

CARBON LIMITS

Value creation of decarbonization through French and Norwegian examples

Quick study performed for the ClubCO₂ – *March 2021*



Decarbonization is a cost for the industry with not enough incentives as of today to make it a business
But if the industry is not decarbonized, the cost on society will be much higher

In France the objectives are clear and will be certainly reviewed to cope with the enhanced ambitions of Europe

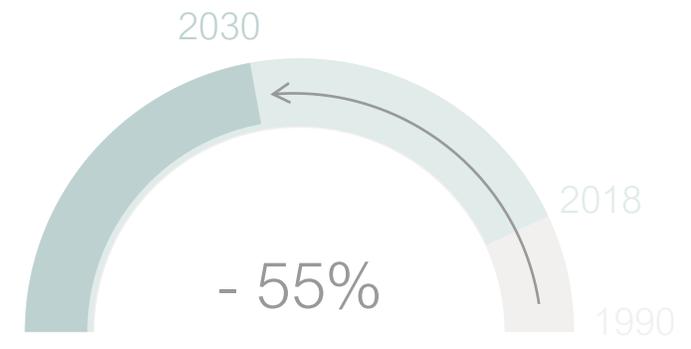
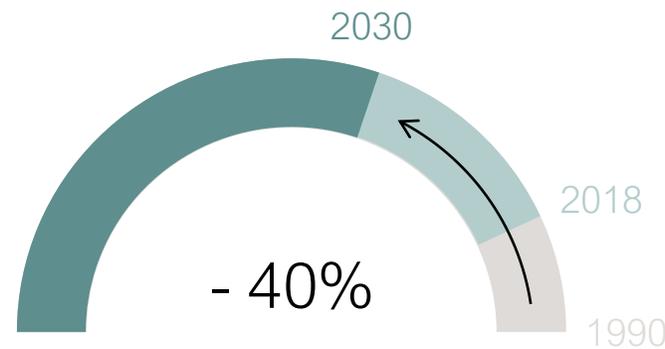
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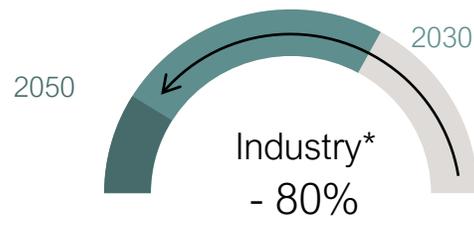
France



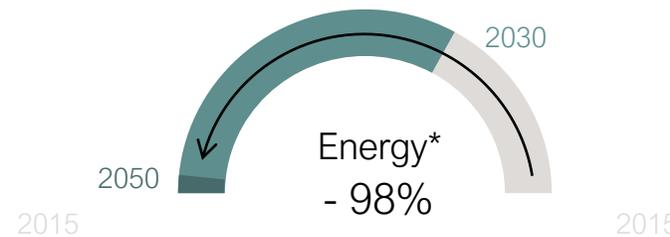
EU (December 2020)



Net-zero for 2050



Combustion and process



Almost fully decarbonized by 2050



Mostly CH₄

The example of Axe Seine study – Normandy region



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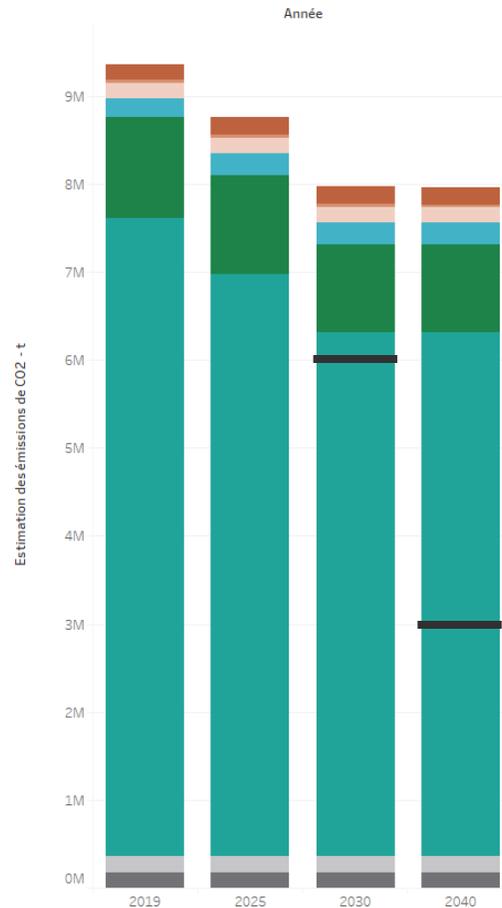
- Type of industries: refineries / chemical / petrochemical / waste incinerations
- The industrial partners were asked to complete a questionnaire where they had to quantify their emission reduction possibilities without CCUS



If CCUS is not applied on the industry, reaching the targets set out in the IPCC, the European Green Deal and the national strategies is impossible – *Example of Axe Seine Study (Normandy)*



Evolution temps - émissions



Secteur d'activité

- Fabrication d'autres produits chimiques inorganiques de base n.c.a.
- Fabrication d'autres produits chimiques n.c.a.
- Fabrication d'autres produits chimiques organiques de base
- Fabrication de gaz industriels
- Fabrication de produits azotés et d'engrais
- Raffinage du pétrole + Pétrochimie
- Traitement et élimination des déchets dangereux
- Traitement et élimination des déchets non dangereux

— Maximum indicative level of emissions according to SNBC scenario to achieve targets – equivalent level of efforts from all (no closure)

Need in CCUS: 2 MtCO₂/y in 2030 – 5/6* MtCO₂/y in 2050 along the Axe Seine

*Avis ADEME: https://www.ademe.fr/sites/default/files/assets/documents/avis-ademe-csc_france_2020-011234.pdf

The Example of Hauts de France

Dunkirk

1/5 around 1/5 of French industrial emissions



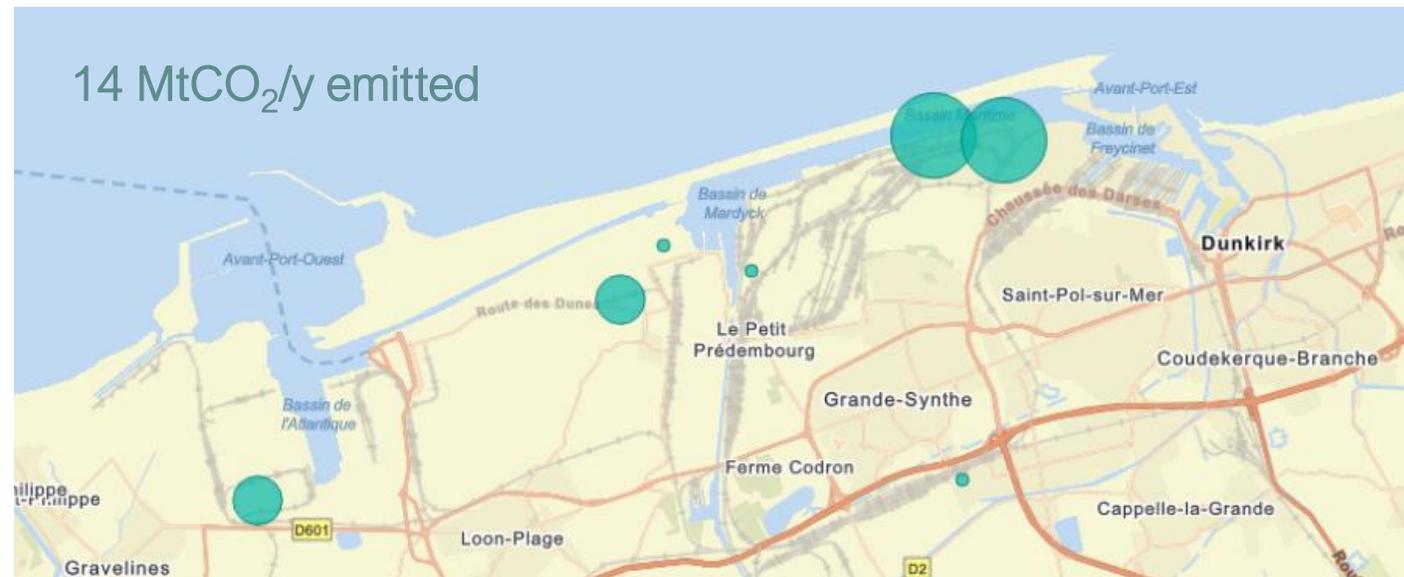
Largest energy platform in Europe (LNG terminal, nuclear plant, pipeline and electricity interconnections, large industry consumers)



Iron and steel / cement / manganese alloy / aluminum / petrochemical + a gas fired power plant



A consortium with public / private stakeholders is currently studying all CCUS options and building a CCUS roadmap for Dunkirk (also covering energy savings, energy efficiency, circular economy)



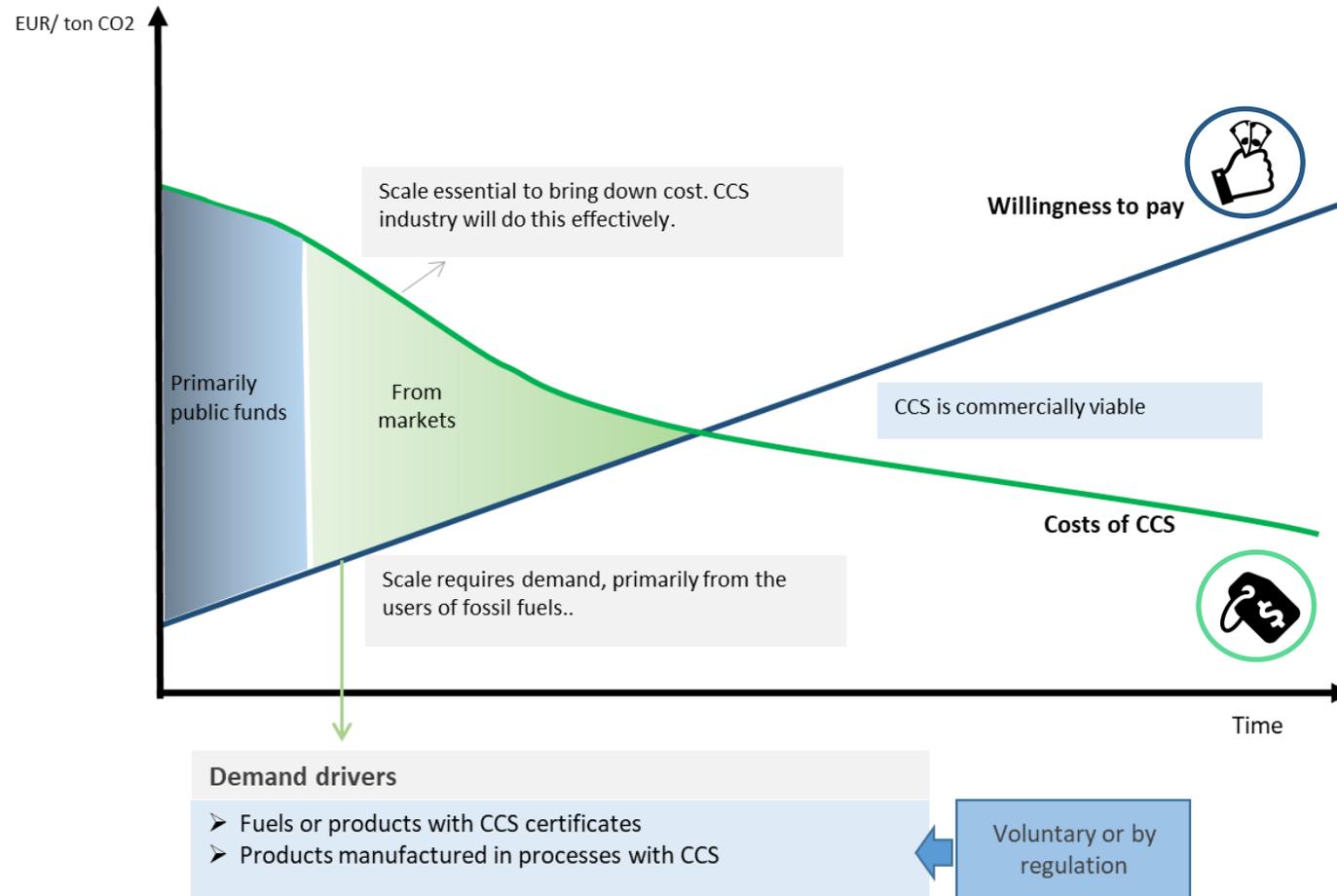
2 MtCO₂/y by 2030 to store and use (5 - 10* MtCO₂/y in 2050 depending on H₂ role)



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But CCS has a cost and for now it has to be subsidized to bring the cost of the technology down



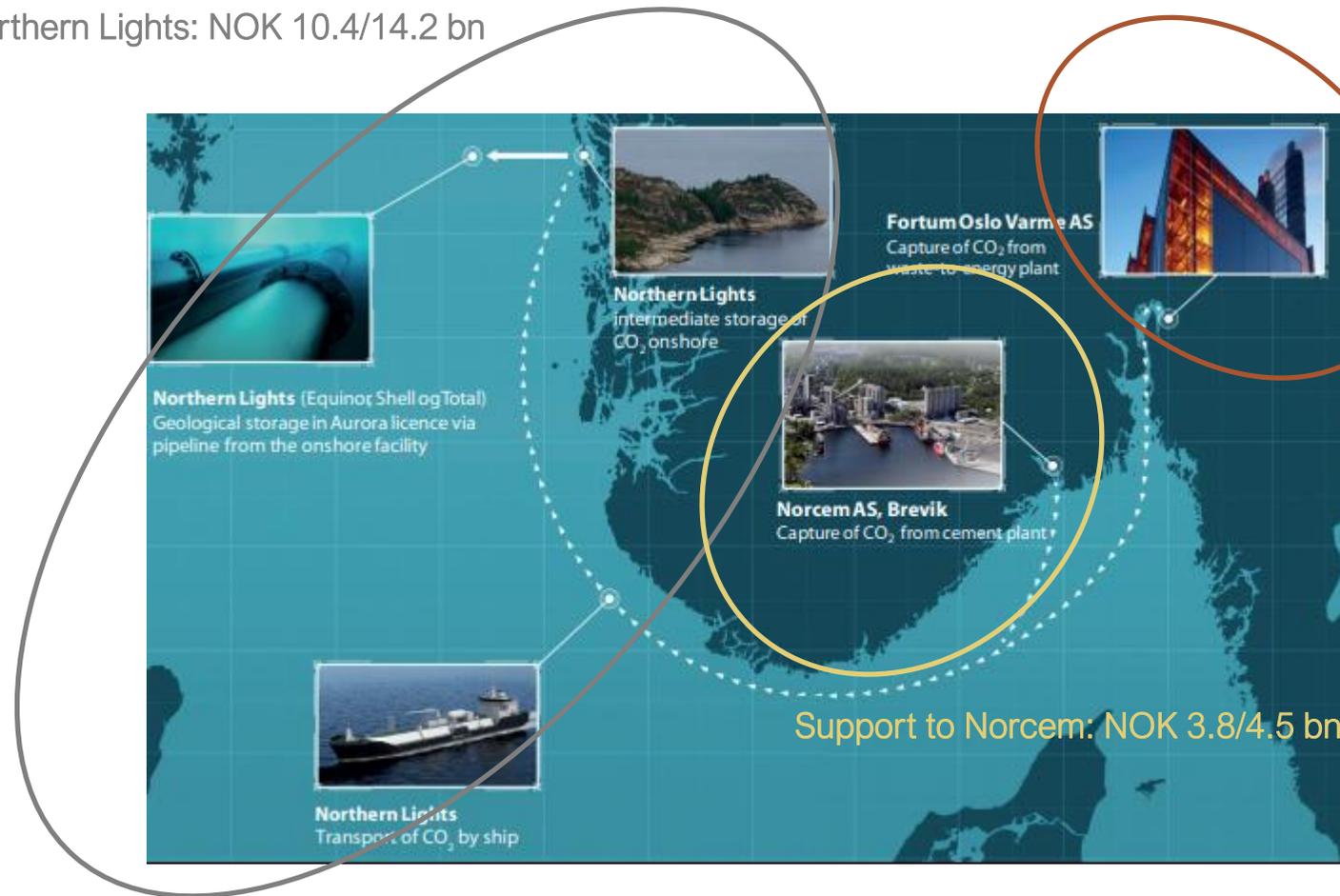
In Norway, the government decided in December 2020 to invest NOK 16.8 bn to support CCS deployment

Support for construction and over 10 years operation

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Support to Northern Lights: NOK 10.4/14.2 bn

Support to Fortum Oslo Varme AS
Varde: NOK 2.6/6.4 bn
Have to secure additional funding from EU Innovation Fund + other sources



<https://www.regjeringen.no/en/aktuelt/funding-for-longship-and-northern-lights-approved/id2791729/>

Source image: Gassnova

Source data: Table 6.1 - Longship – Carbon capture and storage — Meld. St. 33 (2019–2020) Report to the Storting (white paper)

Benefits of State Investment for Longship CCS

State aid for Longship



NOK 16.8 Billion

will create



10 – 20 MtCO₂ reduction from the initial projects
+ *some removed from the atmosphere if BioCO₂* considered*



 1,500 – 3,000 FTEs** in construction phase (*some in France for FOV facility*)

 200 jobs kept + 170 additional jobs during operation phase



600,000 tonnes of low carbon cement produced annually

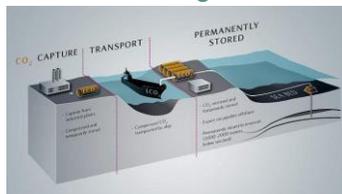


400,000 tonnes of low carbon waste burnt

CO₂-free heat production for 160,000 housing units



Northern Lights site



>0.7 Mt CO₂/y additional storage capacity to host third party volumes
+ *additional benefits from the emitters that will use this capacity*

Norwegian Ministry of Petroleum and Energy. Longship-Carbon Capture and Storage. Report to the Storting (white paper).

*12% CO2 emissions from biogenic origin in Norcem and 50% in FOV

**FTE= full-time employees

Employment prospects of CCS

CO₂ management in Europe (towards 2050)

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Current employment



Future employment linked to CCS industry



Direct jobs » Indirect jobs (ripple effects)



Low CCS scenario
50-170 MtCO₂/y

Medium CCS scenario
130-320 MtCO₂/y

High CCS scenario
390-1067 MtCO₂/y

	Current employment	Low CCS scenario 50-170 MtCO ₂ /y	Medium CCS scenario 130-320 MtCO ₂ /y	High CCS scenario 390-1067 MtCO ₂ /y
 Europe	6.5 million	18,500 » 30,000	30,000 » 57,000	86,500 » 150,000
 Norway	210,000	4,000 » 7,000	6,500 » 11,500	19,000 » 33,500
CCS Longship project 	400	170 operation	150 - 200 jobs created per MtCO ₂ (50% capture + 50% transport and storage)	

Waste incineration employment: [https://www.europarl.europa.eu/RegData/etudes/STUD/2017/581913/EPRS_STU\(2017\)581913_EN.pdf](https://www.europarl.europa.eu/RegData/etudes/STUD/2017/581913/EPRS_STU(2017)581913_EN.pdf), Cement and concrete employment: https://ec.europa.eu/growth/sectors/raw-materials/industries/non-metals/cement-lime_en, Chemical industry employment: [https://cefic.org/app/uploads/2019/01/The-European-Chemical-Industry-Facts-And-Figures-2020.pdf](https://ec.europa.eu/growth/sectors/chemicals_en#:~:text=Furthermore%2C%20the%20EU%20chemicals%20industry%3A&text=has%20sales%20amounting%20to%20%E2%82%AC,across%20all%20value%20supply%20chains,Petrochemical industry: <a href=), Steel industry employment: https://ec.europa.eu/growth/sectors/raw-materials/industries/metals/steel_en, Norwegian employment: <https://www.regjeringen.no/en/dokumenter/>, Norwegian Ministry of Petroleum and Energy. Longship-Carbon Capture and Storage. Report to the Storting (white paper), Zero. (2019). New business models for carbon capture and storage. SINTEF. (2018). Industrial Opportunities and employment prospects in large-scale CO₂ management in Norway.

The benefits of CCUS in the 2 French regions

A preliminary calculation

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MtCO₂/y*



5-10

 ~ 5,000 - 10,000 FTEs
 ~ 25,000 Jobs kept in Dunkirk**
+ ~ 350 - 750 additional jobs for CCS operation

Low carbon steel
Low carbon cement
Low carbon manganese alloy
Low carbon aluminum
Etc ...



6

 ~ 5,000 FTEs
 ~ 4,500 Jobs kept
+ ~ 400 additional jobs for CCS operation

Low carbon oil products
Low carbon waste incineration
Low carbon chemicals
Low carbon fertilizer
Low carbon H₂
Etc ...

*AVIS ADEME, https://www.ademe.fr/sites/default/files/assets/documents/avis-ademe-csc_france_2020-011234.pdf + calcul Carbon Limits

**Claude Calesse, Euraénergie – emplois directs et indirects

*** Bruno Petat, Synerzip – emplois directs

Industry employment in 2020 : <https://www.insee.fr/fr/statistiques/2122336> (Normandie - 197,000) / <https://www.insee.fr/fr/statistiques/2121818> (Hauts de France – 281,500)

CO₂ capture impact on product price

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Construction sector:
Low carbon concrete



25 %

Base cost: NOK1,000 /m³ concrete



1-2 % total cost increase for
a standard freeway



<1 % total cost increase for
building construction

Waste sector:
Low carbon waste
incineration



20 %



Additional cost: 50 NOK/month
waste disposal fee for a
household

Steel sector:
Low carbon steel



25 %

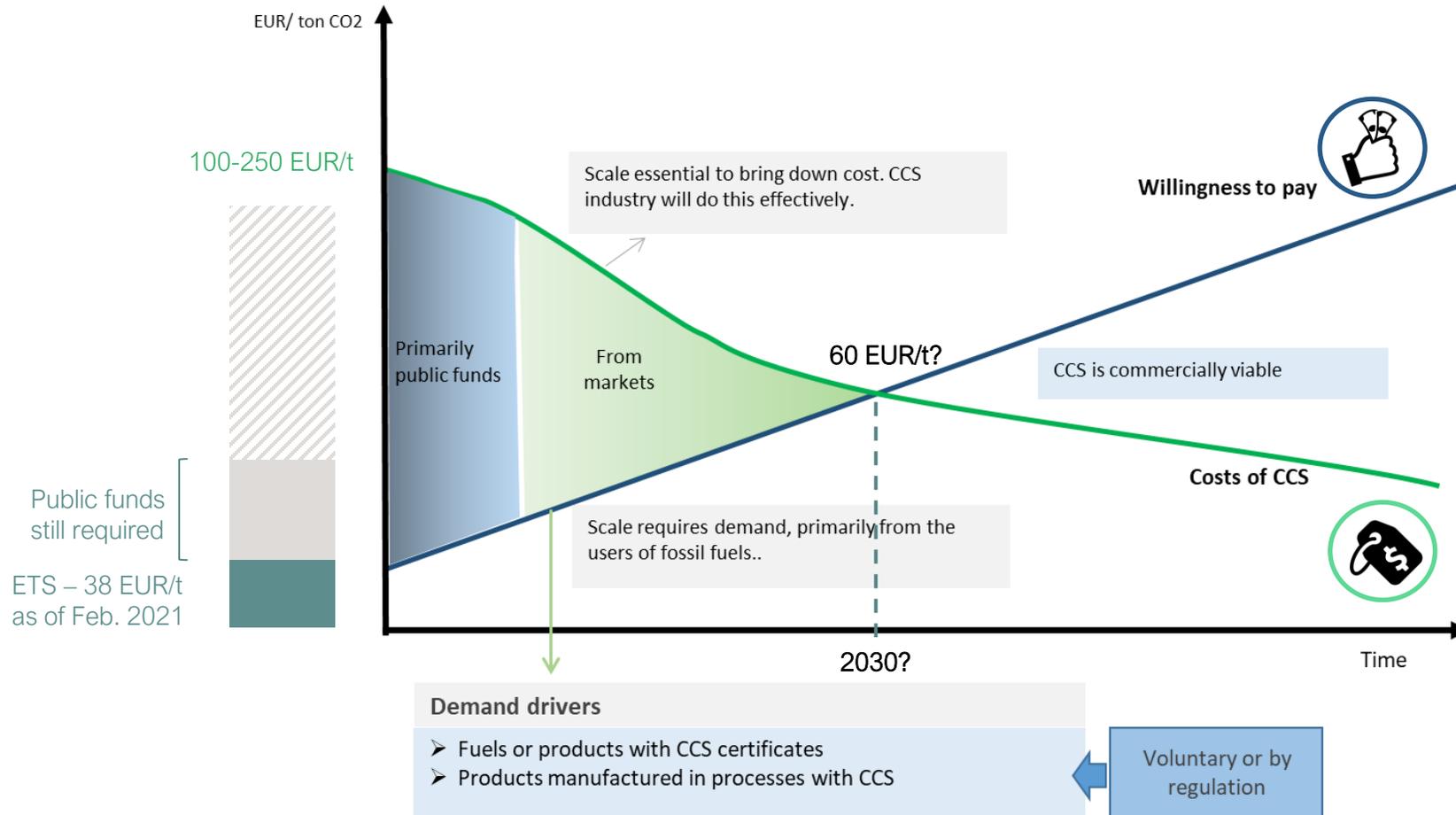


<1% total cost
increase on car

Zero. (2019). **New business models for carbon capture and storage.**

Rootzén and Johnsson, Energy Policy 98 (2016) 459–469, Climate Policy 17, 6, (2017) 781-800, See also (in Swedish), <http://www.dn.se/debatt/plan-saknas-for-att-minska-basindustrins-klimatpaverkan/> (in Swedish)

The demand drivers seem to be more and more topical but a little push from governments is still required



Thank you for your attention
Many thanks to the ClubCO₂

