
# 3D: A H2020 Project for the Demonstration of the DMX™ Process

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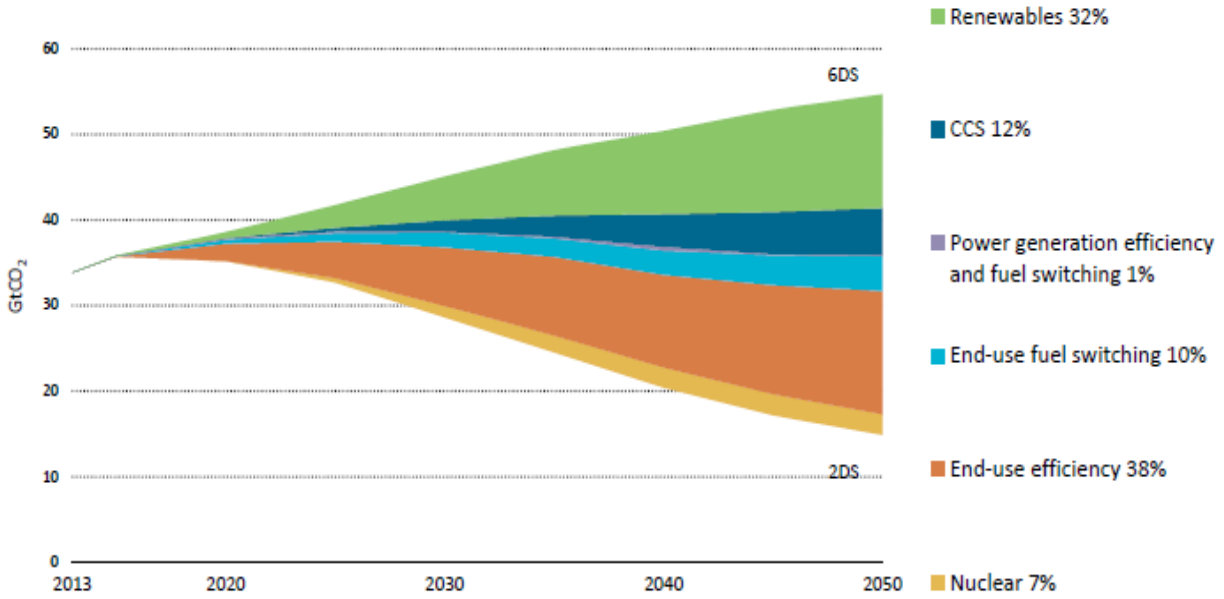
PCCC-5

# Outline

- Context
- DMX™ Process
- 3D Project
  - 3D in a Nutshell
  - Objectives
  - Synopsis
- 3D Pilot Plant

# Context : GHG Mitigation in Industry

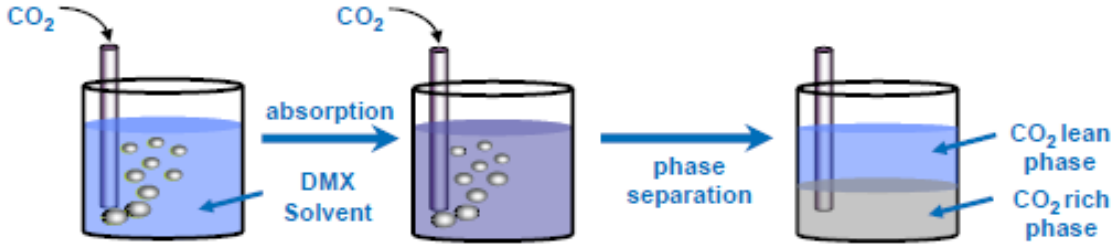
- In IEA 2DS, CCS in Industry is supposed to deliver 12 % of $CO_2$ emission cuts by 2050

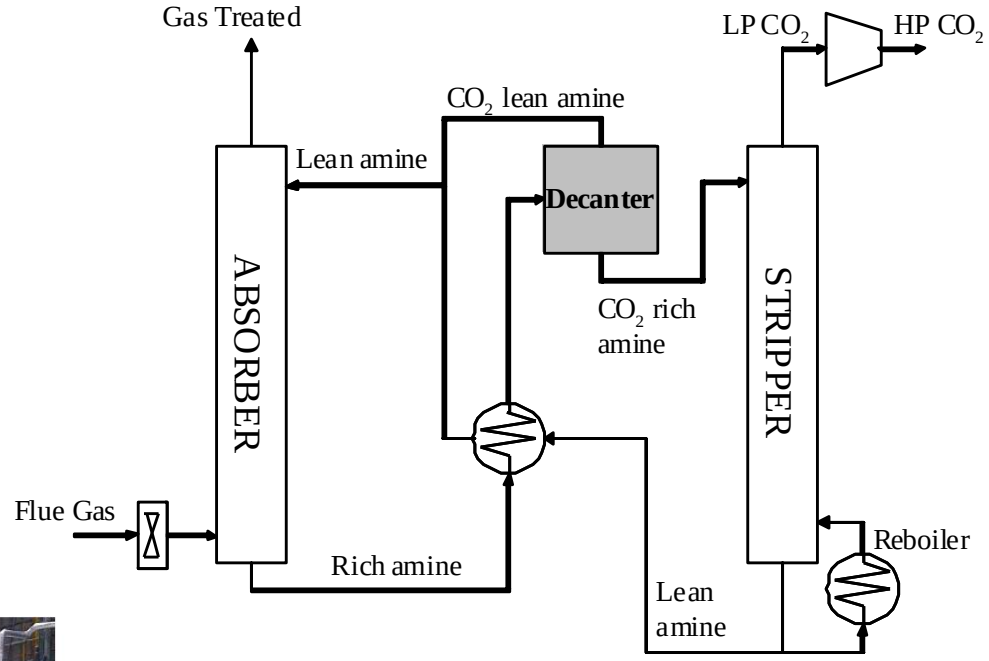



PARIS2015
CONFÉRENCE DES NATIONS UNIES SUR LES CHANGEMENTS CLIMATIQUES
COP21·CMP11

- Ambition of the European Union: Reduction from 1.7 tons of $CO_2$ per tonne of steel to less than 1.2 in 2030 only reachable via CCS

# DMX™ Process




## Performances

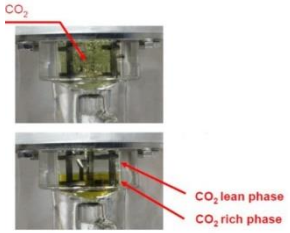
1) Very high cyclic capacity (4 times MEA)
2) Solvent very stable ➔ $CO_2$ may be produced in Pressure (up to 6 barg)
3) No corrosion observed with Carbon Steel

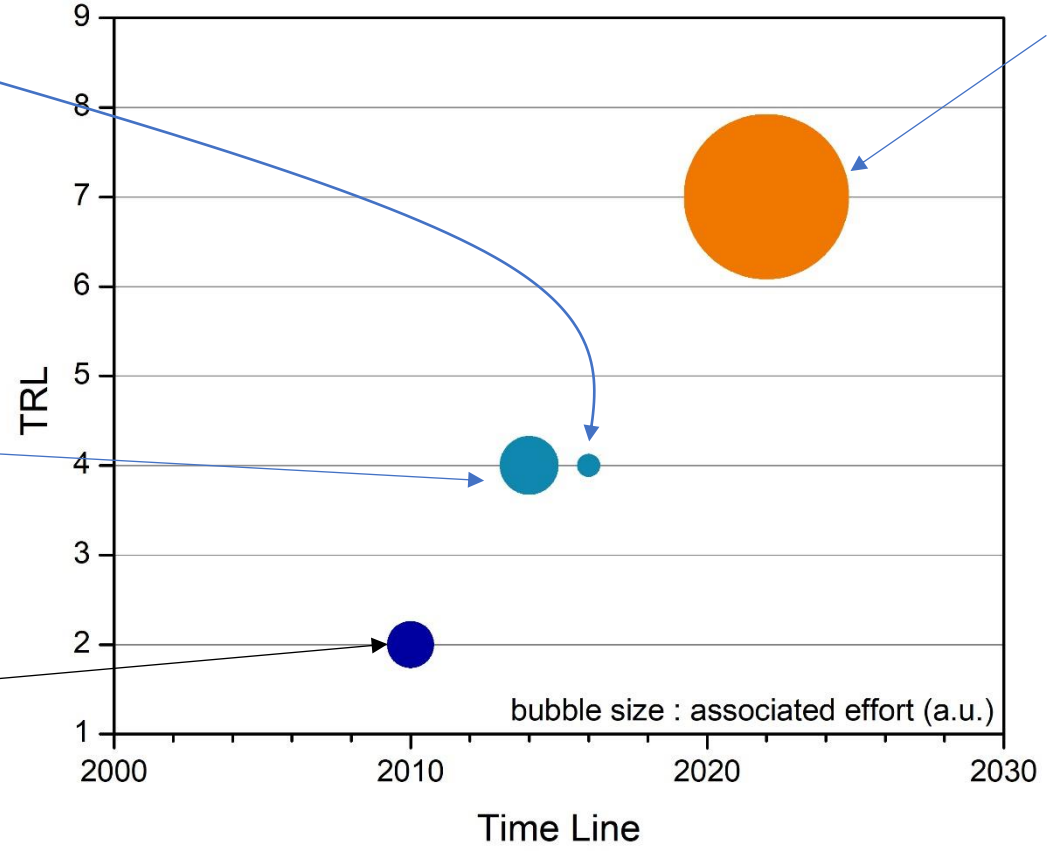
# DMX Technology Development

VALORCO project
(steel mill case)

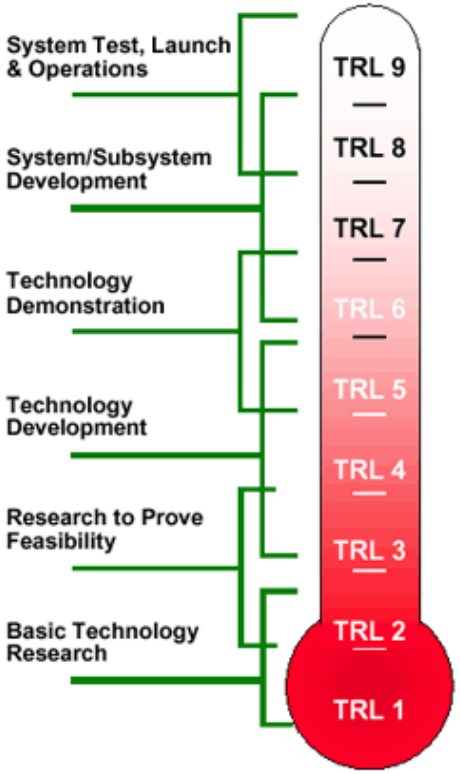
OCTAVIUS
(coal case)

Lab tests @ IFPEN



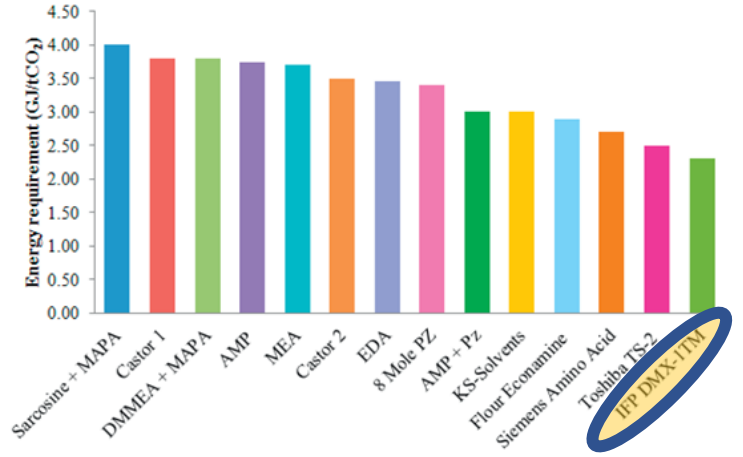

3D project



# Main Results of the OCTAVIUS Project (Coal Power Station Application)

- Low Energy for solvent regeneration ( < 2.3 GJ/tCO2 @ 90 % capture rate / without any integration)

Singh P. (IEAGHG), Van Swaaij W., Brilman D.,
Energy Efficient Solvents for CO2 Absorption from Flue Gas: Vapor Liquid Equilibrium and Pilot Plant Study,
Energy Procedia 37 (2013) 2021-2046, Oral présentation , GHGT-11, Kyoto, 2012.




- Results of the techno-economic evaluation

| Process | Power Plant (without capture) | Power Plant + MEA (No LVC) | Power Plant + DMX™ |
|---|---|---|---|
| Net Elect. Production (MW) | 743.5 | 559.0 | 592.2 |
| Net Efficiency (%) | 45.4 | 34.1 | 36.0 |
| | | | |
| **Penalty (points)** | | **- 11.3** | **- 9.4** |

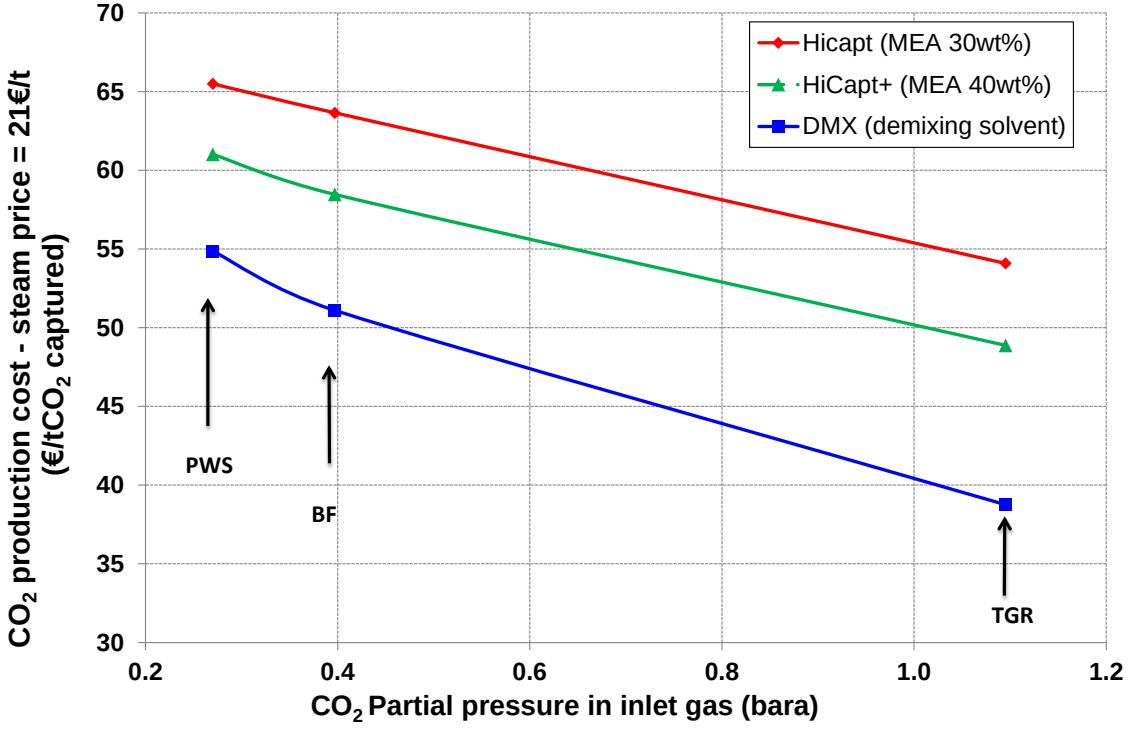
**(Costs include $CO_2$ compression @ 110 bar)**

| Process | Power Plant (without capture) | Power Plant + MEA (No LVC) | Power Plant + DMX™ |
|---|---|---|---|
| $CO_2$ Emissions (ton/MWh) | 0.76 | 0.08 | 0.08 |
| | | | |
| C.O.E. (€/MWh) | 61.2 | 99.0 | 89.9 |
| **COE Increase (%)** | | **+ 61.9** | **+ 46.9** |
| | | | |
| **$CO_2$ avoided Cost (€/ $CO_2$ ton)** | | **56.5** | **42.5** |

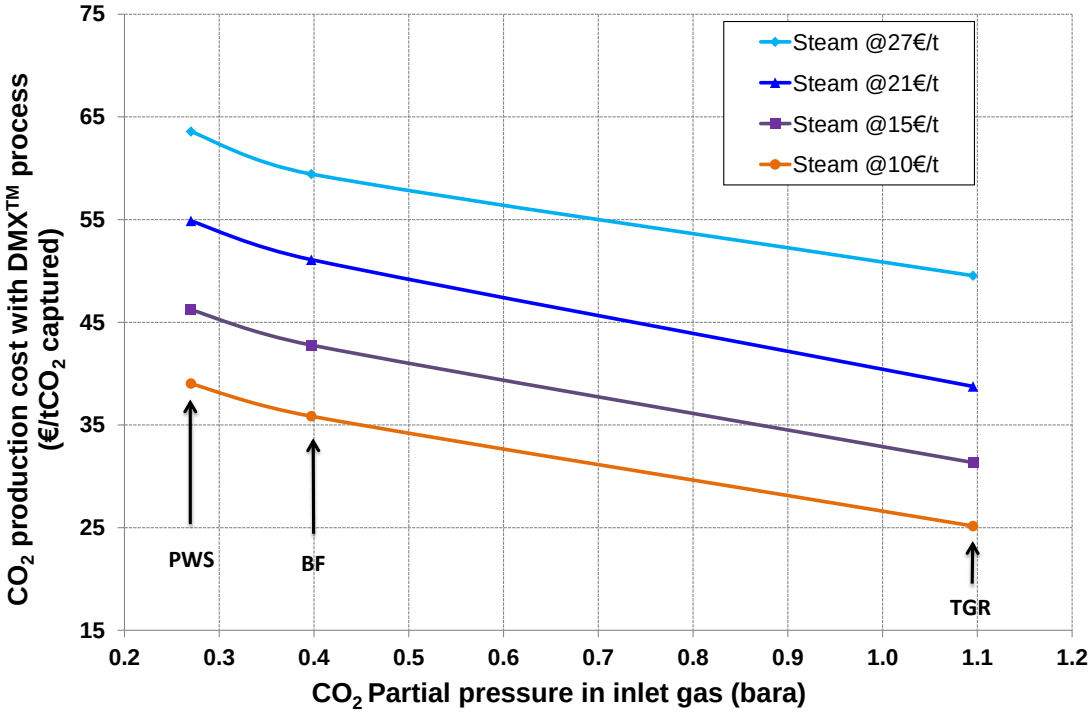
# Main Results of the Valorco.Project.(Steel Mill Application)

- 3 cases considered: Power Station (PWS), Blast Furnace (BF), Blast Furnace with Top gas Recycle (TGR)
- 3 processes studied: MEA 30 wt%, MEA 40 wt%, DMX™ process

## $CO_2$ production cost (steam price = 21€/t)




## Steam price impact on $CO_2$ production cost for DMX™ process




(Costs include $CO_2$ compression @ 6 barg)

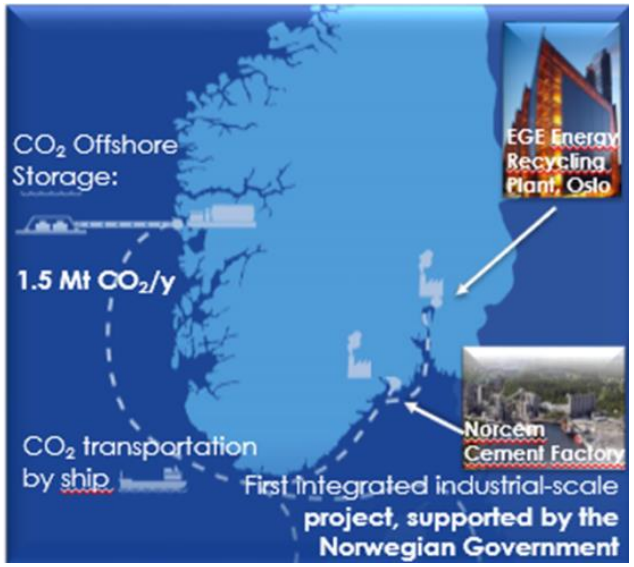
# 3D in a Nutshell

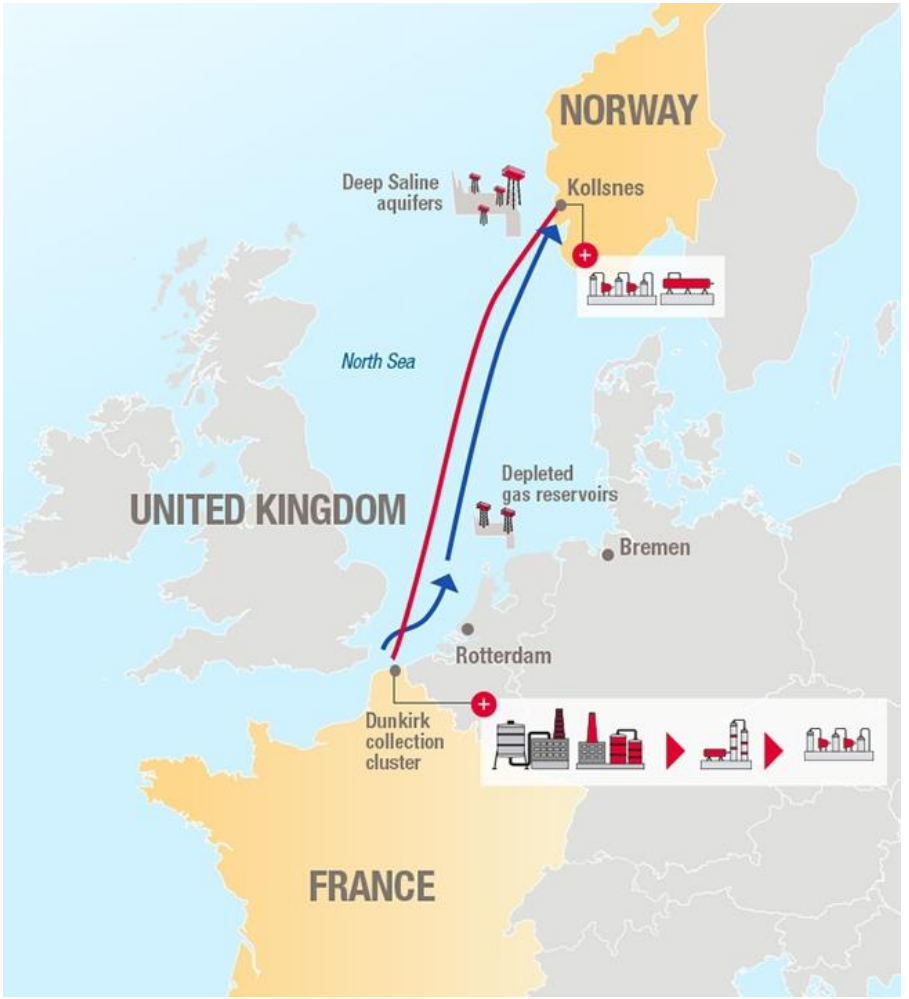
- **D**MX **D**emonstration in **D**unkirk
- H2020 project (call 2018 / topic LC-SC3-NZE-1)
- Project start-up : 01/05/2019
- Duration : 48 months
- Estimated eligible costs : 19.2 M€
- EU funding : 14.7 M€

# 3D Objectives

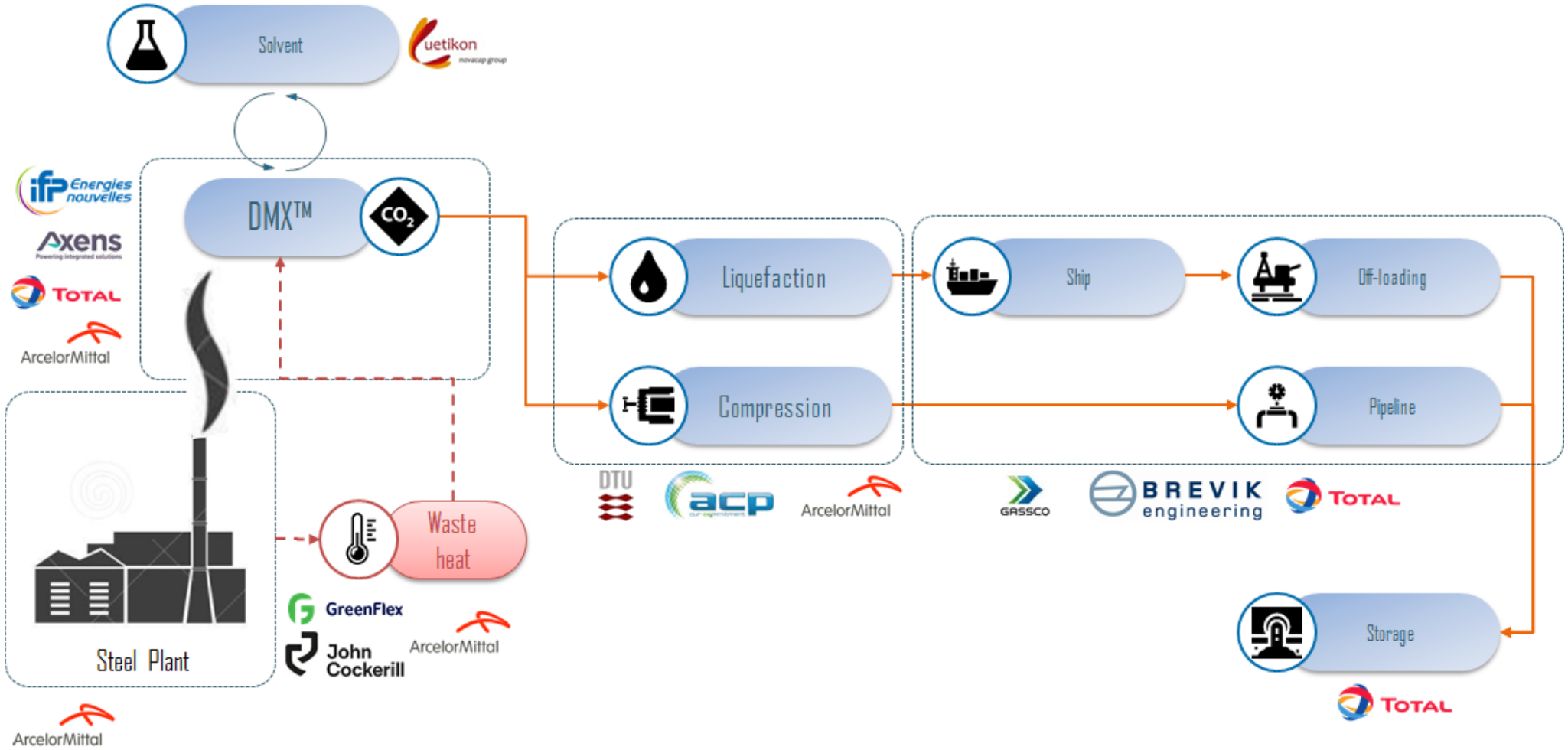
- Demonstrate the DMX™ Process
- Prepare a first CCS large-scale demonstrator (> 1Mt$CO_2$/y)
- Study the CCS cluster 2035 Dunkirk-North Sea (10 Mt$CO_2$/y)

**Norwegian project Northern Lights**



# 3D Synopsis



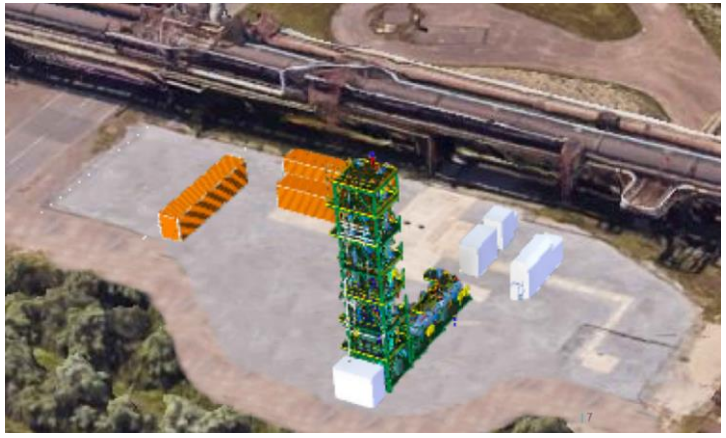

Social Sciences and Humanities, Life Cycle Analysis and Cost

CCS cluster 2035 in Dunkirk

# 3D Pilot Plant

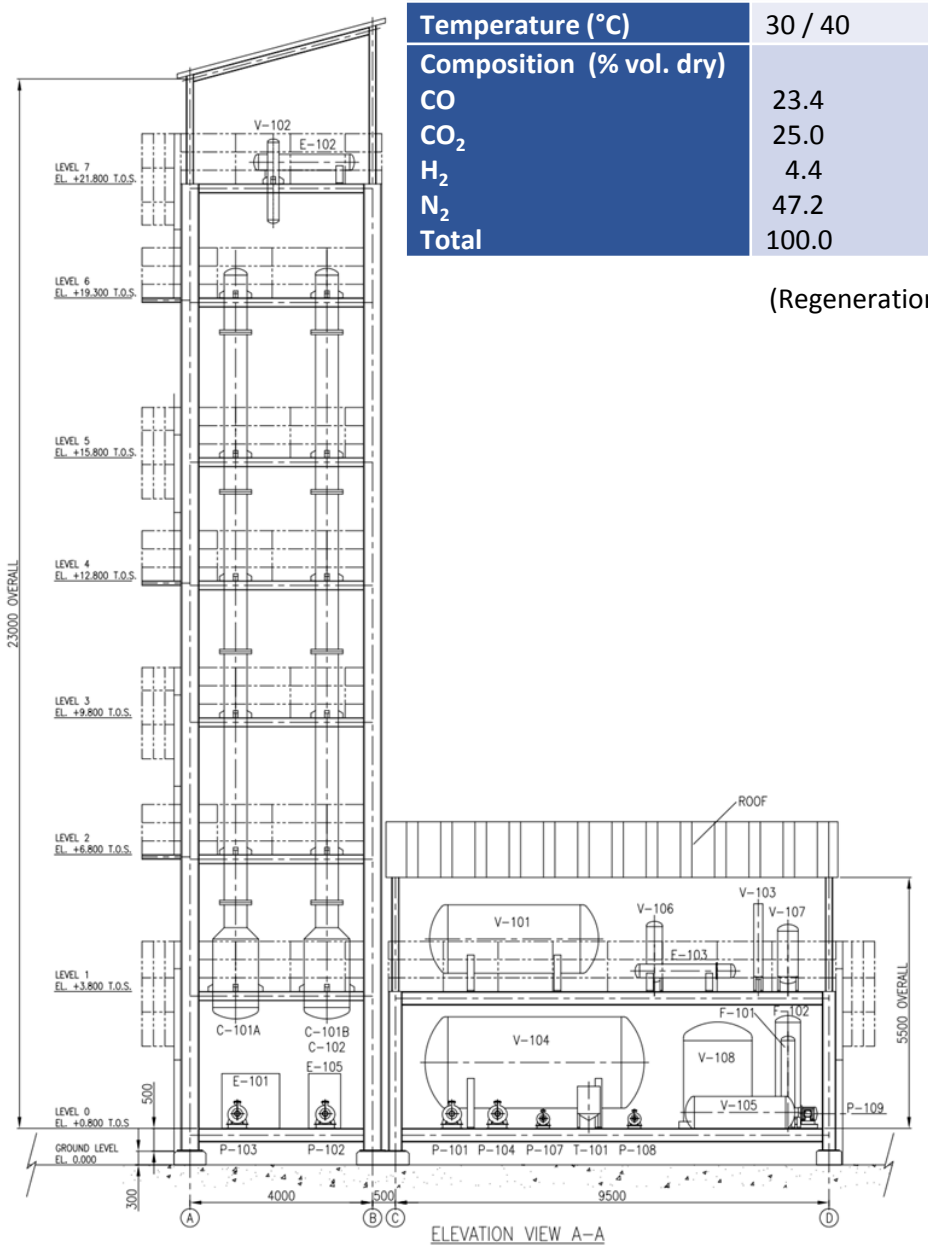
## Capacity = 0.5 $tCO_2$ captured/hour

## Future location of the DMX pilot to be built @ ArcelorMittal steel mill in Dunkirk



| Capacity ($tCO_2$ capture/h) | 0.5 |
|---|---|
| Raw gas pressure (barg) | 0.082 up to 3<br>(after compression) |
| Temperature (°C) | 30 / 40 |
| Composition (% vol. dry) | |
| CO | 23.4 |
| $CO_2$ | 25.0 |
| $H_2$ | 4.4 |
| $N_2$ | 47.2 |
| Total | 100.0 |

(Regeneration up to 6 bars)



# DMX Experimentation

- **Permitting & FEED in progress**
- **Pilot Building to be achieved in June 2021**
- **Experimentation (September 2021 – December 2022)**
  - **Phase 1 : Pilot Start-up** (3 months)
    - Precommisioning
    - Commissioning
    - Test Run
  - **Phase 2 : Parametric study** ( 6 months)
    - Regeneration pressure and decantation pressure
    - Absorption pressure
    - $CO_2$ capture rate
    - Packing height

    → Process performances evaluation : solvent flow rate, regeneration duty, CO effect.
    → Operation conditions optimisation
    → Models and simulation validation
  - **Phase 3 : 2 long run tests** (2 x 3 months)
    - Conditions defined after parametric studies

    → Process operability and solvent stability evaluation
    → Corrosion effect

# DMX™ Process Commercialisation

- AXENS will commercialise the DMX™ process.

- Based on the pilot plant experimentation and the pre-FEED studies carried out within 3D, a first CCS demonstrator could be launched in Dunkirk with storage in Norway just after the end of this project (2022-2023).

- First application should be $CO_2$ capture on blast furnace gas but the DMX™ process will be also commercialise for decarbonisation of flue gases from different origins (coal power stations, boilers, cement plants, petrochemical and refining units).

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# Thank.You