# DECARBONISATION OF CHEMICAL INDUSTRY

# MODULE 4

Material for group work

# GOALS OF SECTORAL GROUP WORK

- Identify the main sources of greenhouse gas emissions in your sector.
- Familiarize yourself with the target indicators and quantitative measures of decarbonization in the industry.
- Learn which climate risks companies in this sector consider most significant.
- Assess the activities and technological solutions that are most common and acceptable in the short and long term for sector decarbonization

# MAIN SOURCES OF GREENHOUSE GAS EMISSIONS IN THE CHEMICAL INDUSTRY

- Energy production: The chemical industry uses a significant amount of energy to drive reactions and processes. Burning fossil fuels results in carbon dioxide (CO2) emissions (Scope 1), and electricity consumption in production is associated with indirect emissions (Scope 2).

- Chemical synthesis: Many chemical processes require high temperatures and pressures, which can lead to greenhouse gas emissions. For example, the synthesis of ammonia and methanol can be associated with CO2 emissions (Scope 1).

- Cement production: Cement production is an energy-intensive process involving the calcination of limestone and clay at high temperatures. This leads to CO2 emissions as a result of chemical reactions (Scope 1).

- Fertilizer production: The production of nitrogen fertilizers is associated with greenhouse gas emissions, as the ammonia synthesis process requires a significant amount of energy and raw materials (Scope 1).

- Oxidation reactions: Oxidation processes used to produce various chemical products can lead to greenhouse gas emissions (Scope 1).

•Oil: The combustion of petroleum products, such as gasoline and diesel, in car engines, airplanes, and industrial plants also causes CO2 emissions.

•Natural gas: While natural gas is considered a cleaner fuel compared to coal and oil, its combustion also results in CO2 emissions.

# "WHAT PROCESSES LEAD TO SCOPE 1 AND 2 GHG EMISSIONS AT YOUR COMPANY?"

Use of fossil fuels:_____
Chemical reactions: _____
Electricity consumption:_____
Other sources: _____

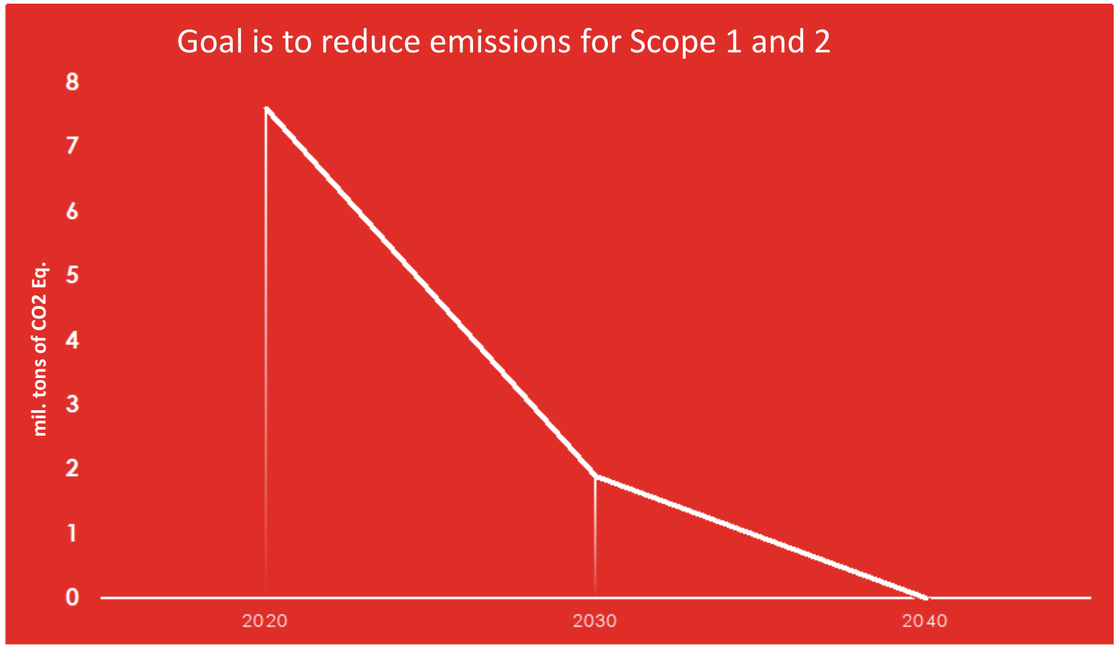
# HEAT GENERATION

| Company | Target year: 2030 |
|---|---|
| **SABIC (Saudi Arabia)** | Objective: Reducing greenhouse gas emissions by 25% by 2025 and 100% by 2030 through the transition to carbon-neutral technologies.<br>Indicator: the percentage of industrial processes that are carbon-neutral |
| **Evonik Industries (Germany)** | Objective: Reducing greenhouse gas emissions by 50% across the entire value chain by 2030.<br>Indicator: the total volume of CO2 emissions, including those from the company's suppliers and consumers (Scope 1, 2, 3). |
| **Dow Chemical Company (USA + 160 countries)** | Objective: By 2030, reduce methane emissions by focusing on reducing greenhouse gas emissions by 15%.<br>Indicator: the level of methane emissions per metric ton of product. |

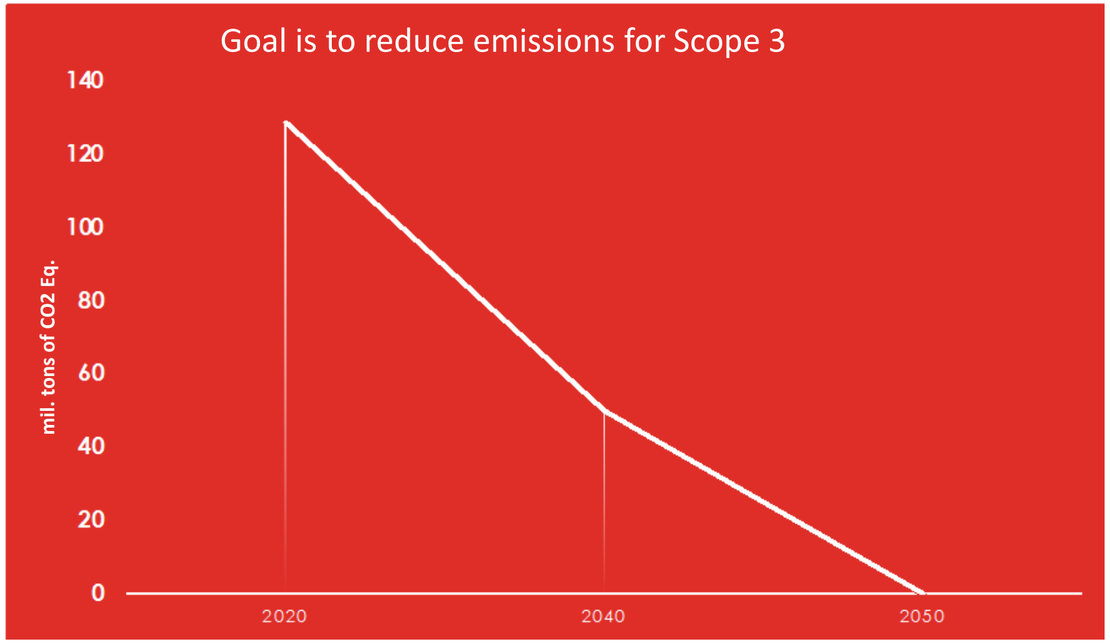
# EXAMPLES OF CORPORATE GOALS**

One of Europe's largest energy companies: supplier of electricity to 50 million customers.

Reduce Scope 1 and 2 emissions by 75% by 2030 and by 100% by 2040.




Reduce Scope 3 emissions by 50% by 2030 and by 100% by 2050.



# DOW CHEMICAL: INCREASING ENERGY EFFICIENCY IS THE FIRST STEP TOWARDS CARBON NEUTRALITY

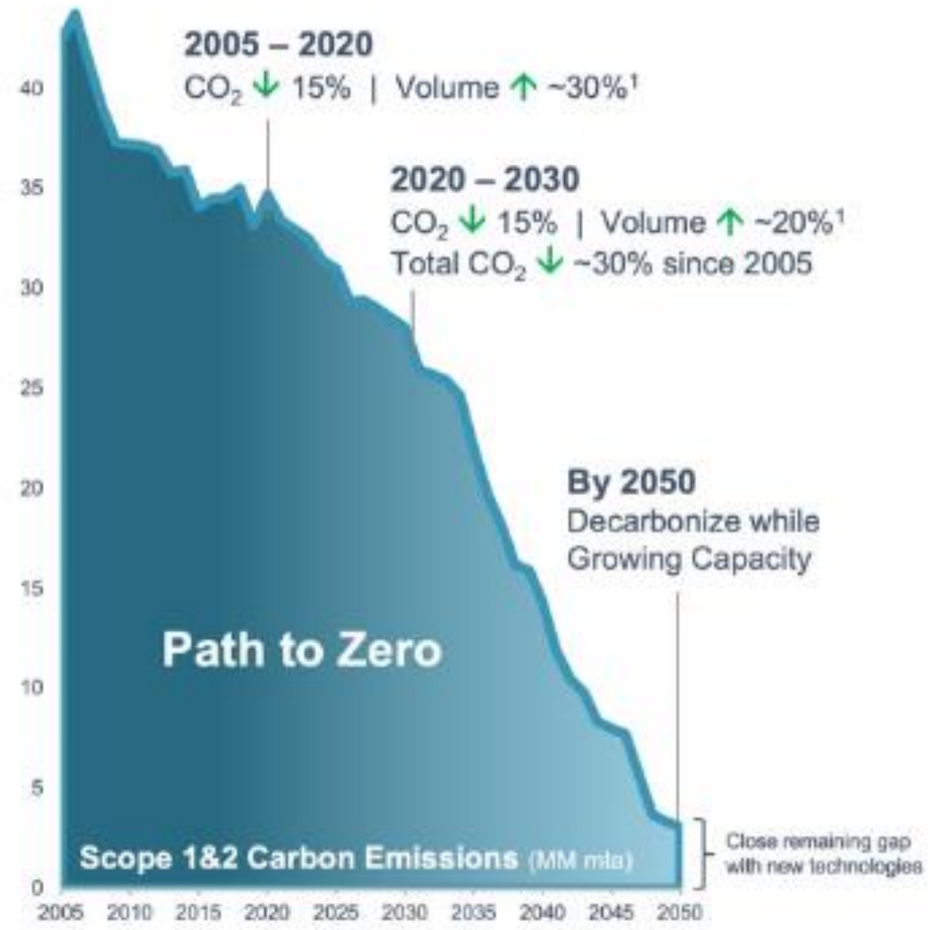
| Action | | Description |
|---|---|---|
| Transition to alternative fuels | Nontraditional RES | Utilization of biomass and plastic waste |
| | Integrated hydrogen production | Integrated hydrogen production |
| Energy efficiency and process optimization | | Energy management, heat recovery, equipment modernization |
| Electrification | | Electrification of heat and chemical process production |
| Carbon capture and storage (CCS) | | Utilization of CO2/CO as alternative feedstock |

# DOW CHEMICAL: "INCREASING ENERGY EFFICIENCY IS THE FIRST STEP TOWARDS CARBON NEUTRALITY.

The company Dow has modernized one of its mixed crackers in Plaquemine, Louisiana, using Fluidized Catalytic Dehydrogenation (FCDh) technology for propylene production.

The patented FCDh technology can reduce capital costs by approximately 25%, decrease energy consumption, and greenhouse gas emissions by around 20%.

This cost-effective and highly profitable upgrade enhances integration, ensuring reliable supply of an additional >100,000 metric tons of propylene to meet growing demand in key end markets



# AIR LIQUIDE: TRANSITION TO GREEN HYDROGEN.

- The "H2 HUB Flanders" project aims to construct a 20 MW green hydrogen production facility capable of producing up to 3,000 tons of green hydrogen annually, expected to commence operations in 2024.

- In Air Liquide's highly efficient ammonia cracking process, they employ next-generation reactor tube thermal integration technology. This ensures maximum conversion of ammonia to hydrogen with zero direct CO2 emissions.

- A key element of the ammonia cracking process is the ammonia cracker, which is a catalytic cracking furnace in which the ammonia synthesis reaction is reversed at elevated temperatures. The resulting cracking gas consists mainly of hydrogen and nitrogen. After a subsequent separation stage, purified hydrogen is obtained.

- The economic viability of this project was supported by grant financing from the Flemish government.

- Air Liquide has committed to investing approximately 8 billion euros globally by 2035 in the low-carbon hydrogen value chain as part of their ADVANCE strategic initiative

# COMPARISON OF ACTIONS

| **Summary of the action** | Energy efficiency and process optimization | Transition to alternative energy sources | Utilization of green hydrogen | Carbon capture and storage |
|---|---|---|---|---|
| **Emission reduction potential in %** | -25% | -100% | -100% | -100% |
| **Technological readiness (from 1 to 3)** | 3 | 2 | 1 | 1 |
| **Investments** | Low | Average | Low | High |

# EVALUATE THE TECHNICAL AND ECONOMIC FEASIBILITY OF IMPLEMENTING DECARBONIZATION ACTIONS AT YOUR ORGANIZATION

| Actions | Technologically possible | Economically justified |
|---|---|---|
| Energy efficiency and process optimization | | |
| Transition to alternative energy sources | | |
| Utilization of green hydrogen | | |
| Carbon capture and storage | | |

Rate from 1 (low) to 5 (high)

# WHAT MEASURES HAVE ALREADY BEEN IMPLEMENTED AT YOUR ENTERPRISE?

Utilization of RES :_____

Improving energy efficiency : _____

Modernization of production processes :_____

Other measures: _____

# CLIMATE RISK ASSESSMENT

## RISKS ASSOCIATED WITH THE GLOBAL TRANSITION TO LOW CARBON DEVELOPMENT

- Credit Risk Associated with ESG (Environmental, Social, and Governance): Risk of facing higher interest rates and difficulties in accessing financing due to strict ESG compliance requirements.

- Regulatory Risk: Risk of potential changes in national climate-related legislation, including greenhouse gas taxation, carbon footprint reduction targets, and potential litigation for non-compliance with regulatory requirements.

- Market risk: Risk exposure to carbon taxation in importing countries of production.

- Customer Risk: Risk of losing customers due to failure to meet their decarbonization targets as a supplier.

# CLIMATE RISK ASSESSMENT

Risks related to the negative impact of climate change on operations

- Operational risk for metallurgy due to changes in precipitation levels
- Operational risk due to extreme temperatures
- Operational risk due to extreme weather conditions
- Operational risk due to water scarcity

# ASSESS THE IMPACT THAT THE RISK MAY HAVE ON YOUR ENTERPRISE AND THE PROBABILITY THAT THE RISK WILL MATERIALISE

| Risk | Impact | Probability |
|---|---|---|
| Credit risk: Access to capital | | |
| Regulatory risk: Stricter legislation | | |
| Market risk: Taxation of imports | | |
| Customer risk: Loss of markets | | |
| Operational Risk: Changes in precipitation levels | | |
| Operational Risk: Extreme temperatures | | |
| Operational Risk: Extreme weather conditions | | |
| Operational risk: Water scarcity | | |

# RESULTS OF GROUP WORK

What are the main sources of GHG emissions in your industry?
What goals do your companies set for themselves?
Which decarbonization measures do you consider most realistic?
Which measures have already been implemented?
What are the main climate risks for your company?