CO_2 quality challenges through the CCS value chain

CCS Conference - June 14, 2022

About DGC

Danish Gas Technology Centre

- Danish Gas Technology Center
  - was established in 1988
  - is owned by Evida (86,1%) and Energinet (13,9%) until June 30, 2022 – after that Evida (100 %)
- Around 30 employees.
- Turn-over 4.5 million € (2021).
- DGC is a specialized supplier of R&D, consultancy, measurements and assessments.
- Key areas of expertise include green gas (biogas, bio natural gas, hydrogen, CO_2) application, quality, safety and environmental performance.
- DGC holds a laboratory, accredited (EN 17025) to test gas appliances and to make gas analysis.
- Test Centre for Green Gases with stationary and mobile test facilities.
- DGC is EU Notified Body for gas appliances and boiler efficiency.

About ConsenCUS

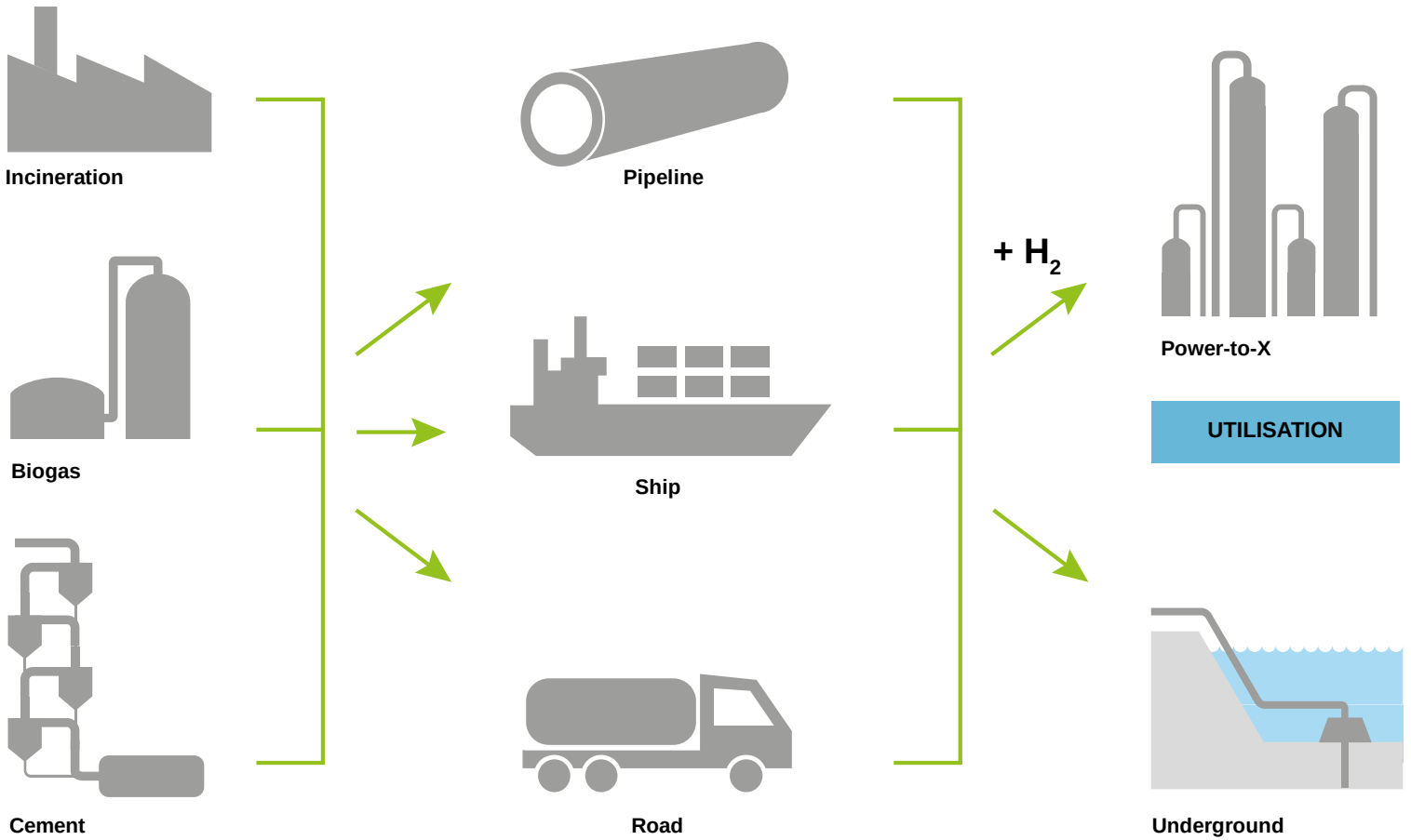
- 19 partners
- Duration: May 2021-May 2025
- Total cost: 13.9 mill €

- Demonstrating CO_2 capture technology at industrial sites.
- Life-cycle analysis and techno-economic evaluation for CCUS.
- Design of CO_2 clusters and carbon value chains.
- Address socio-economic and political barriers for CCUS.

https://consencus.eu/

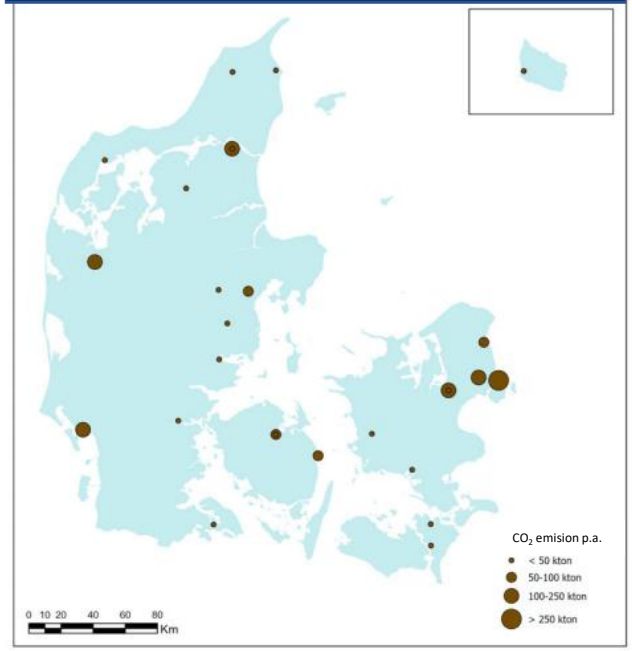
This project has received funding from the European Union's Horizon 2020 research and Innovation programme under grant agreement N° 101022484.

CO_2 Value Chain

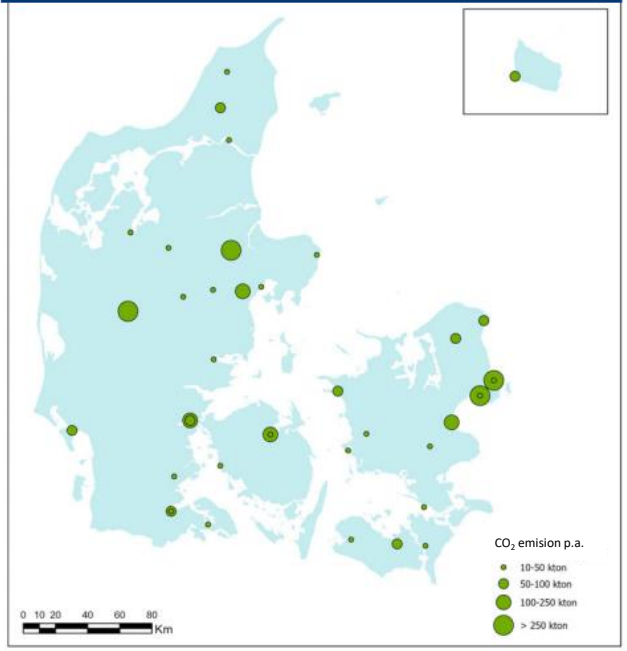


CO_2 point sources in Denmark

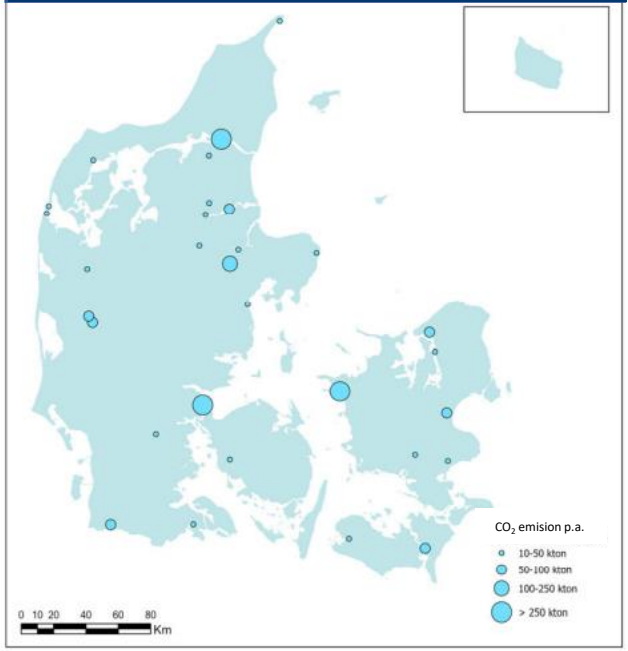
Waste incineration



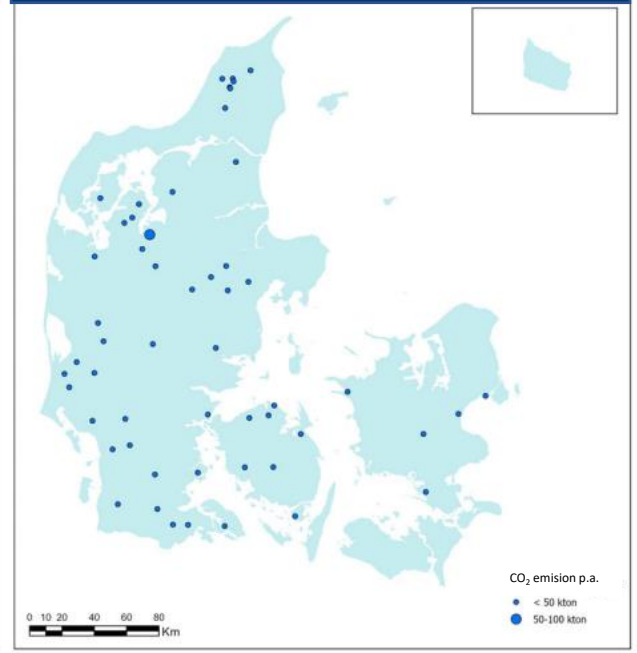
Selected power and district heating plants



Large industrial plants



Biogas upgrading



Ref: ENS

Sources of biogenic CO_2 in Denmark

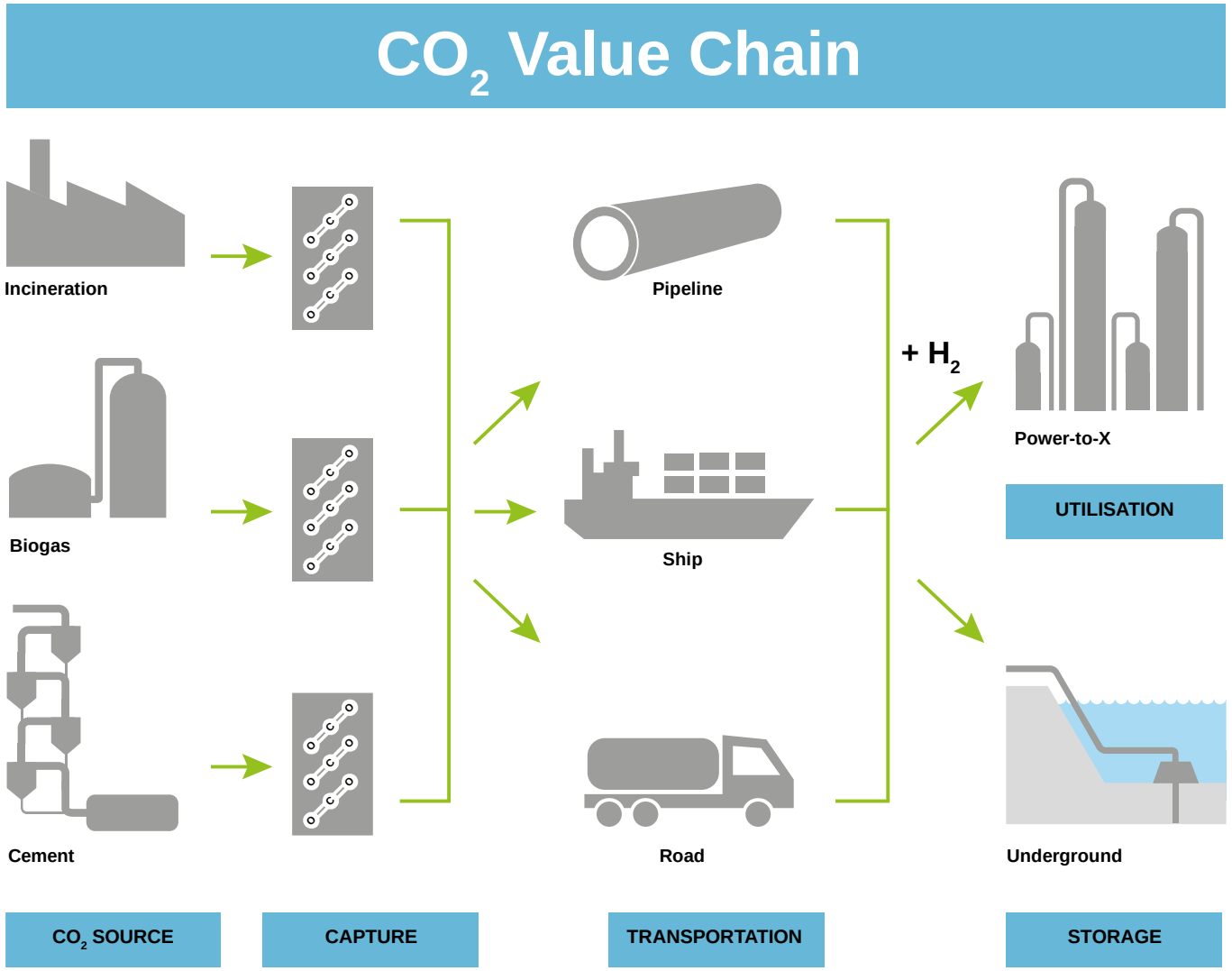
- Approx. 765,000 ton CO_2/yr from 36 biogas plants alone.
- Additional CO_2 from biomass, waste incineration and industry
- Evida focuses on transporting CO_2 from sources to ports for CCS or e-fuel production

CO_2 quality: CO_2 is not just CO_2 …

- Depends on
  - Source
  - CO_2 capture technology
  - Means of transportation
  - Utilization
  - Storage site
- CO_2 quality limits depends on
  - Operating properties
  - Health and safety
  - Material selection
  - Application

CO_2	H_2S	Aromatic hydrocarbons	Cd, Tl
H_2O	Total sulphur	Formaldehyde	Particulates
H_2	CH_4	Acetaldehyde	Oil and grease
O_2	NO_x	Methanol	Terpenes
N_2	CO	Ethanol	Nitrosamines
Ar	Amine	HCN	Nitramines
SO_x	NH_3	Hg	Glycol

.. List not exhaustive



Examples of CCS value chain

	Transported by	Phase	Operating pressure bar g	Operating temperature °C
Northern Light, Equinor/ Shell/TotalEnergies, Norway, 2019	Ship	Liquid	13-18	Around -26
Porthos, NL, 2021	Onshore and offshore pipeline	Gas (onshore) Dense (offshore)	35 (onshore) 130 (offshore)	
Fluxys Belgium	Onshore pipeline	Gas	20-33	20-40
EOR onshore pipeline, KinderMorgan, US, 2019	Onshore pipeline	Supercritical	Typical 137-207 Minimum 89	Max 49

References: Northern Light – Porthos – KinderMorgan – Fluxys

Examples of CCS value chain: CO_2 quality #1

	CO_2	H_2O	H_2	O_2	N_2	Ar	SO_x	H_2S	Total sulphur	CH_4	NOx	CO
	%, min	ppm	ppm	ppm	%	%	ppm	ppm	ppm	%	ppm	ppm
Northern Light, Equinor/ Shell/TotalEnergies, Norway, 2019		30	50	10			10	9			10	100
Porthos NL, 2021	95	70	7500	40	2.4	0.4		5	20	1	5	750
Fluxys Belgium	95	40	7500	40	2.4	0.4	10	5	20	1	5	750
EOR onshore pipeline, KinderMorgan, US, 2019	95	630		10	4			20	35			
Food and beverages application, EIGA	99.9	20		30			1	0.1	1		2.5	10

Examples of CCS value chain: CO_2 quality #2

	Amine	NH_3	Aromatic hydrocarbons	Formal-dehyde	Acetal-dehyde	Methanol	Ethanol	HCN	Hg	Cd, Tl	Non-volatile residue	Non-volatile organic residue
	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm w/w	ppm w/w
Northern Light, Equinor/ Shell/TotalEnergies, Norway, 2019	10	10		20	20				0.03	0.03		
Porthos, NL, 2021	1	3	0.1	10 (total aldehyde)		620	20	2				
Fluxys Belgium	1	3	0.1	10 (total aldehyde)		620	20	2	0.03	0.03		
EOR onshore pipeline, KinderMorgan, US, 2019												
Food and beverages application, EIGA		2.5	0.02		0.2	10		0.5			10	5

How to measure and what to measure

- Detection limits will be different from flue gas measurement in online measurement.
- Many impurities can already be measured.
- DGC are developing new methods for more components.

CO_2	H_2S	Aromatic hydrocarbons	Cd, Tl
H_2O	Total sulphur	Formaldehyde	Particulates
H_2	CH_4	Acetaldehyde	Oil and grease
O_2	NO_x	Methanol	Terpenes
N_2	CO	Ethanol	Nitrosamines
Ar	Amine	HCN	Nitramines
SO_x	NH_3	Hg	Glycol

Thank you for your attention

Kate Harboe – kha@dgc.dk