CHART OF THE MONTH

Vol.16

Paths to decarbonize energy-intensive industries: The case of CCUS

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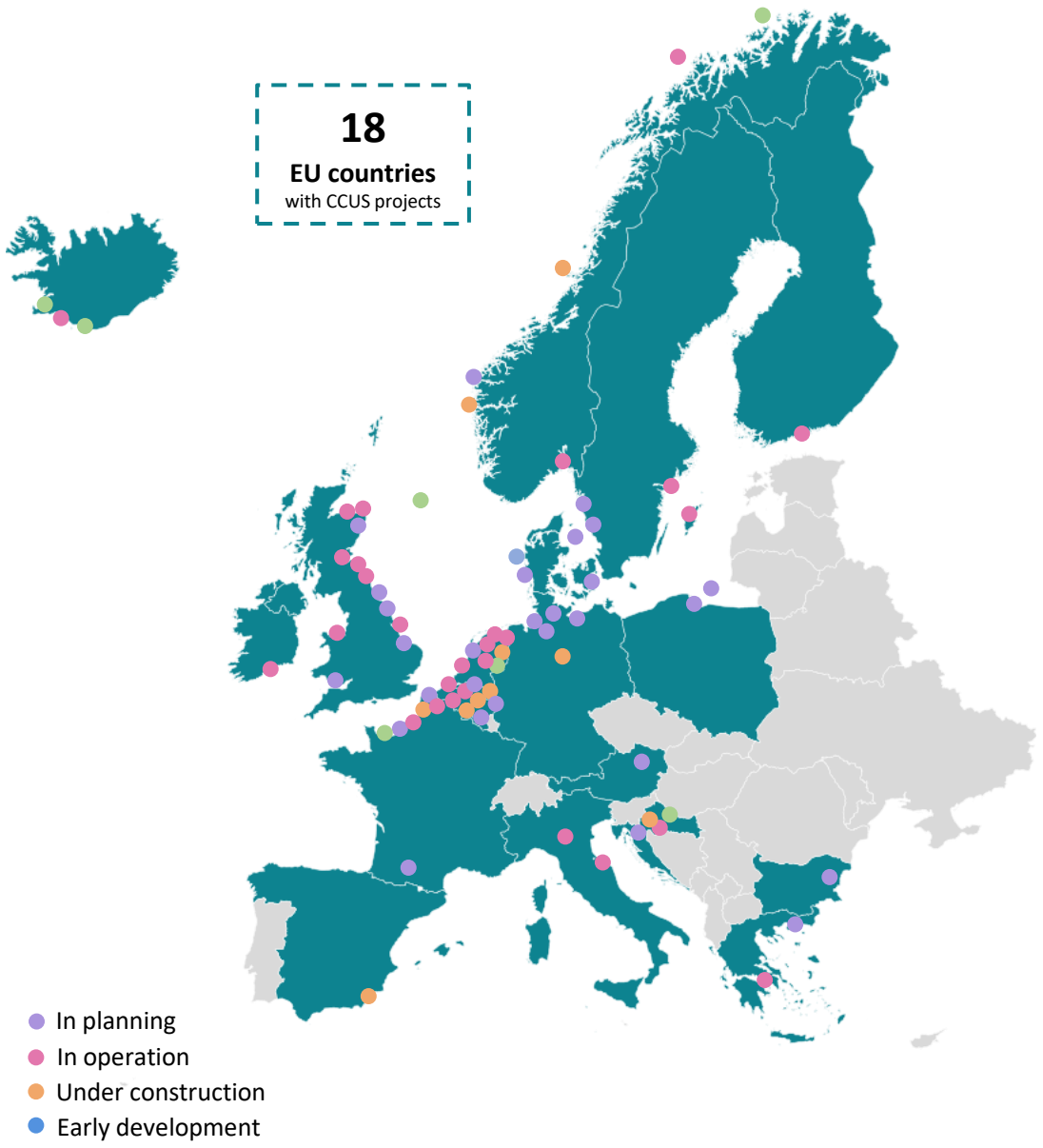
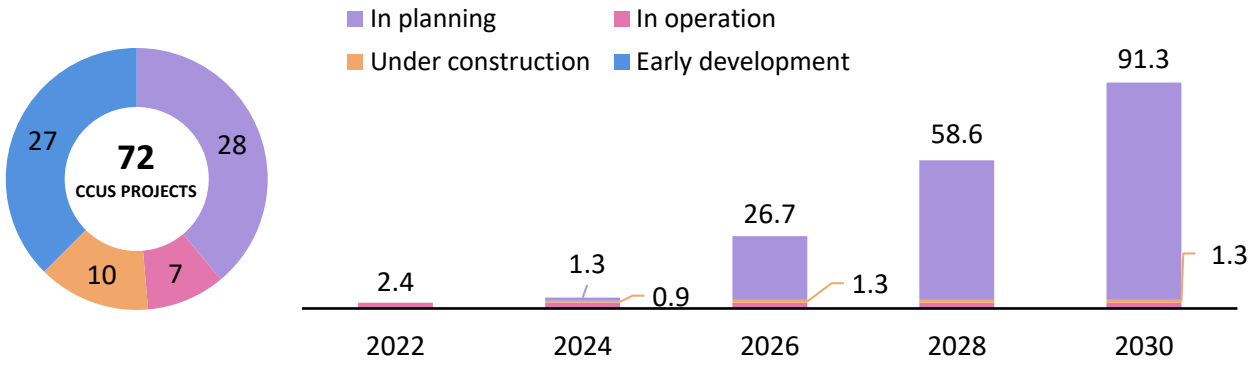
Paths to decarbonize energy-intensive industries: The case of CCUS

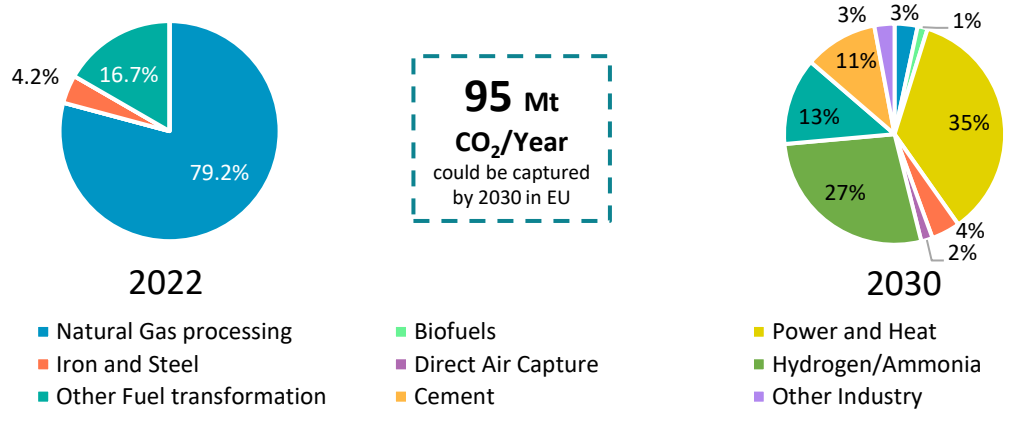
Existing & planned CCUS projects in Europe



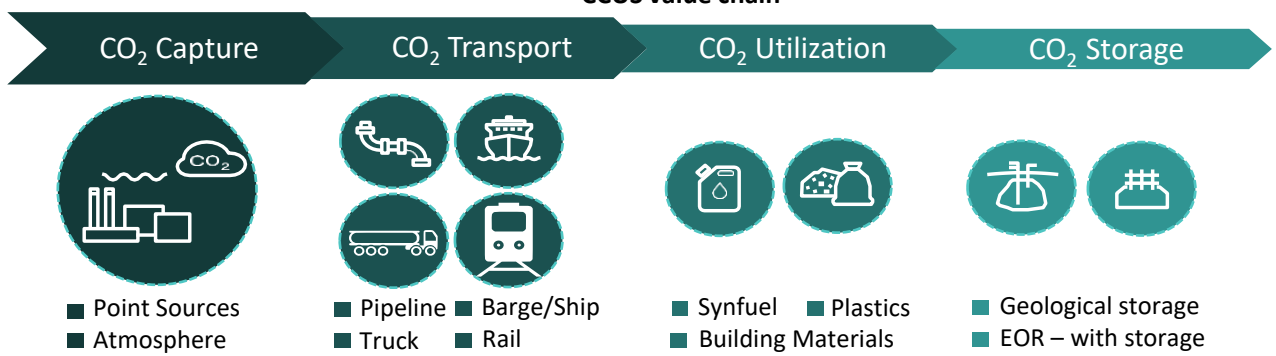
Operational and Planned Carbon Capture Capacity of total CCUS projects in Europe by 2030 ($MtCO_2$/year)



Carbon Capture capacity share per sector in Europe (%)



CCUS value chain



Source: IEA, DOE, IOGP, IEEFA, HEREMA, HAEE Analysis

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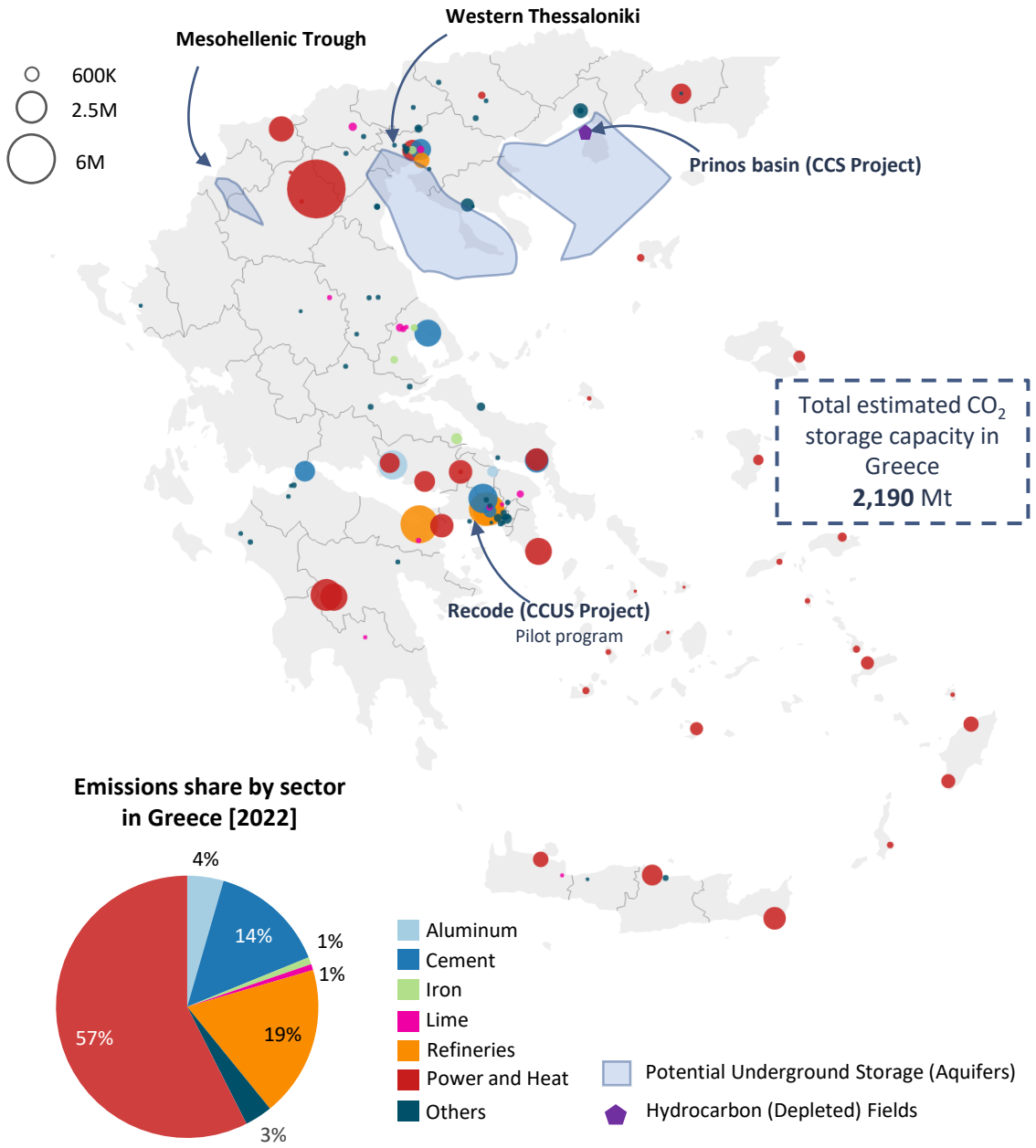
EU-ETS Verified emissions by sector in 2022 and potential CO_2 storage sites in Greece (tCO_2)

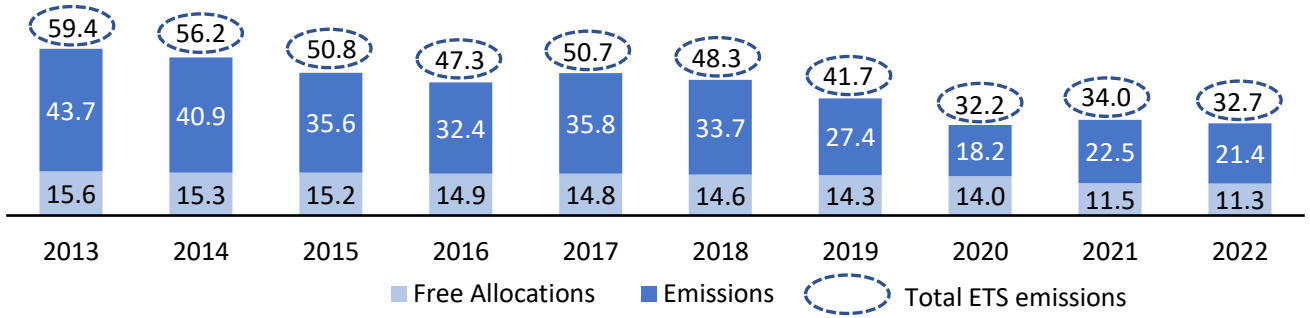


CCS/CCUS projects in Greece

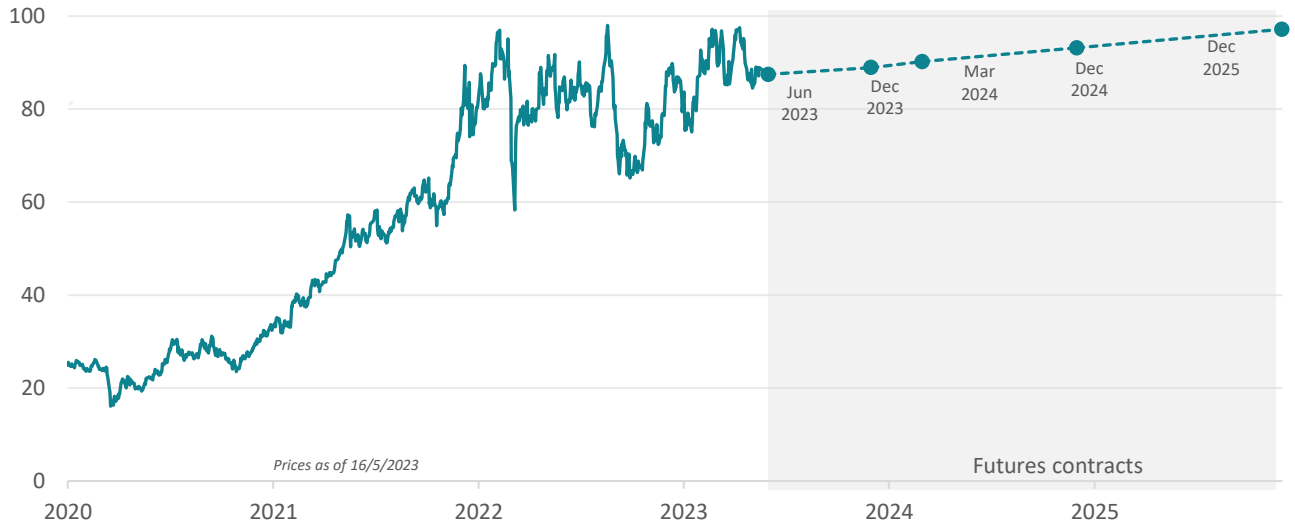
→ ***Prinos Basin*** (CCS project – In Planning): Storage of CO_2 in depleted oilfield. Aims to capture & store 100 million tonnes of CO_2

→ ***Recode project*** (CCS project – Early Development): Pilot installation in a cement plant, to produce added – value additives

Comparison of total EU-ETS Carbon Emissions and Free Allocations in Greece ($MtCO_2$/year)



EU ETS CO_2 Prices (€/tn)



Source: IOGP, EUTL, IOP*, ICE, HAEE & Deloitte Analysis

* Nikolaos Koukouzas et al 2016 IOP Conf. Ser.: Earth Environ. Sci. 44 052043

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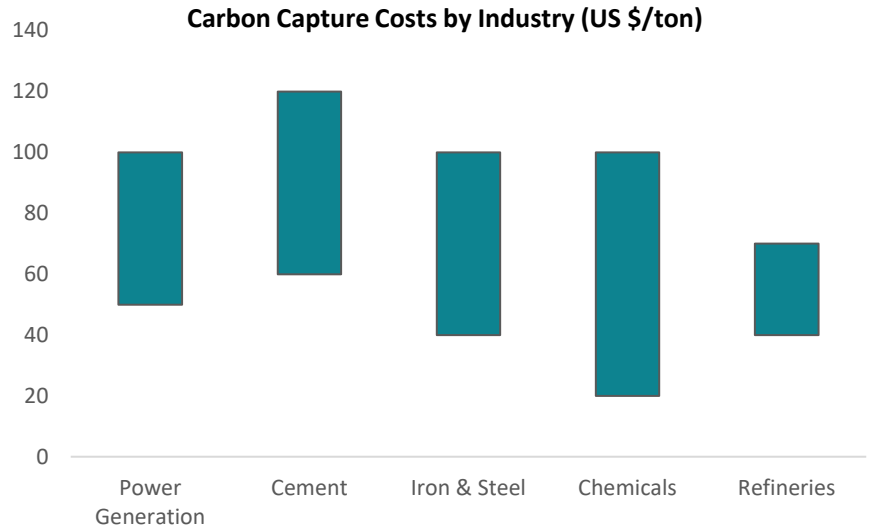
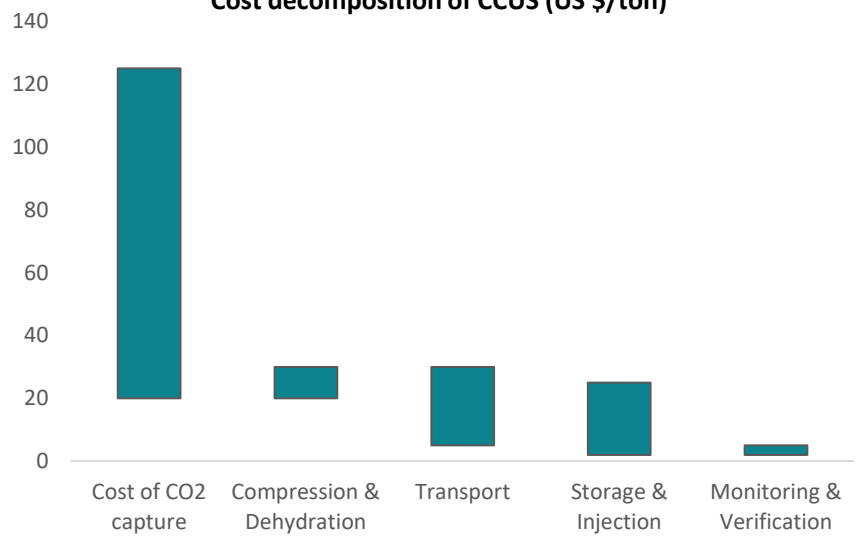
- *Capex costs remain high for the "hard to abate" industries*
- *On average, no significant cost variations are found across industries*



- *CO_2 capture represents the largest cost factor across the CCUS value chain*



Source: Deloitte Analysis, Monitor Deloitte

The 3 building blocks for CCUS success

1 Reduce Technical & Financial cost

I. **Technology costs can see significant reductions by 2030** (e.g., approx. 30-35% compared to today)

II. CCUS is capital intensive. Increasing commercial **scalability** could potentially **lead to financial savings** via restructuring cost of capital and access to financing

2 Enhance Regulatory & Political Support

I. Regulatory drivers are critical for the success of CCUS. Introducing I**ncentives will enable CCUS to gain momentum**

II. Enabling CCUS **access to electricity markets** could potentially prove beneficial.

III. CCUS need to **gain political support** to illustrate their importance as viable option

3 Expand access to market

I. **Public & Private Partnerships could boost the deployment** of projects in order to reduce emissions from carbon intensive industries

II. **CCUS could be coupled** with existing or new blue/ green **hydrogen** facilities

III. Innovative CCUS poly-generation progress could be proved as pathway to explore new markets

In 2022, several CO_2 capture projects were announced. There are currently 72 CCUS projects in Europe: 29 are cross-border, 42 are clusters, and 43 are offshore storage.

In contrast to the current operational capture capacity of 2.4 Mt/year in EU, the planned capacity by 2030 could be 95 $MtCO_2$/year. The majority of CO_2 capture initiatives for 2030 involve the production of power and heat, cement, and blue hydrogen with 35%, 27% and 11%, respectively.

The highest share of EU emissions trading system (EU ETS) in Greece derives mainly by the power and heat sector with a 57% share, followed by refineries and cement with 19% and 14%, respectively.

There are 3 potential underground storage aquifers, located in northern Greece, with the total estimated storage capacity of 2190 Mt CO_2.

The Prinos CCS project, one of the two ongoing projects in Greece, has the potential to store close to 100 % of the Greek manufacturing sector's emissions for 10 years, starting in 2025.

Greece's total ETS emissions allowances decreased by 21.6% between 2019 and 2022. The EU ETS emission allowances of the participating companies have decreased by 26% over the past decade, with an average yearly reduction of 2.5%.

Greece’s industrial and power generation sectors are expected to face higher energy costs driven by the increasing ETS prices.

CCUS stands as a potential emission reduction option for heavy industries and power generation, also for offsetting the progressively increasing ETS prices.

The capital requirements for CCUS development are still high for the carbon intensive industries.

As those projects are increasing their scale along with the technology advancement their costs are expected to drop.

Regulatory and political support is crucial to fully unlock the potential of CCUS, as they are anticipated to play a pivotal role in industries' decarbonization and the overall green transition.

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