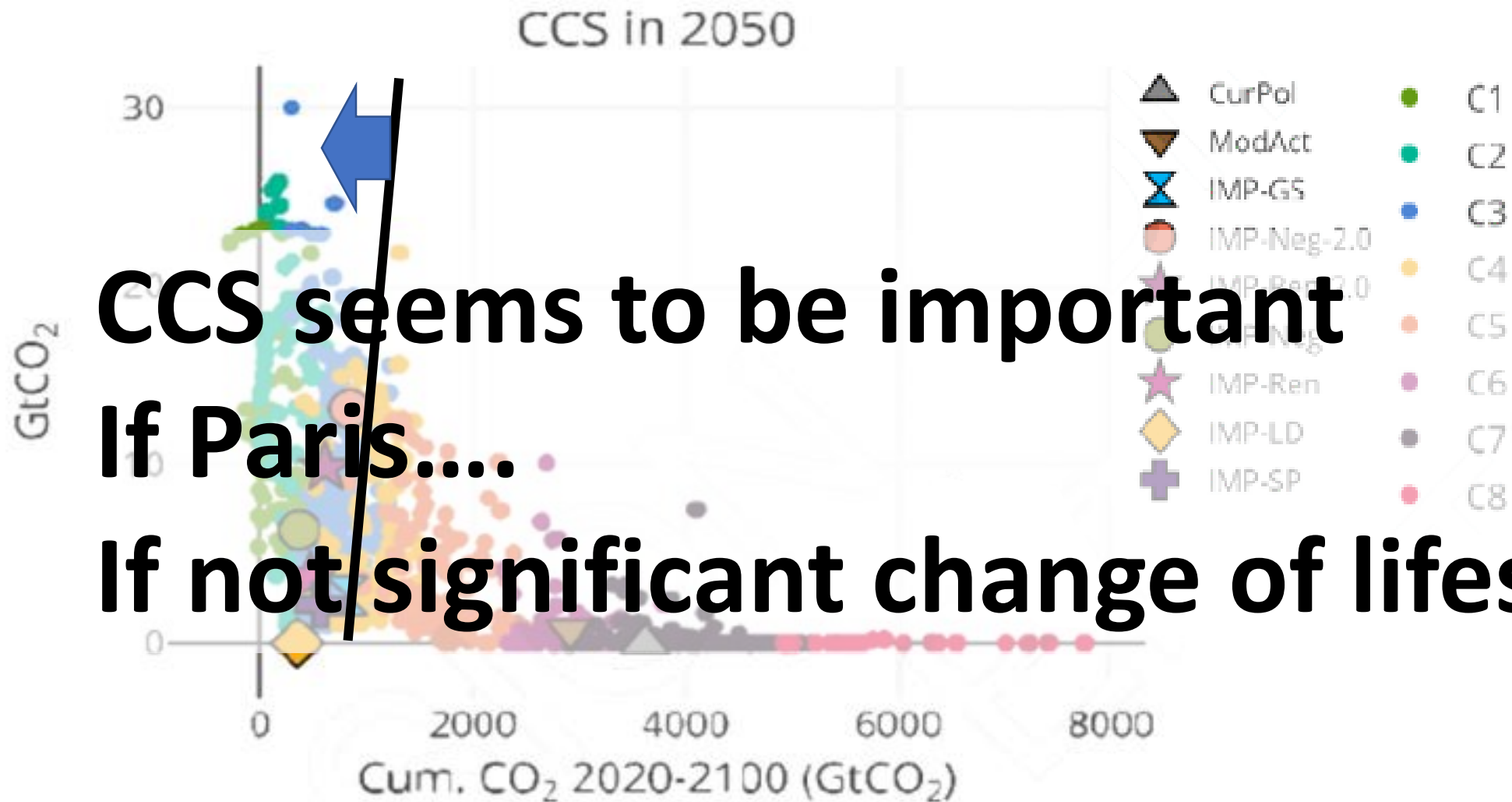


Carbon capture and storage (CCS) – the technology we need for our low carbon future?

Ståle Aakenes
Gassnova



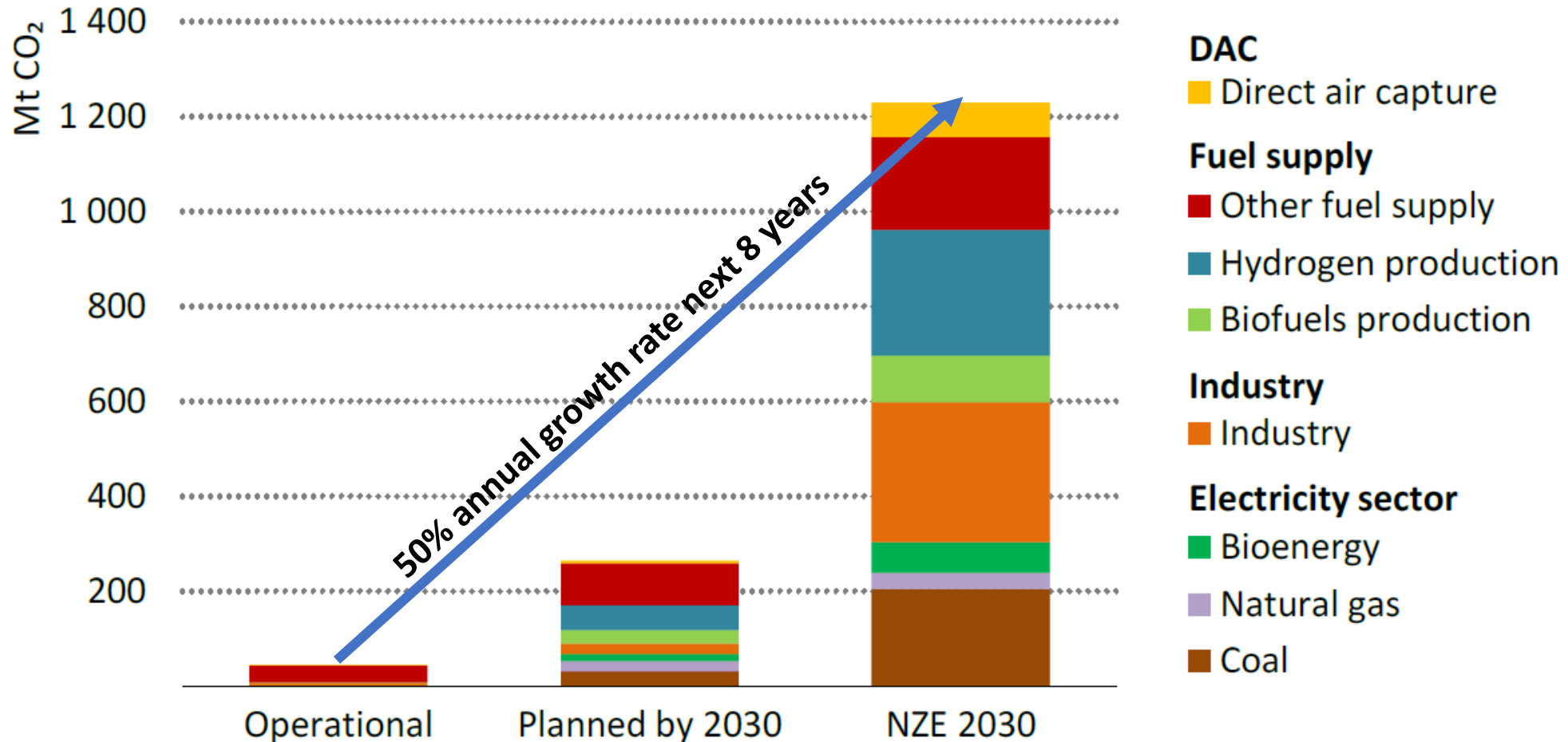
IPCC; Many scenarios aligned with Paris!



**CCS seems to be important
If Paris....**

If not significant change of lifestyle

Few projects realised so far – but huge expectations

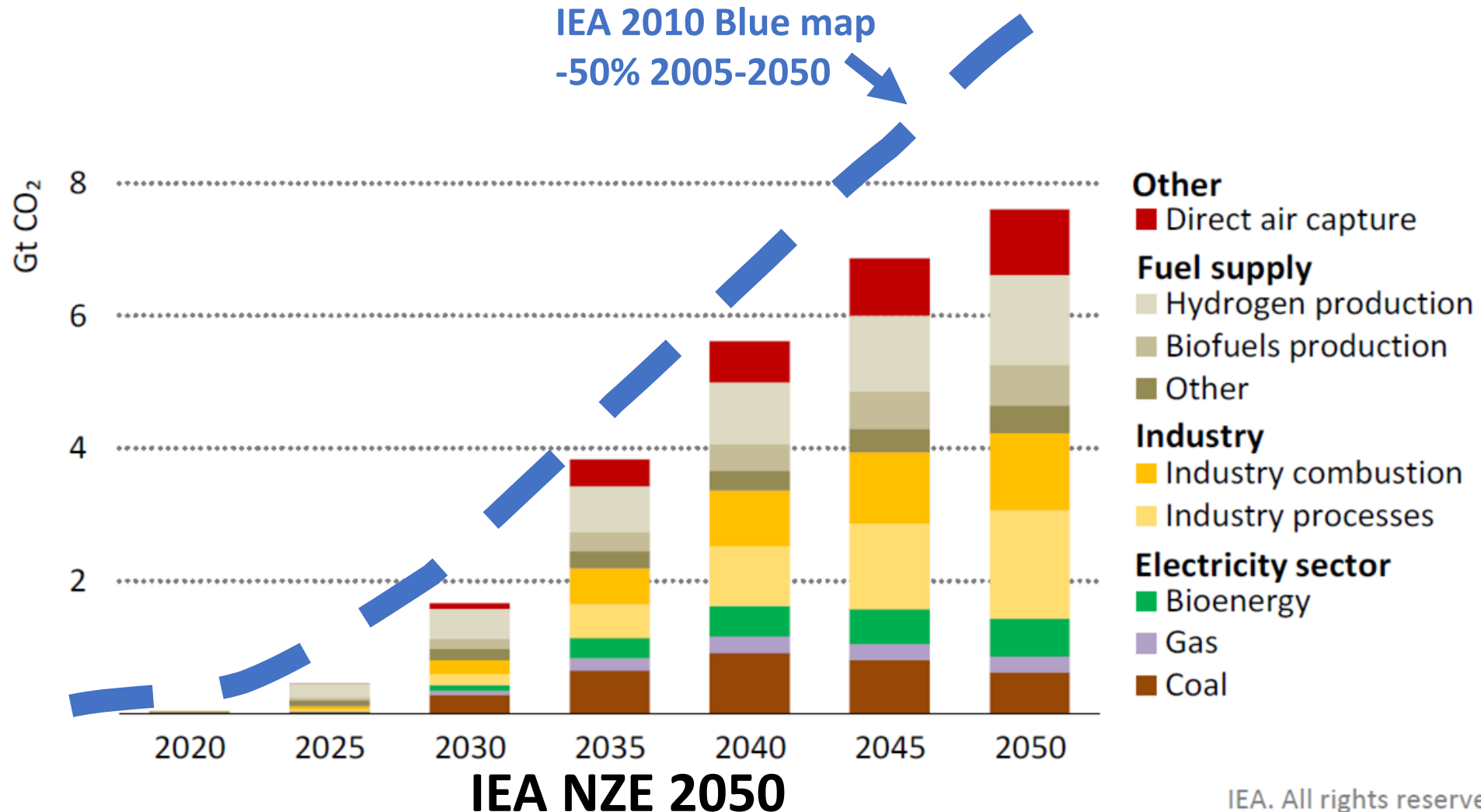


Source: IEA WEO 2022

Major market failures have hampered CCS development

- Negative externalities - Price of emitting CO₂ does not reflect the real cost
 - Coordination failures – Capture vs storage (Chicken and Egg)
 - Spill-over effects – From first movers
- Lack of possibility to make money (No business model)

IEA: CCS requirements in 2022 vs 2010 – difference?

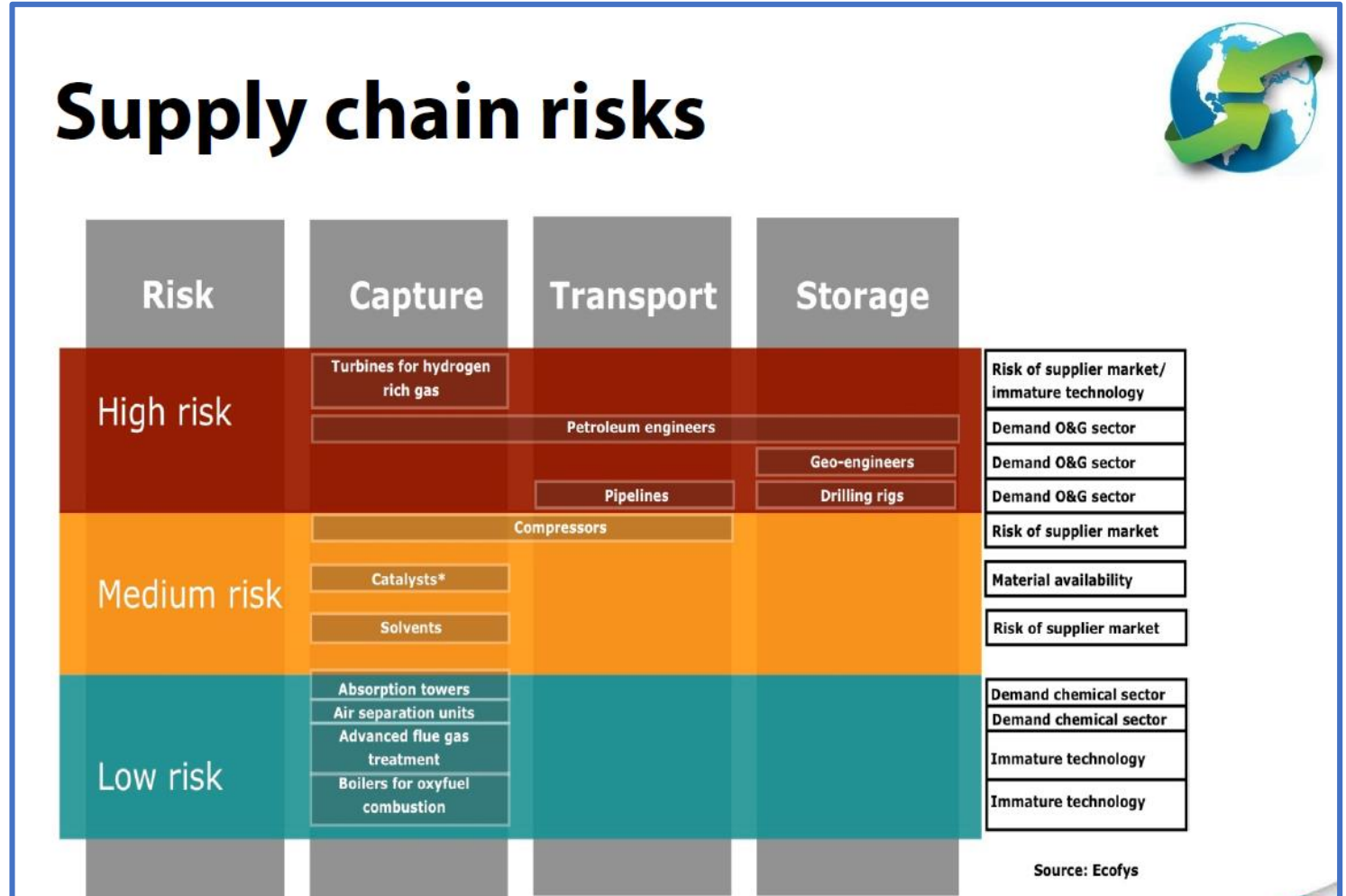


IEA. All rights reserved.

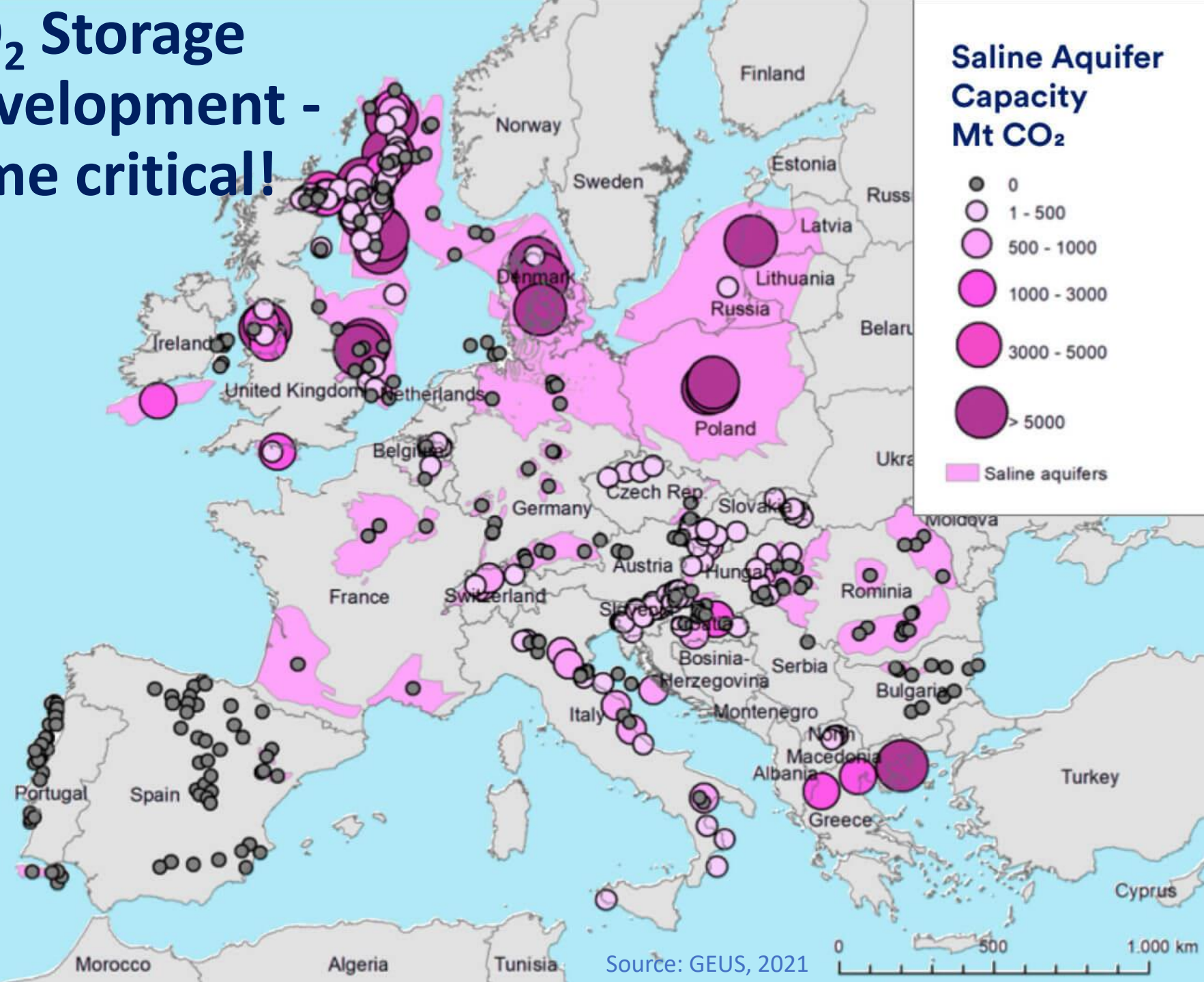
Realism as seen in 2012: Likely... but; Transport & Storage!

- Physical equipment
- People / competence
- Oil & gas industry in transformation
- Based on historical comparable cases

Source: IEAGHG 2012/09
Barriers to Implementation of CCS:
Capacity Constraints



CO₂ Storage development - Time critical!



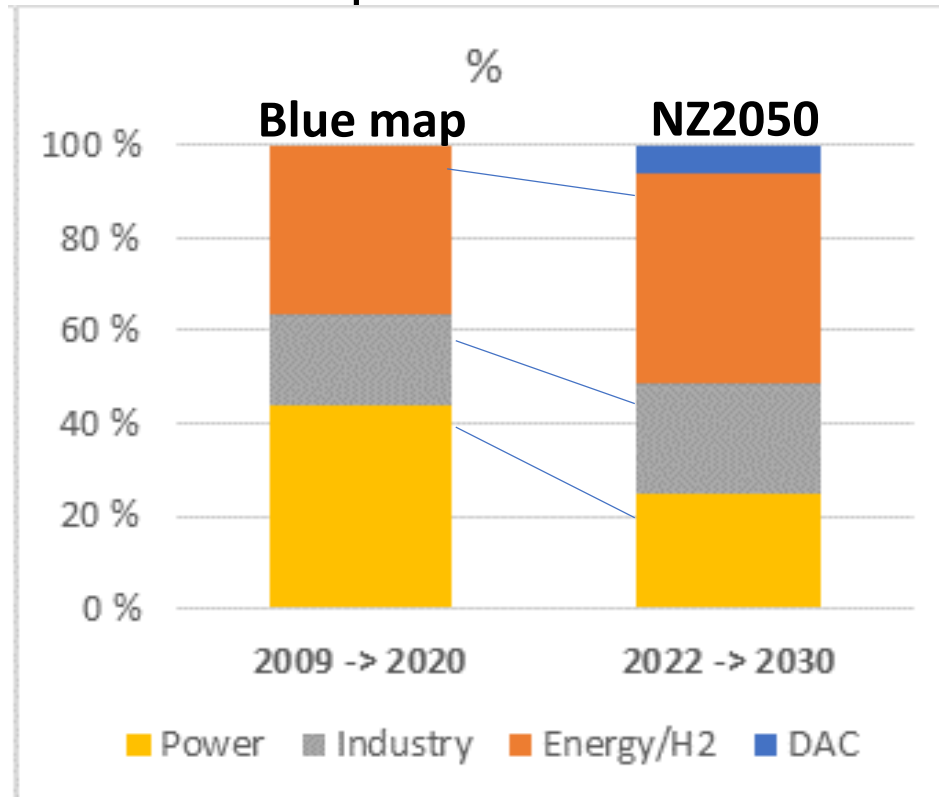
- Nature based
- Capacity mapping
- Risk considerations
- Regulations
- Distance
- Communication
- Appoint operator

→ Time

→ Cost

Another mix → implications?

CCS next decade per sector



Sources: IEA Technology Roadmap 2009
IEA World Energy Outlook 2022

Increased diversity & complexity

- Power – changed focus
- Industry – diverse sources
- H2 – systems integration
- CDR / DACCS – Compensate
- CCU / SAF – replace fossil C

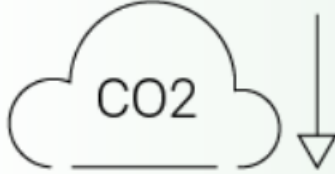


Reducing emissions from point sources → Transforming the energy system



US Inflation Reduction Act

CCS bonanza ahead?

- Significantly improved incentives for CCS
- Predictable value
- Adds to other support (like H2)
- 12 years operation
- Include also small point sources
- Large, although varying expectations by 2030

Carbon capture tax credit would increase under Inflation Reduction Act (\$/tonne)		
	Current	Inflation Reduction Act
		POINT SOURCE DIRECT AIR CAPTURE
UNDERGROUND STORAGE 	\$50	\$85 \$180
UTILIZATION 	\$30	\$60 \$130
UTILIZATION IN ENHANCED OIL RECOVERY 	\$30	\$60 \$130

As of July 28, 2022.
Sources: Clean Air Task Force; S&P Global Commodity Insights

Summing up?

- **Is there a need for CCS?** Yes, likely
- **Has the need for CCS changed?** Not really, but broader
- **Is it doable?** Probably, at least technically, but.....
- **Then what?** Business models – to speed up progress
Storage capacity building – chicken&egg

Thank you!

Ståle Aakenes

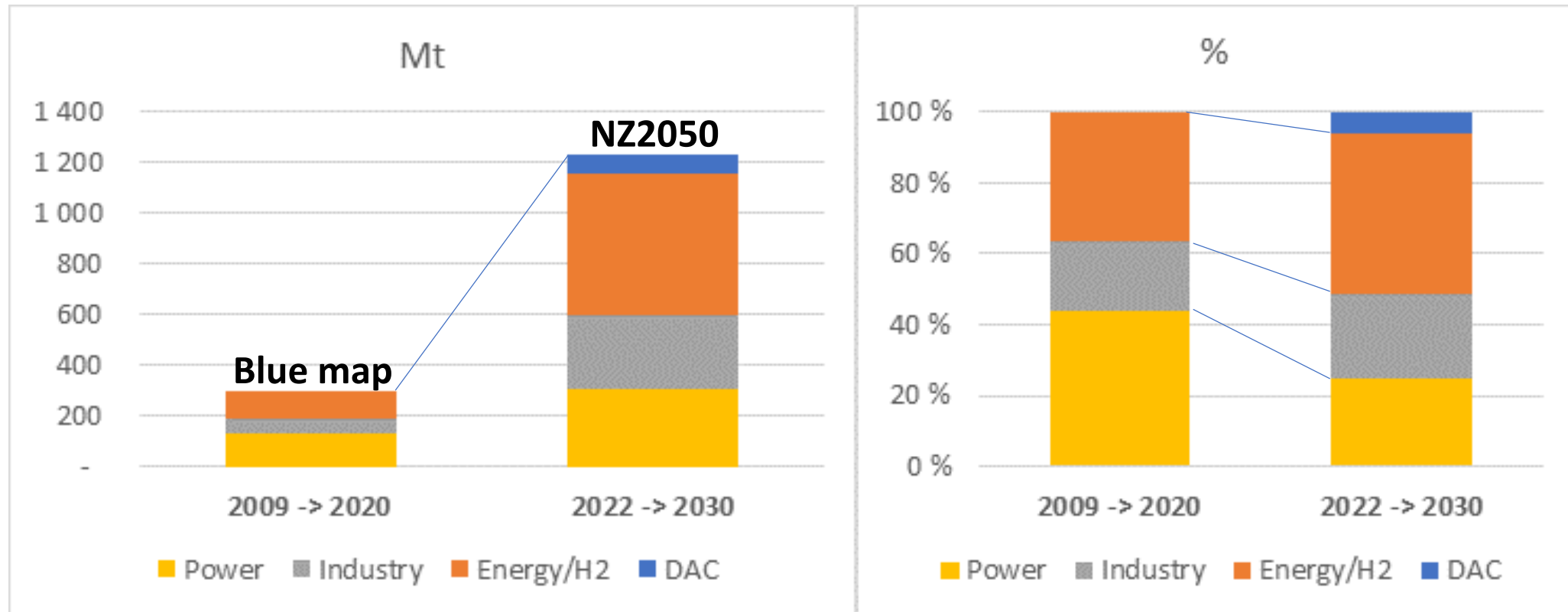
sa@gassnova.no

90 88 50 36



Next decade → Speed, diversity, complexity

CCS next decade (backcasting) per sector



Sources: IEA Technology Roadmap 2009
IEA World Energy Outlook 2022

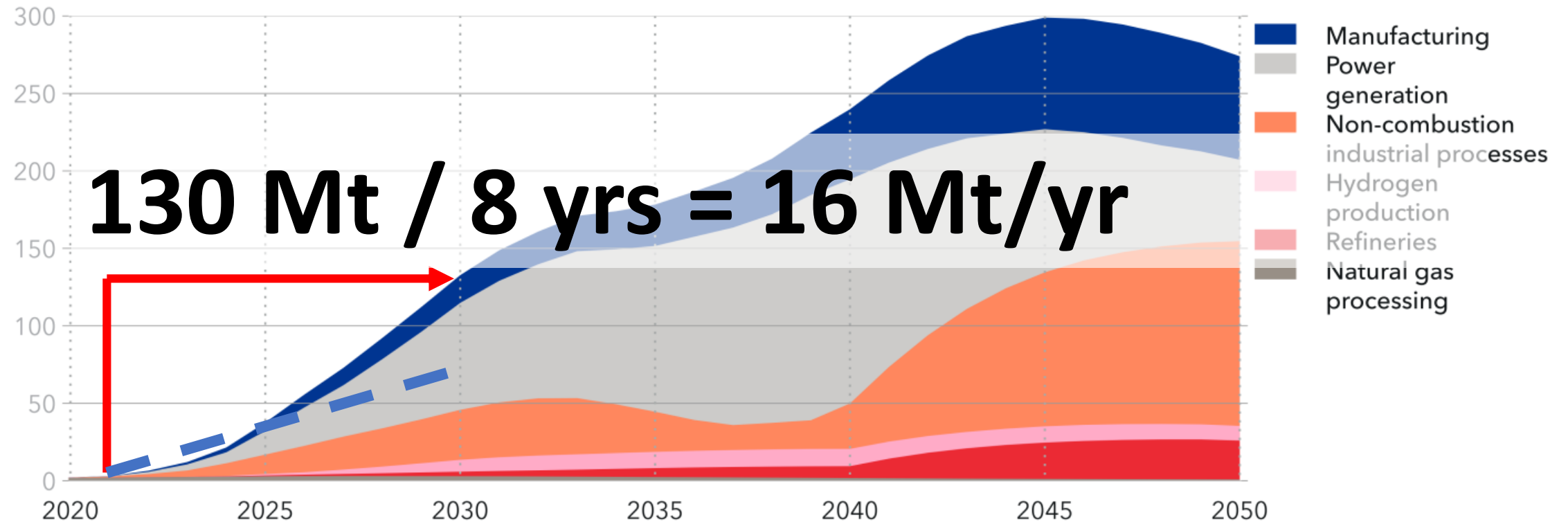


Integrated value chains and new business concepts ahead

Where should we be in 2030?

Europe CO₂ emissions captured (forecast)

Units: GtCO₂/yr



Source: DNV – Energy Transition Outlook 2022

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