

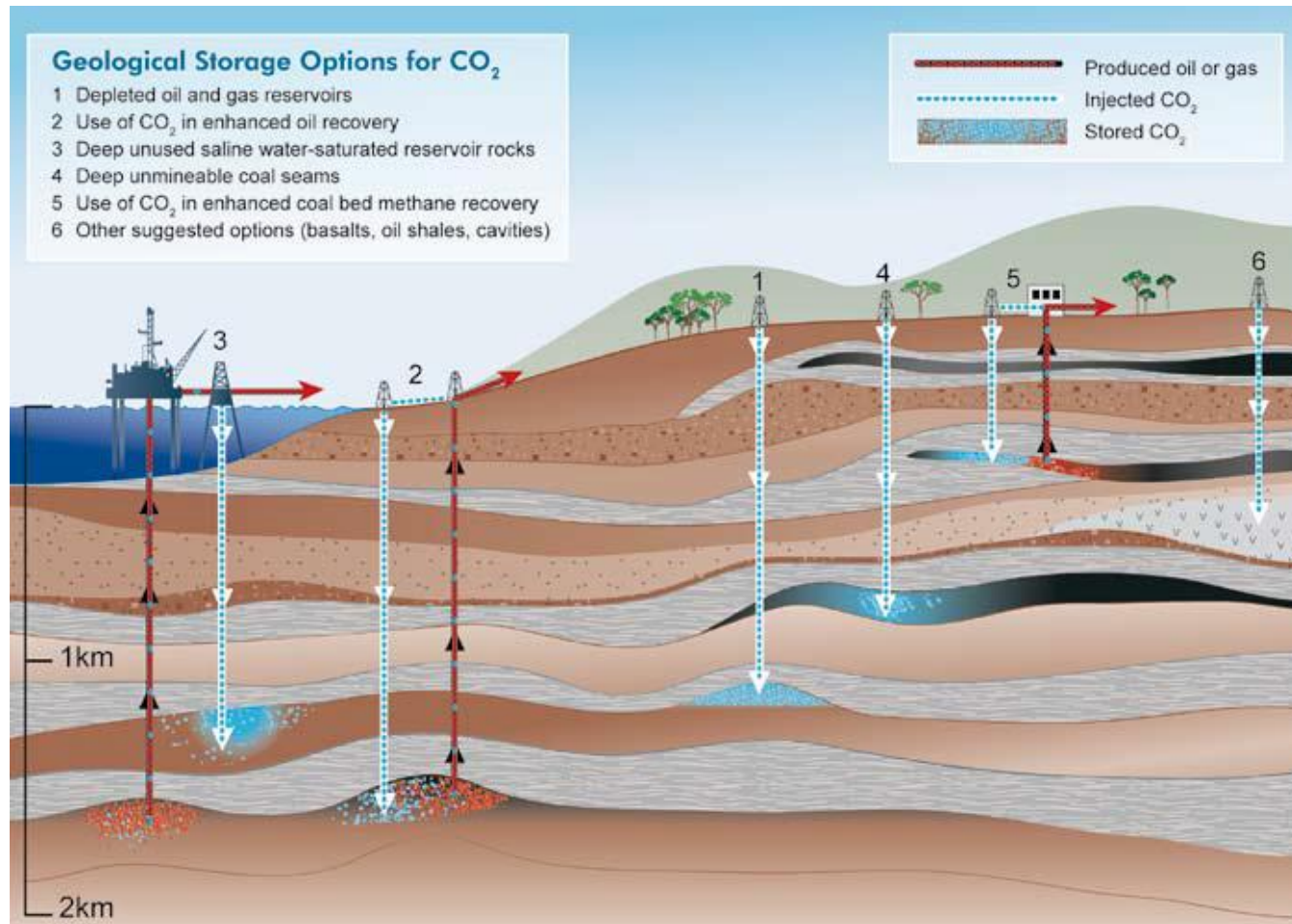
Can CCS and CCU contribute substantially to reach “net zero”?

Current Situation in Germany and Japan

Martin Cames, Laura von Vittorelli | Zoom | 26/01/2022

Introduction: Economic aspects, utilization potentials, GHG mitigation contribution, and environmental risks

Option for CO₂ storage



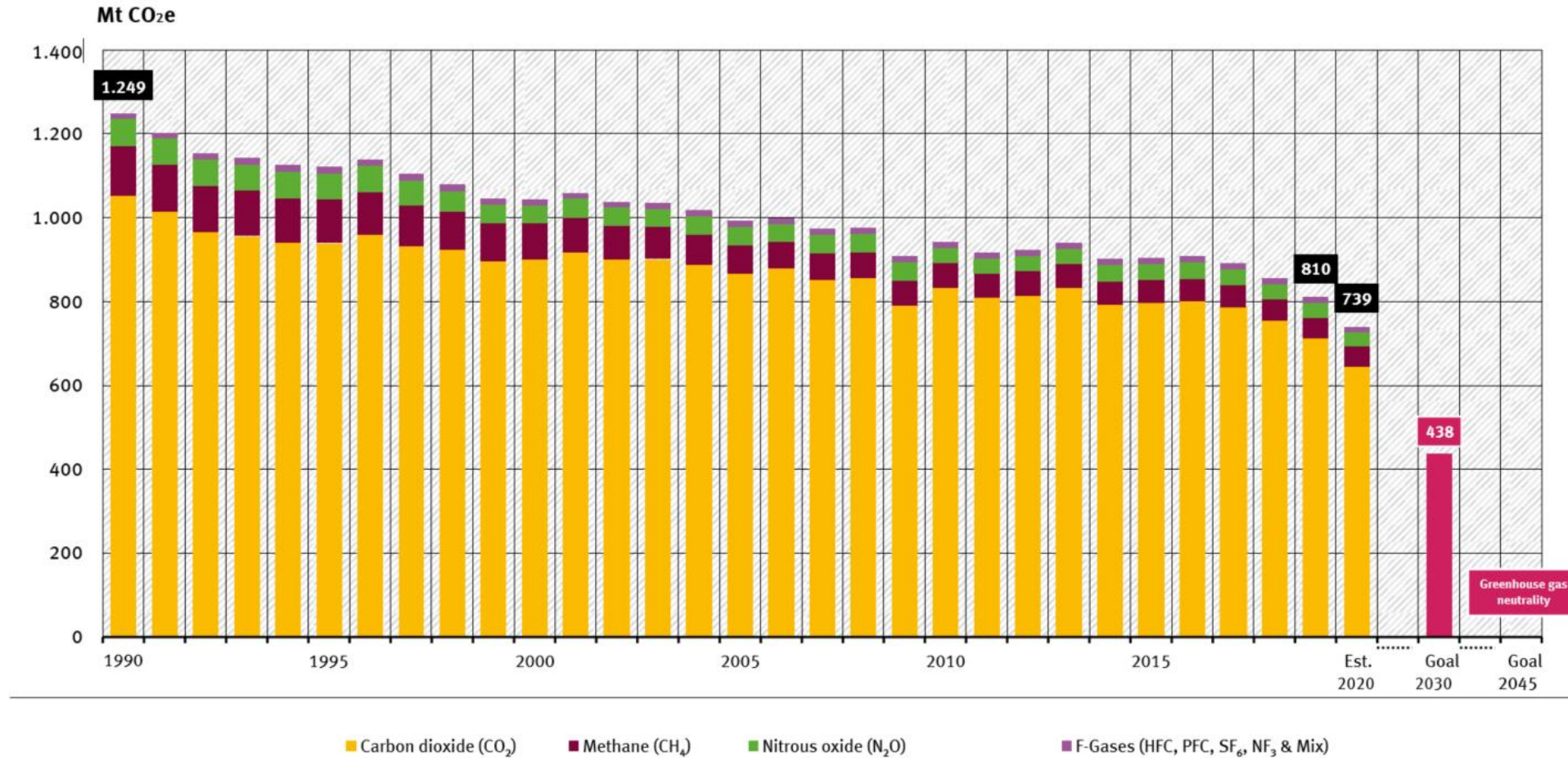
Potentials, risks, challenges

- Potentials
 - Estimates for global storage capacity: 8,000 to 55,000 Gt CO₂
 - IPCC: storage capacity no limitation to scenarios with NET
- Risks
 - Transport through: pipelines, trains, trucks, ships
 - Accidents during capture, transport and injections: emissions and victims
 - Leakage from reservoirs (0.003%/a): emissions
 - Key to avoid leakage: good monitoring
- Challenges
 - Capture, transport and injection require (renewable) energy
 - Energy need increases with disproportionately with the capturing rate

Germany: energy and climate policy background

- 2019: Climate Change Act (CCA) adopted
 - Decarbonisation by 2050
 - Emission targets per sector
- 2021
 - Constitutional Court requested review of the CCA since it was incompatible with the fundamental rights of future generations
 - Old government advanced the decarbonisation to 2045 (see figure on next slide)
 - Coalition agreement of the new government: increased targets
 - Renewable energies: 80% (65%) of gross electricity by 2030
 - Phase out coal power generation ‘ideally’ by 2030 (2038)
 - Need of negative emission technologies for 5% of unavoidable emissions (cement, agriculture: 40-100 Mt CO₂)

Germany: greenhouse gas emissions by gas and reduction target

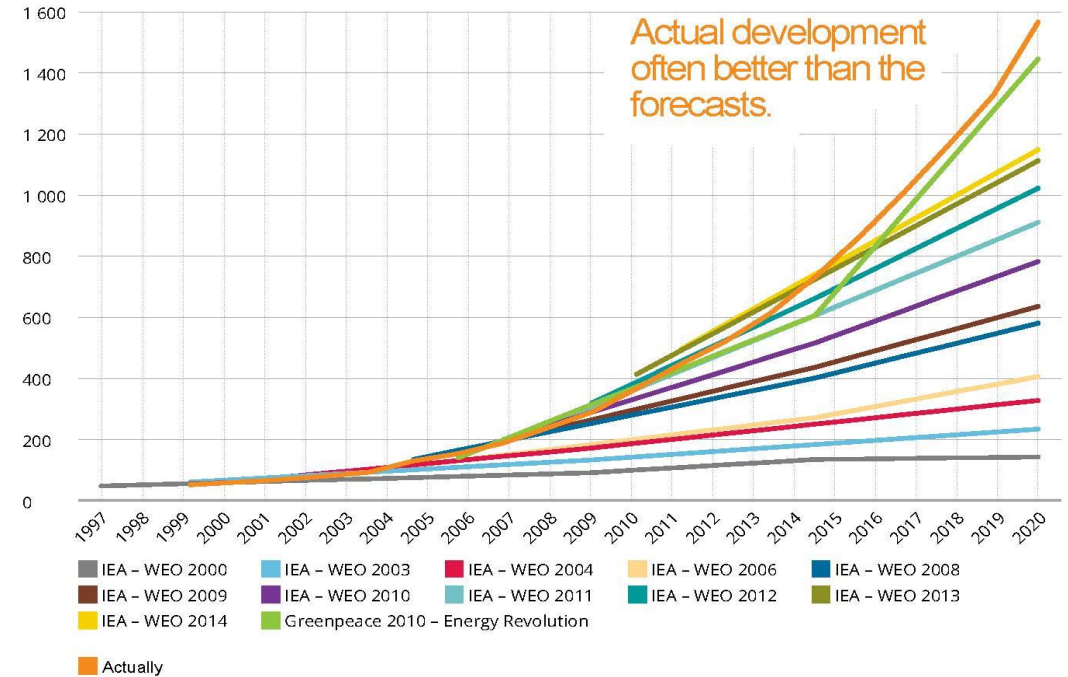
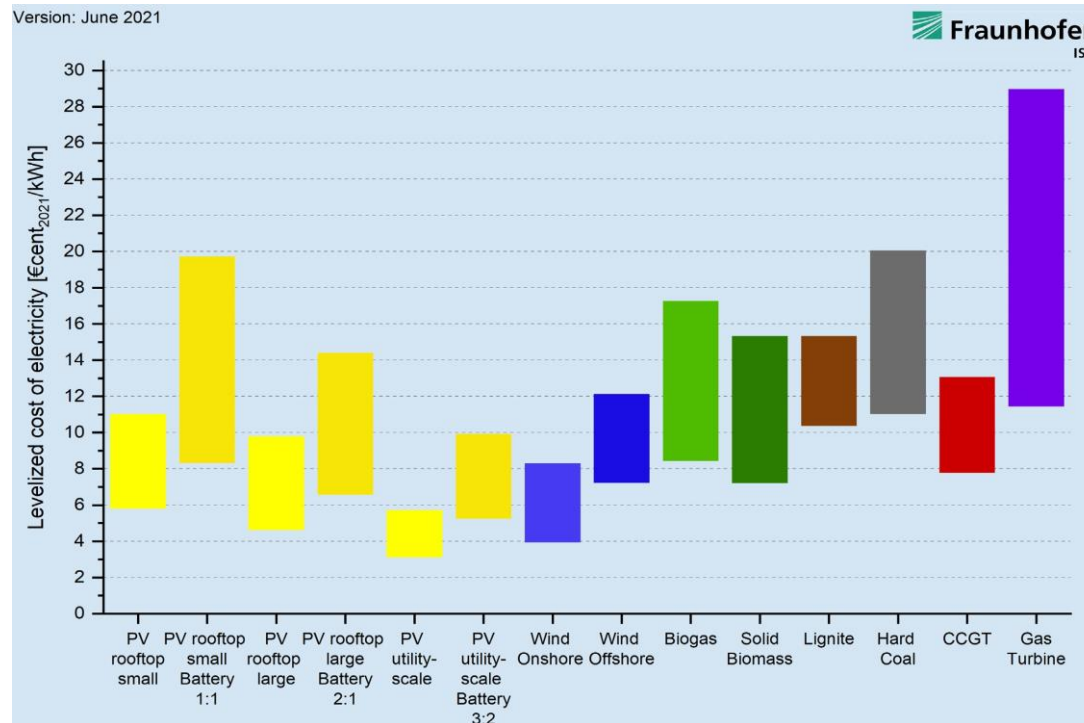


Germany: cost ranges for capture, transport and storage

	USD/t CO ₂	
Total		
Price range	Low	High
Power plants	54	142
Iron & steel	76	142
Cement	73	211
Basic chemistry	43	73
Steam reforming	32	99
DAC low temperature (2030)	123	248
DAC high temperature	117	585

- Dispersed source: 100-600 USD/t CO₂
 - Negative emission technologies towards mid century
 - Synthetic fuels in aviation and maritime transport (heavy to abate sectors)
- Point source: 32-211 USD/t CO₂
 - CCS costs need to be added to production cost
 - Unlikely for power generation since renewable electricity are becoming more and more competitive

Germany: renewable electricity generation



- Levelized cost of renewable electricity already competitive with fossil
- Expansion of renewables historically faster than forecasted

Germany: perception of CCS

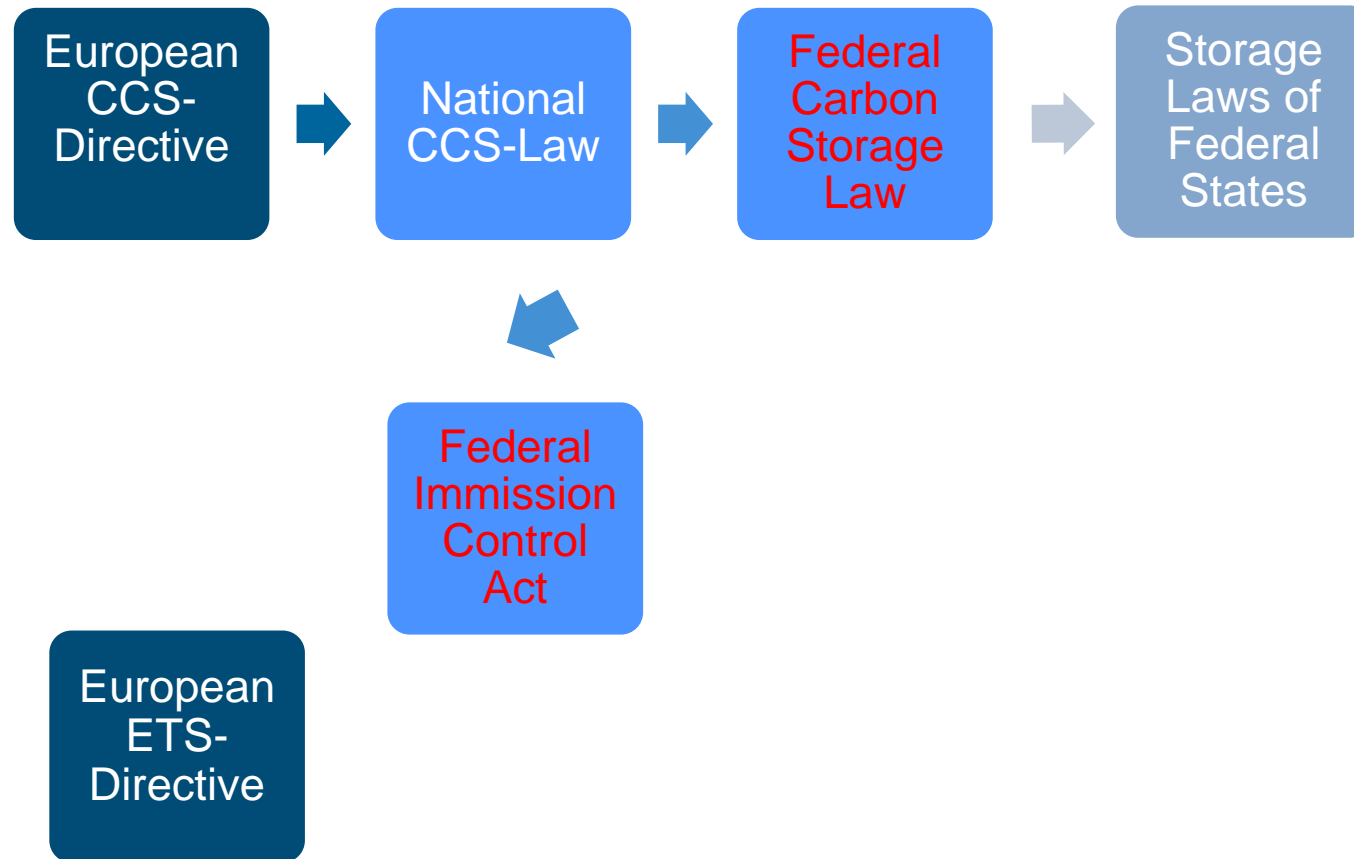
- CCS was discussed as lifetime extension for coal power plants (clean coal)
- Large majorities of the population preferred decarbonisation strategies to be based on renewable energies rather than fossil technologies
- With coal phase out by 2030 CCS is being reconsidered as option to address unavoidable emissions
 - 1) Reducing GHG emissions to the extent possible, particularly all CO₂ from fossil source
 - 2) CCS for heavy-to-abate point sources (cement, lime, etc.)
 - 3) Compensating heavy to abate diffuse GHG emissions such as from agriculture through negative emissions technologies
- Focussed use for certain sectors
- No significant contribution to 2030 targets

Overview of political and regulatory Status Quo of CC(U)S in Germany and the EU

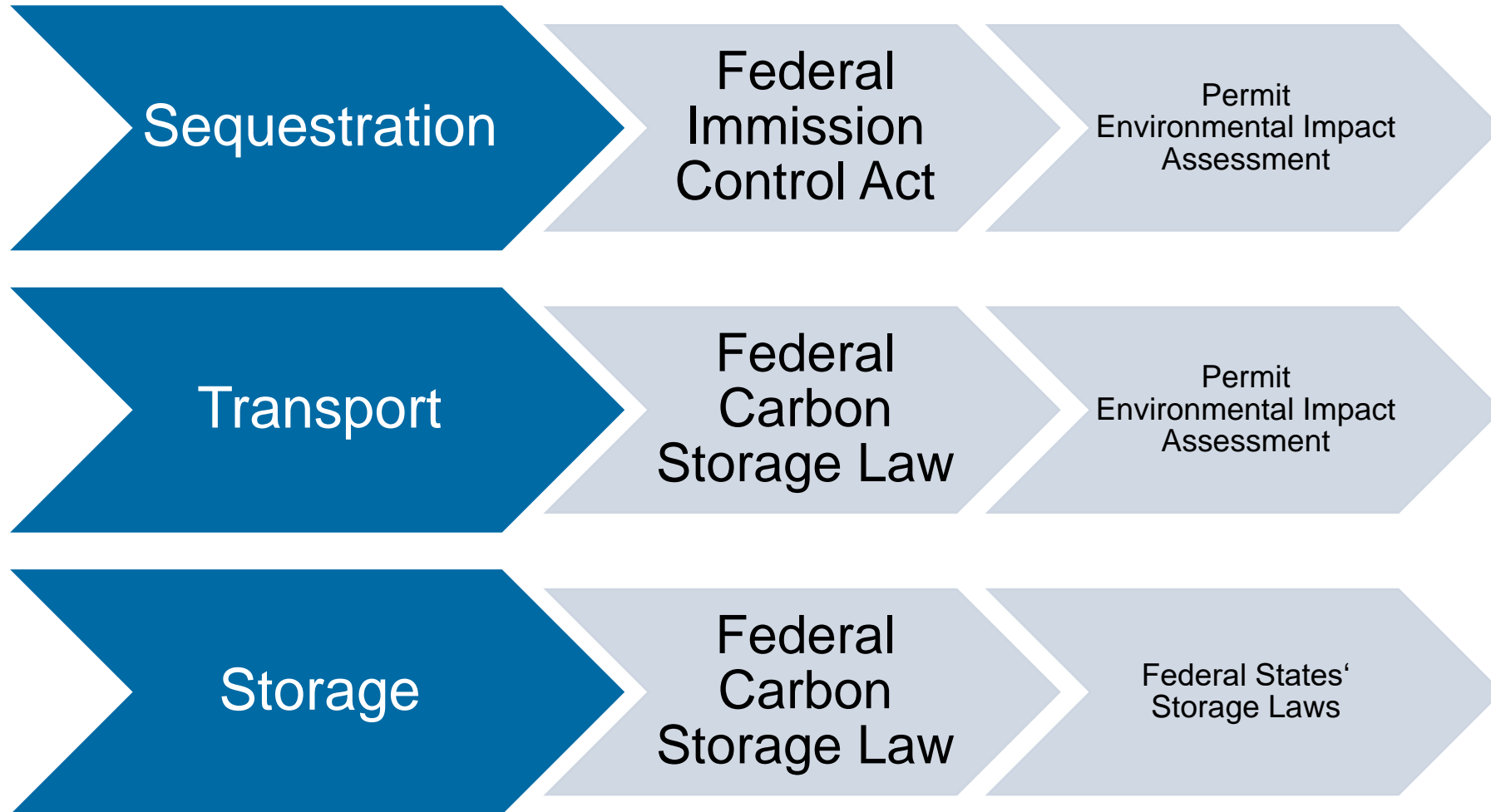
International Framework – Law of the Sea

- Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (London Convention) and its Protocol (London Protocol)
- Within Exclusive Economic Zone (200 nautical miles)
- Allows sub-seabed storage
- Permits must be issued, extensive obligations
- Transport to other countries for CCS now permitted

European and national framework: main laws



Overview of the CCS-chain and regulations



Storage

- EU- CCS Directive allows Member States to:
 - Say no to CCS all together or limit it
 - Sets a framework for sequestration, transport, storage
- Federal Carbon Storage law sets three limits
 - (1) Amount of carbon stored
 - (2) Applications till end of 2016
 - (3) Federal States can opt-out

→ Most important federal states opted out of CCS

EU ETS-Directive

- CCS is included
 - Stored carbon is considered “not emitted”
- CCU only partially
 - Only PCC (precipitated calcium carbonate)

→ Reform of the ETS-Directive

Planned policies by EU

- Carbon storage in CCS/CCU
 - By 2050 200 Mt industrial carbon removal with CC(U)S
 - By 2030 5 Mt annually of carbon from the atmosphere
 - Planned in 2022: Carbon removal certification guidelines (natural carbon sinks + technical solutions)
 - Update CCS guidelines (risk management, monitoring, financing)
- Promote CCU
 - Changing the ETS-Directive
 - Fuel sector (Aviation ReFuelEU, Renewable Energy Directive)
 - Financing research projects

Thank you for your attention!

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