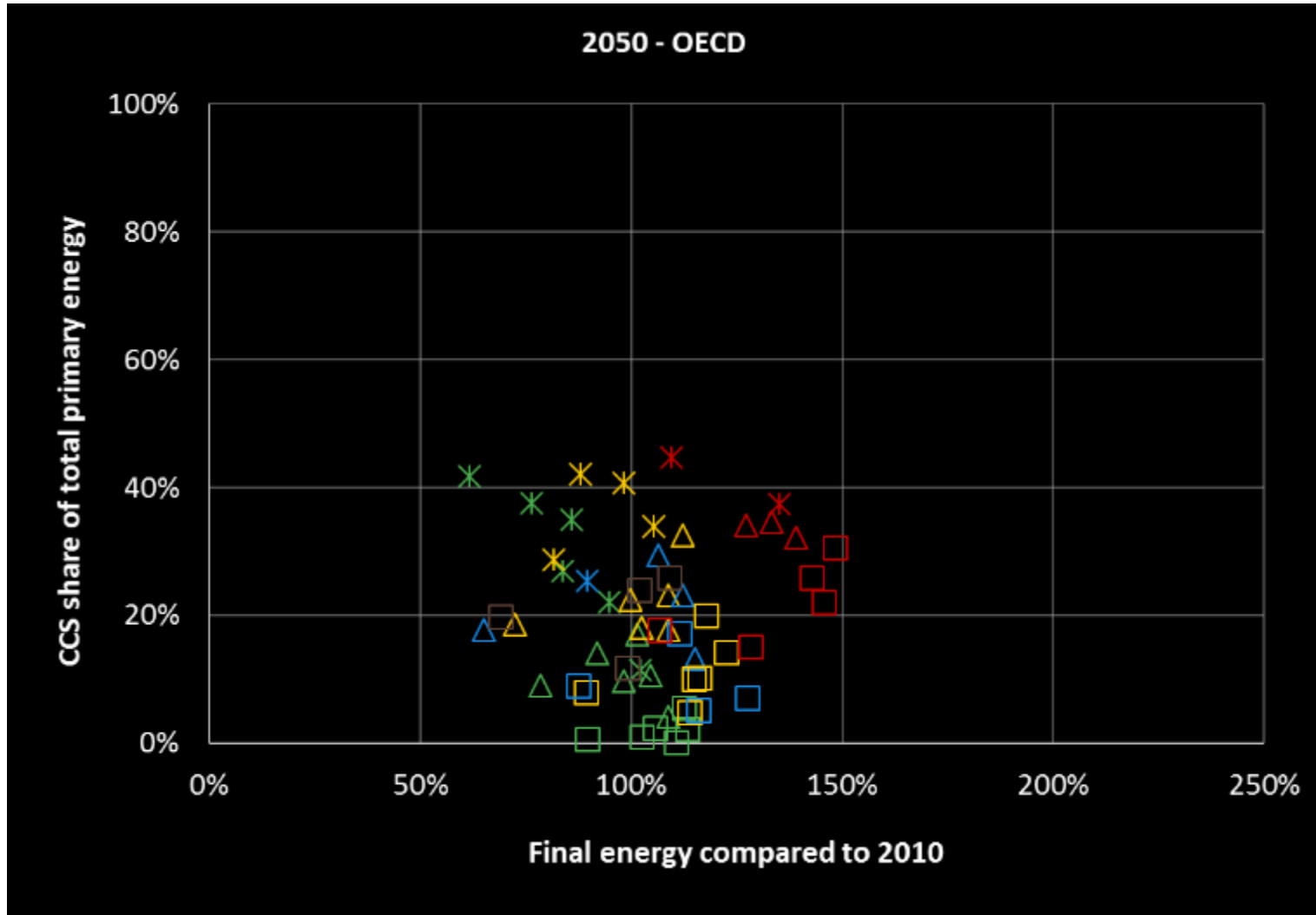


Role of CCS in energy system



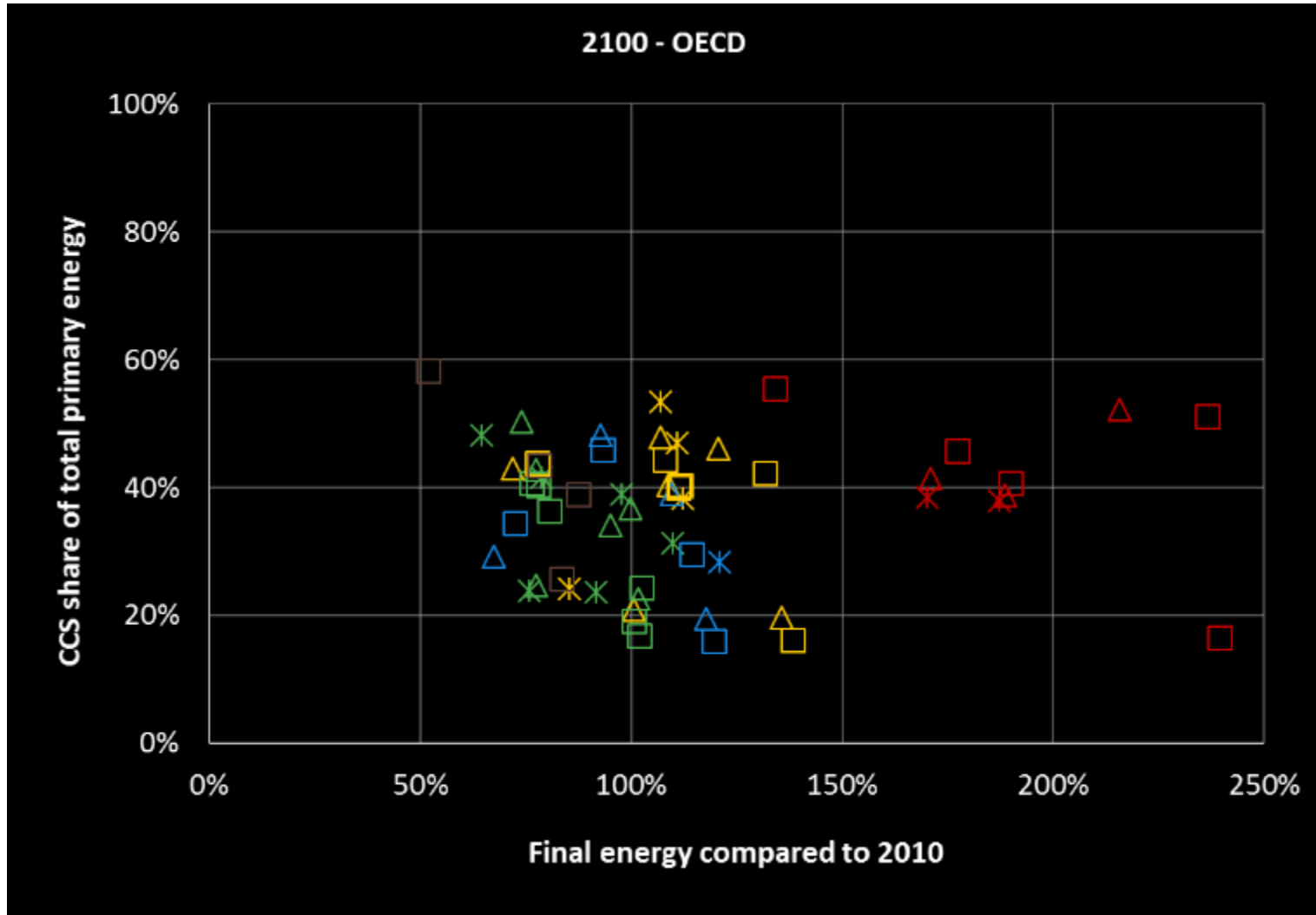
Source: M. van den Broek, Utrecht University, based on data from SSP Database (Shared Socioeconomic Pathways) - Version 2.0, <https://tntcat.iiasa.ac.at/SspDb> and DOI:110.1016/j.gloenvcha.2016.05.009

Role of CCS in energy system



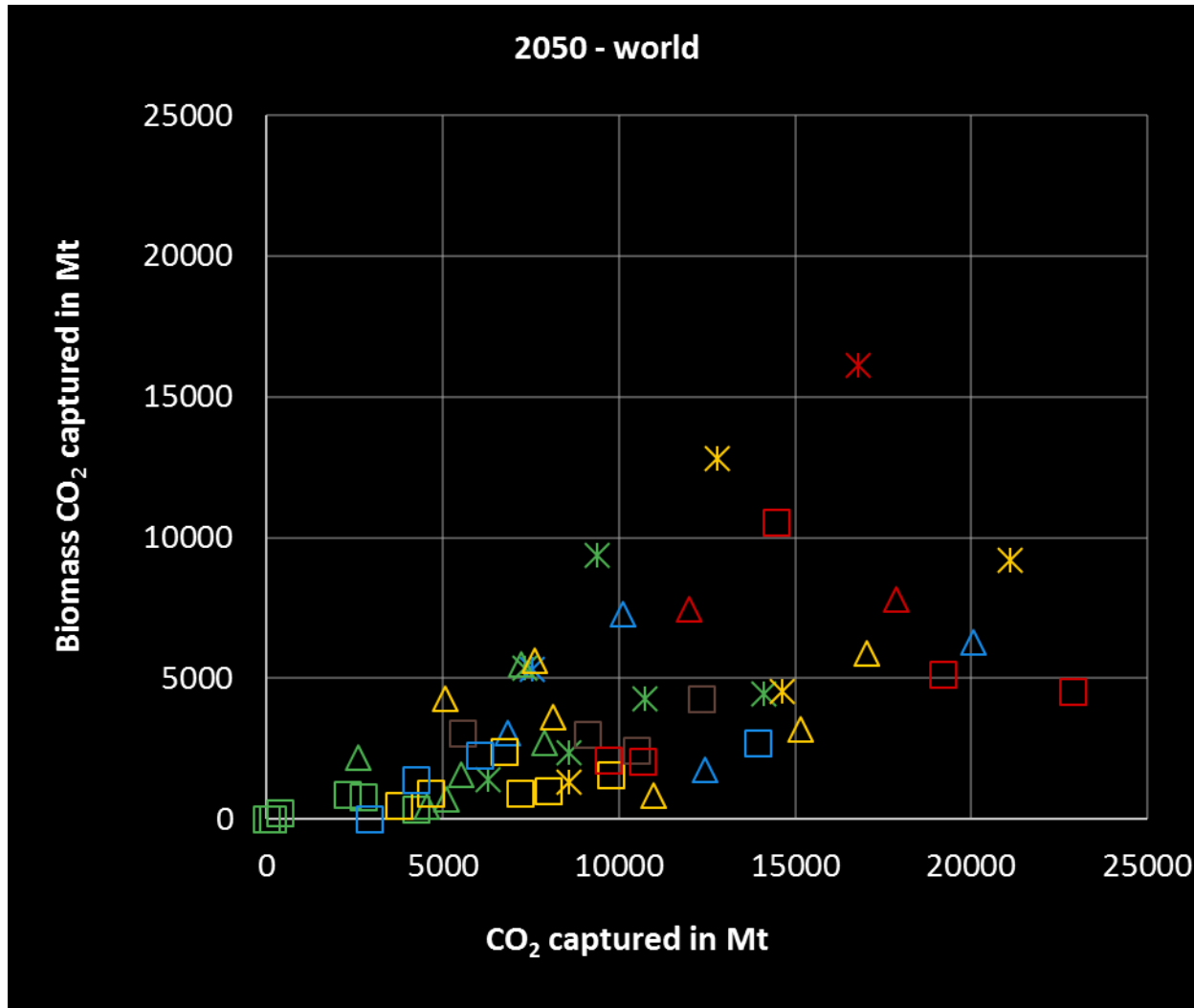
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Role of CCS in energy system



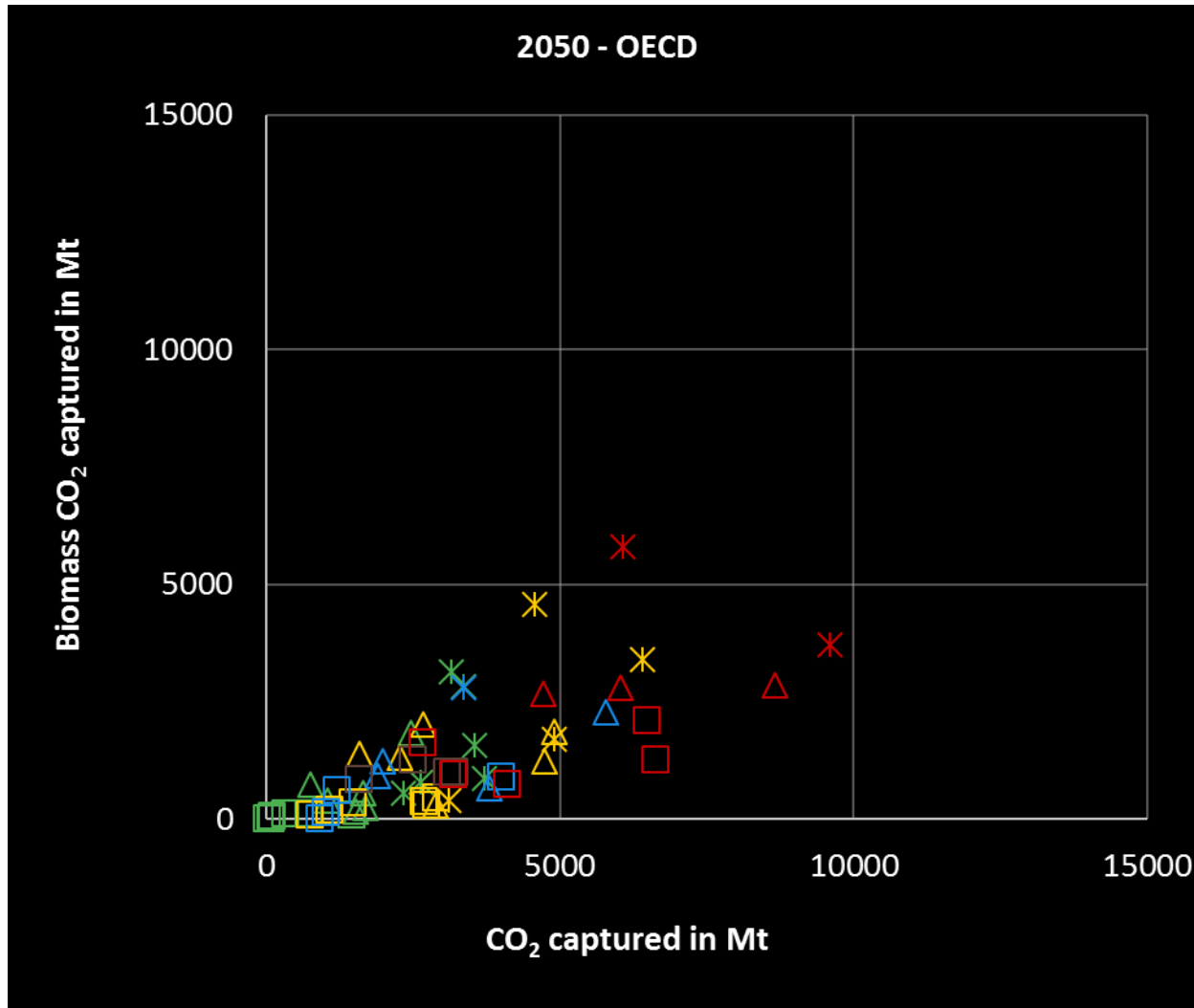
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CO₂ captured in Integrated Assessment Models



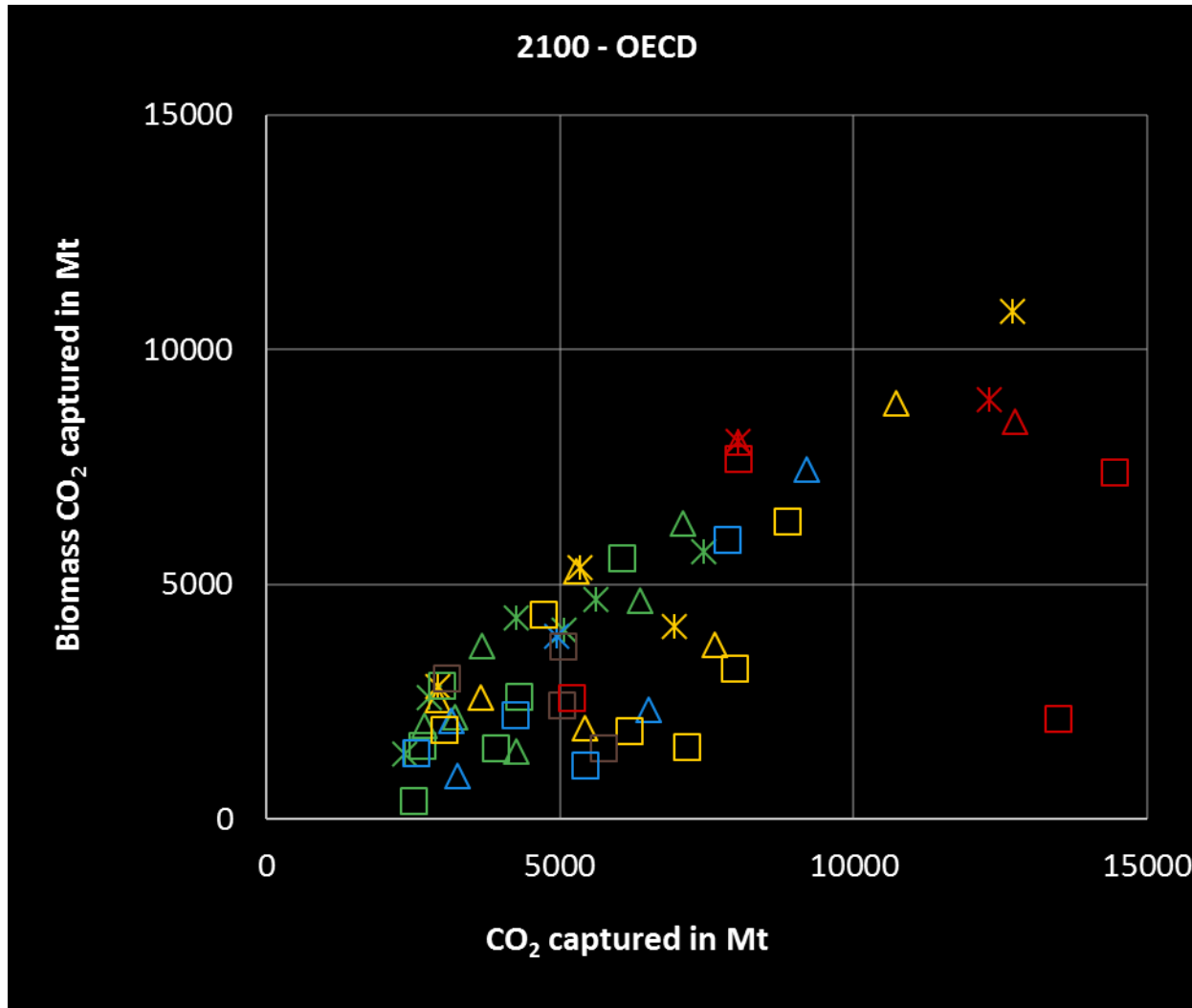
Source: M. van den Broek, Utrecht University, based on data from SSP Database (Shared Socioeconomic Pathways) - Version 2.0, <https://tntcat.iiasa.ac.at/SspDb> and DOI:110.1016/j.gloenvcha.2016.05.009

CO₂ captured in Integrated Assessment Models



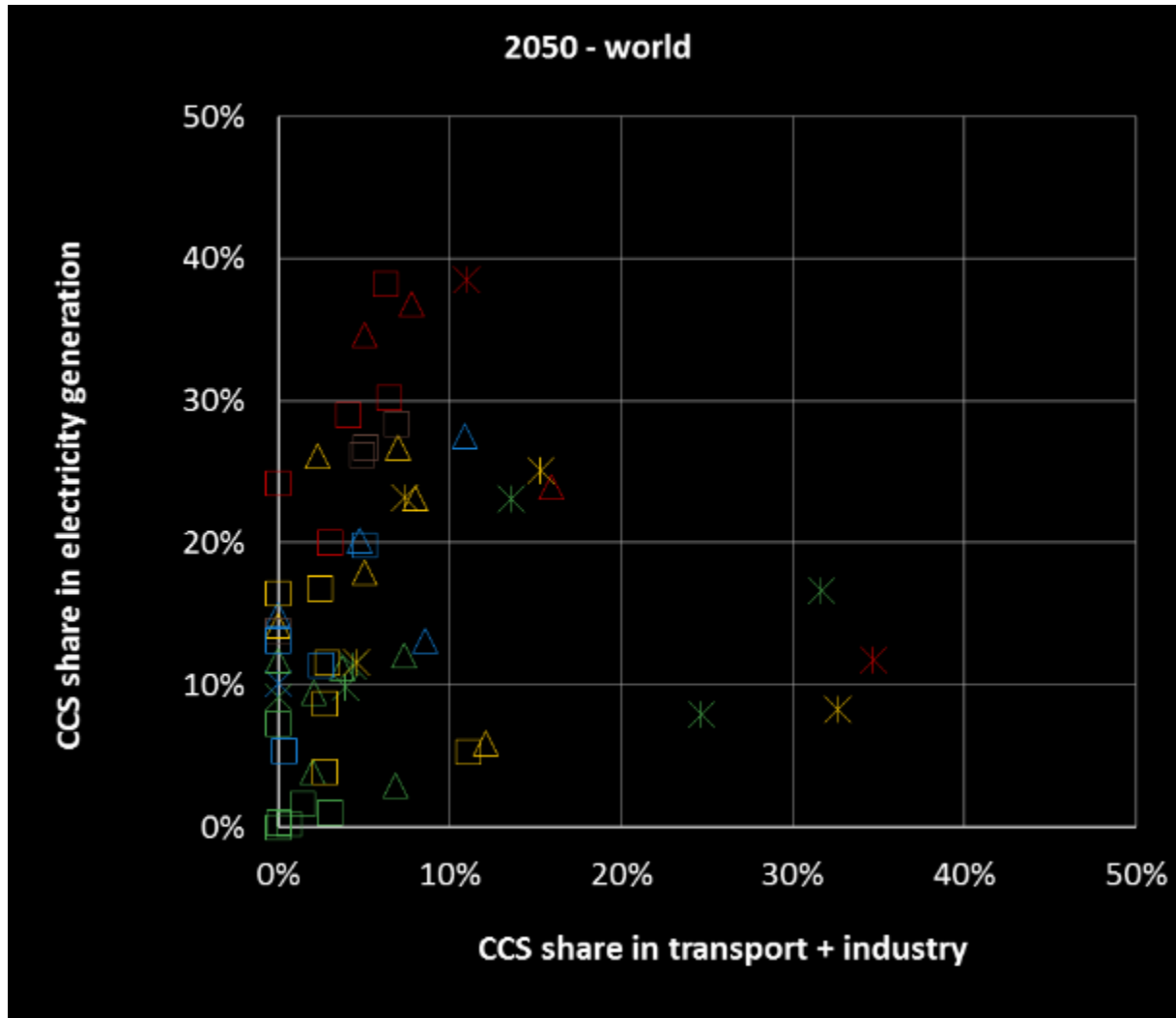
Source: M. van den Broek, Utrecht University, based on data from SSP Database (Shared Socioeconomic Pathways) - Version 2.0, <https://tntcat.iiasa.ac.at/SspDb> and DOI:110.1016/j.gloenvcha.2016.05.009

CO₂ captured in Integrated Assessment Models

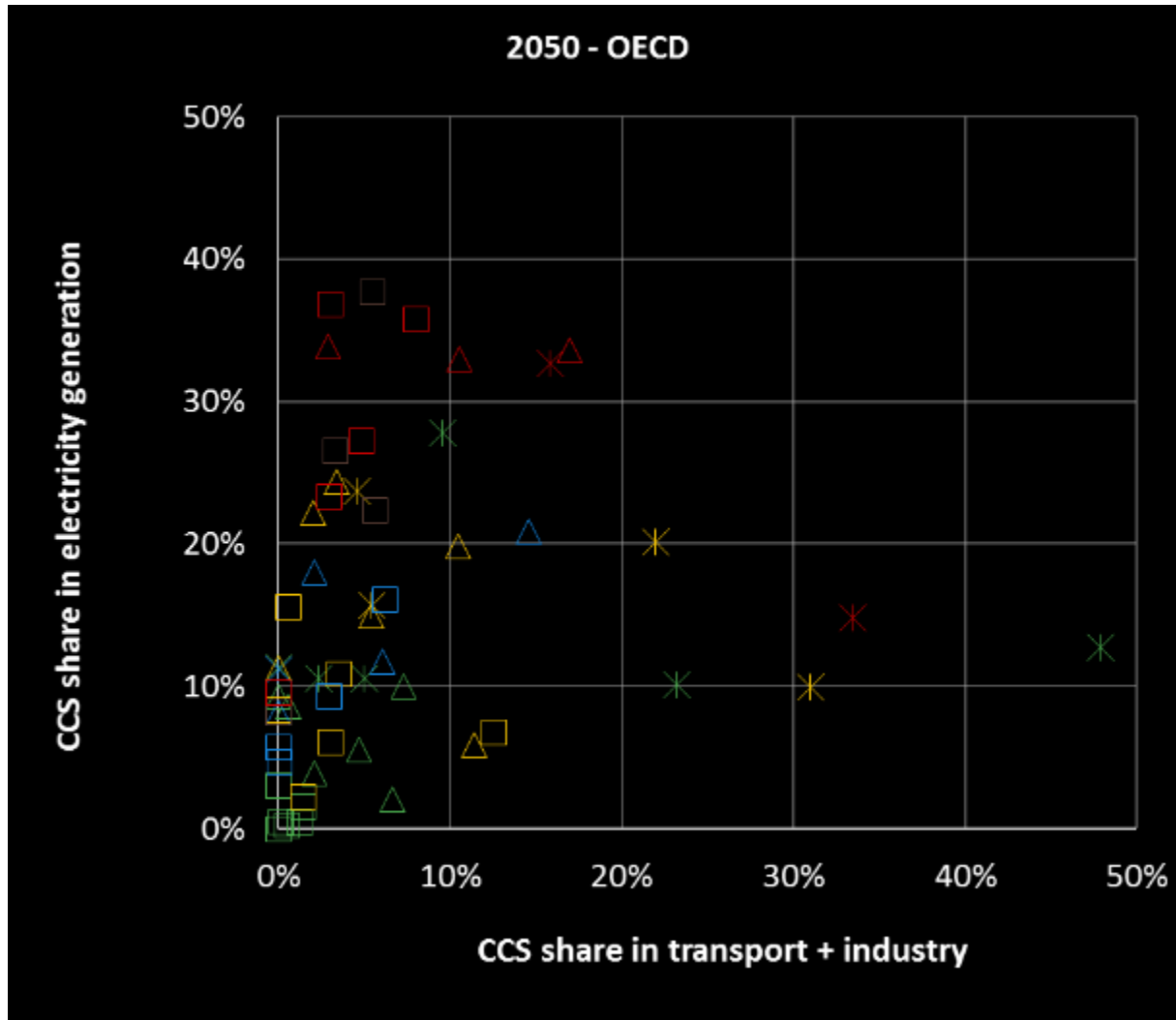


Source: M. van den Broek, Utrecht University, based on data from SSP Database (Shared Socioeconomic Pathways) - Version 2.0, <https://tntcat.iiasa.ac.at/SspDb> and DOI:110.1016/j.gloenvcha.2016.05.009

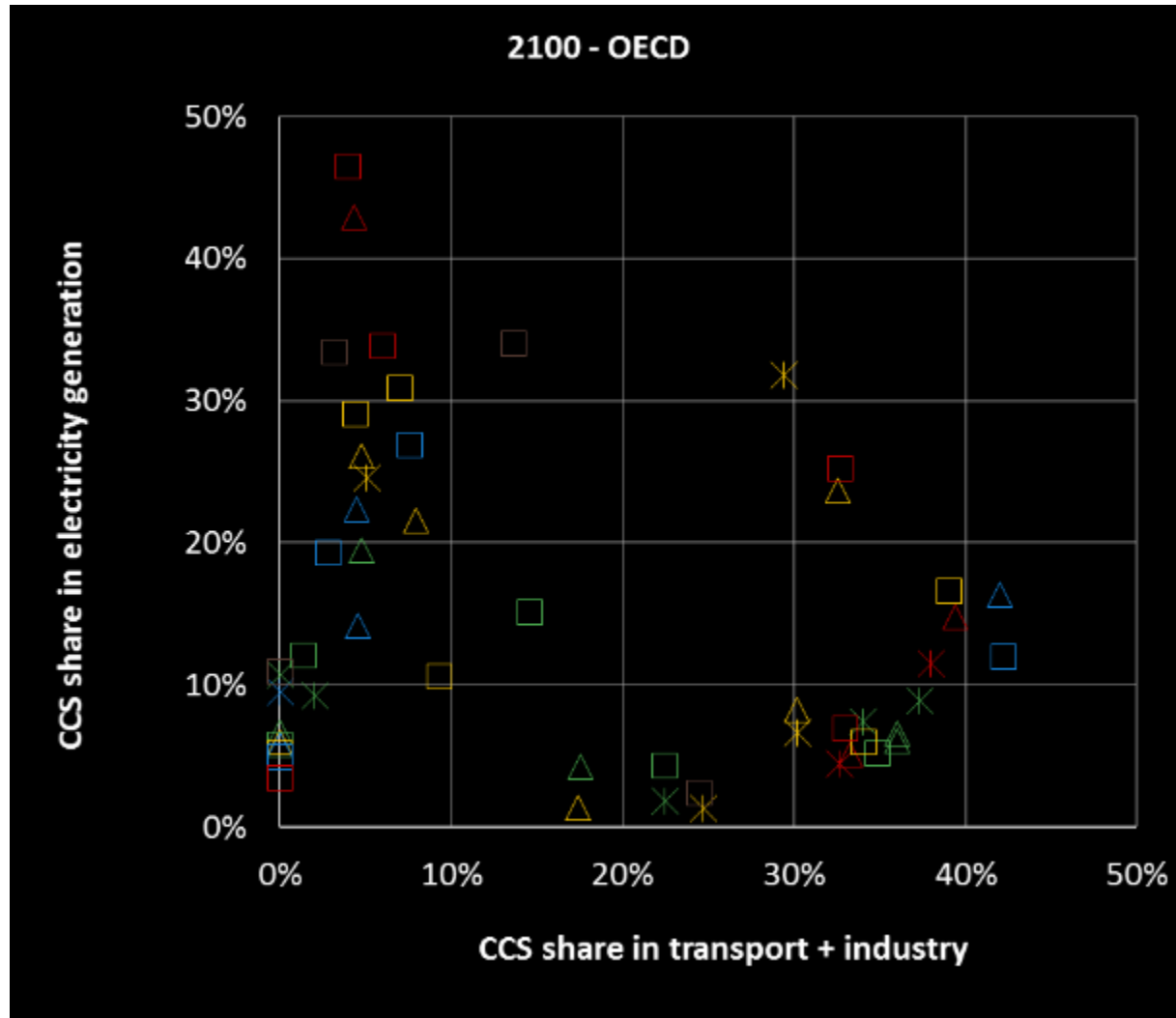
CCS in electricity versus other sectors



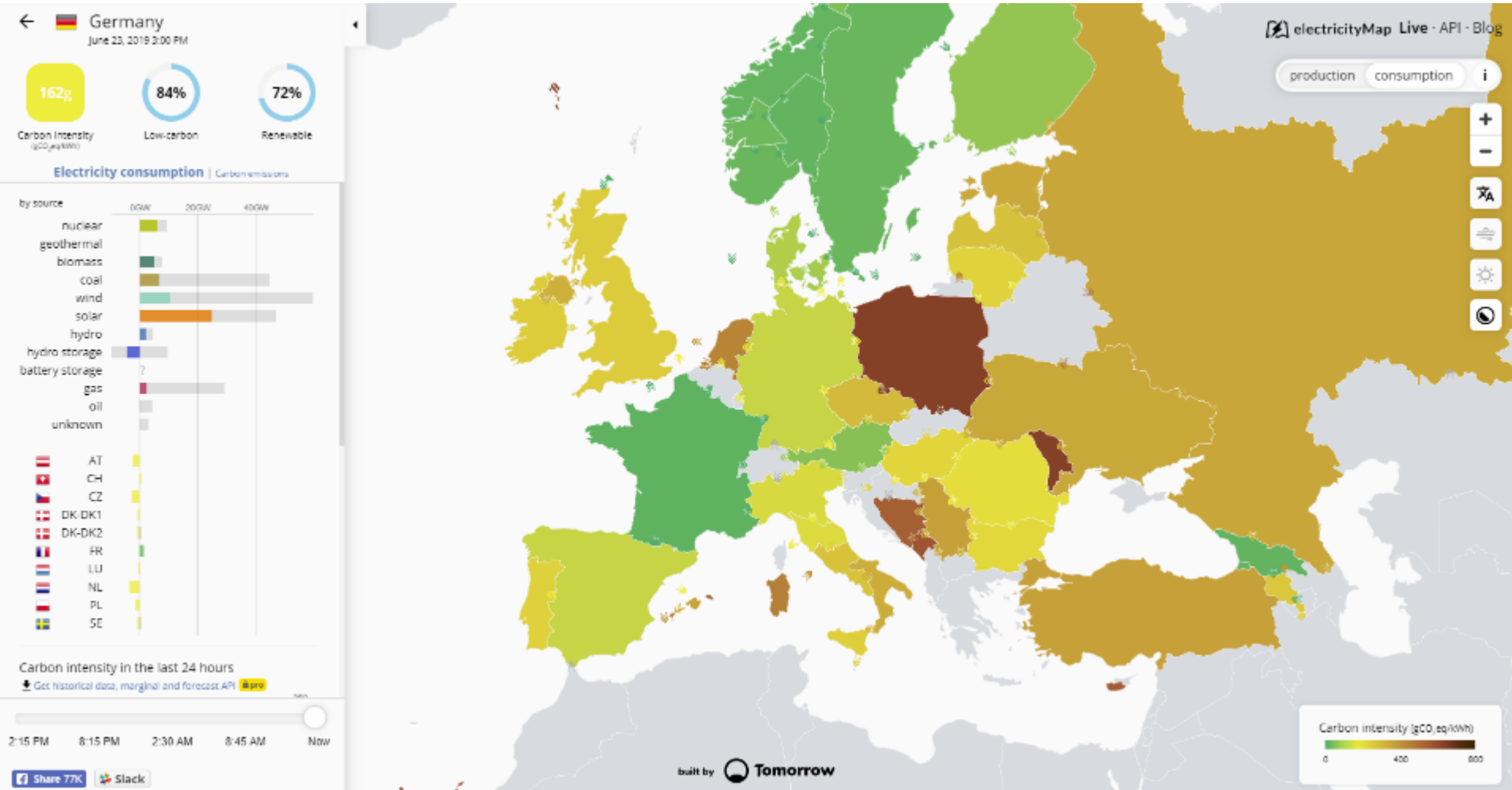
CCS in electricity versus other sectors



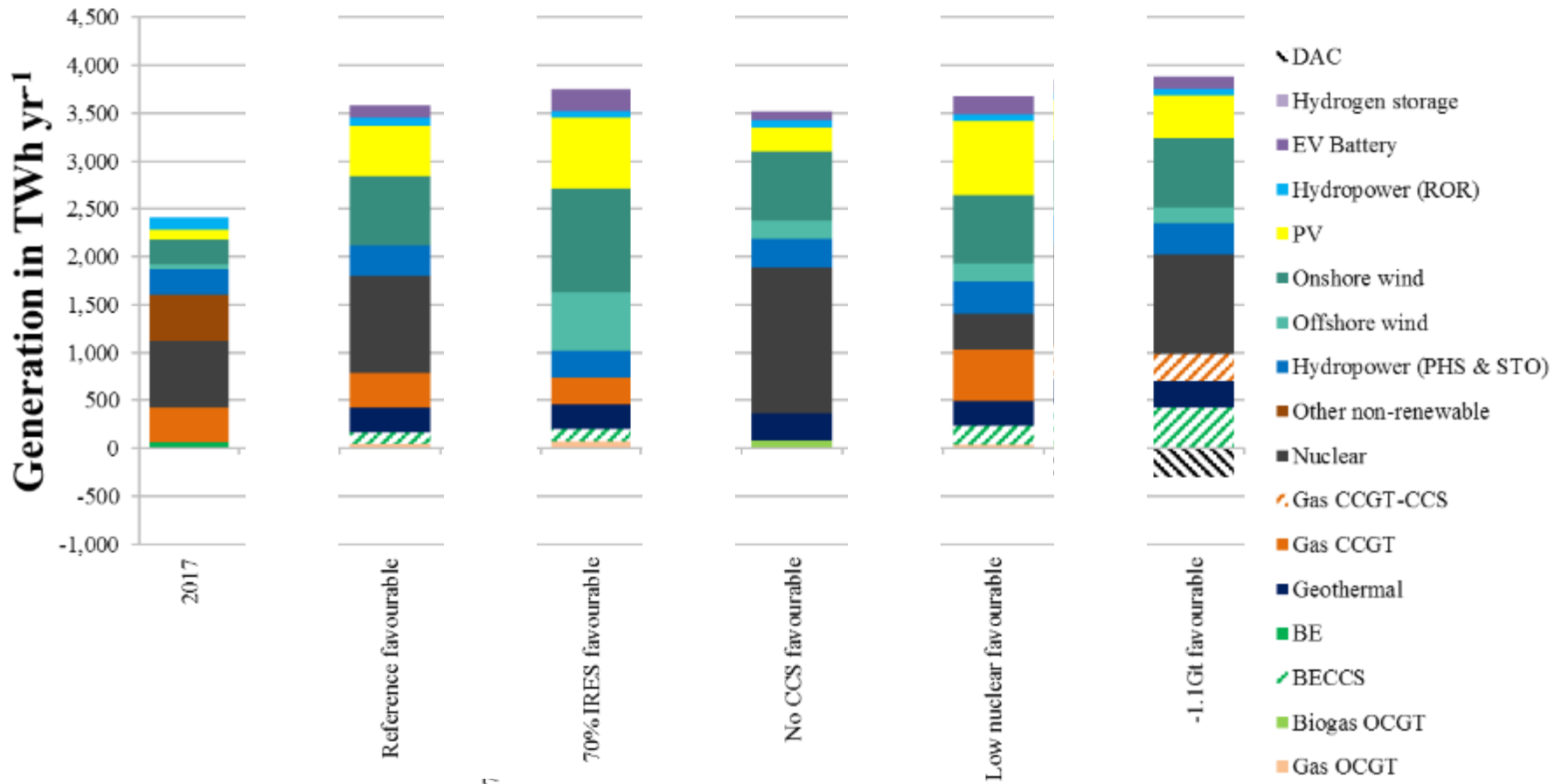
CCS in electricity versus other sectors



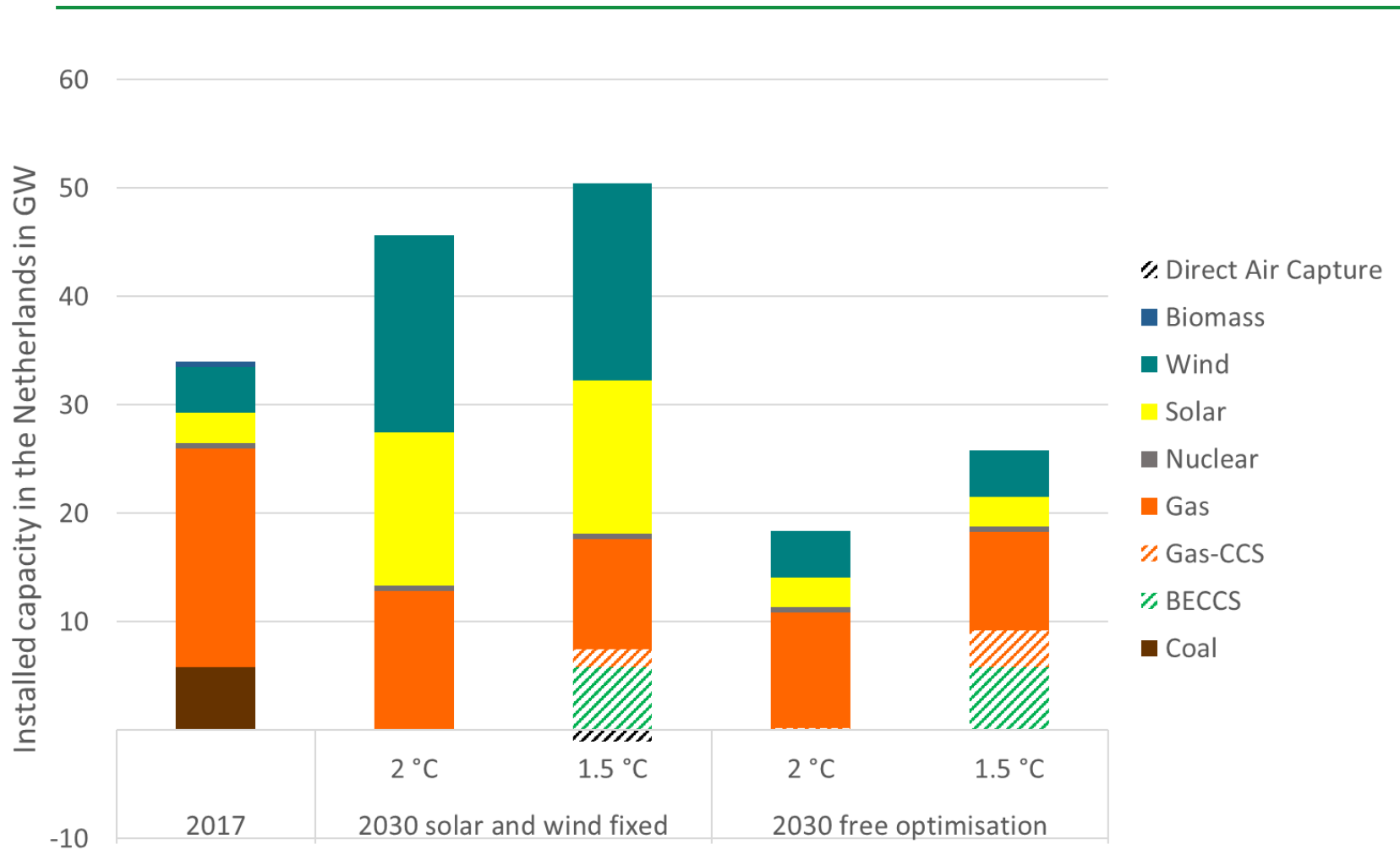
Follow electricityMap.org



European power system in 2050



Dutch power system in 2030



Role of CCS in long term strategies

	Coal	Biomass	Natural gas	Blue H ₂ from NG	Electrolysis H ₂ (electrification)
Electricity t/MWh (410)	85	-925	40 (Allam 0)	60	x
Transport g/km (200)	Gasify + FT	Several processes	Gasify + FT	20	340 → 0 (115 → 0)
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