TechXplore

Company seeks to capture 1 million tons of CO2 from the air per year

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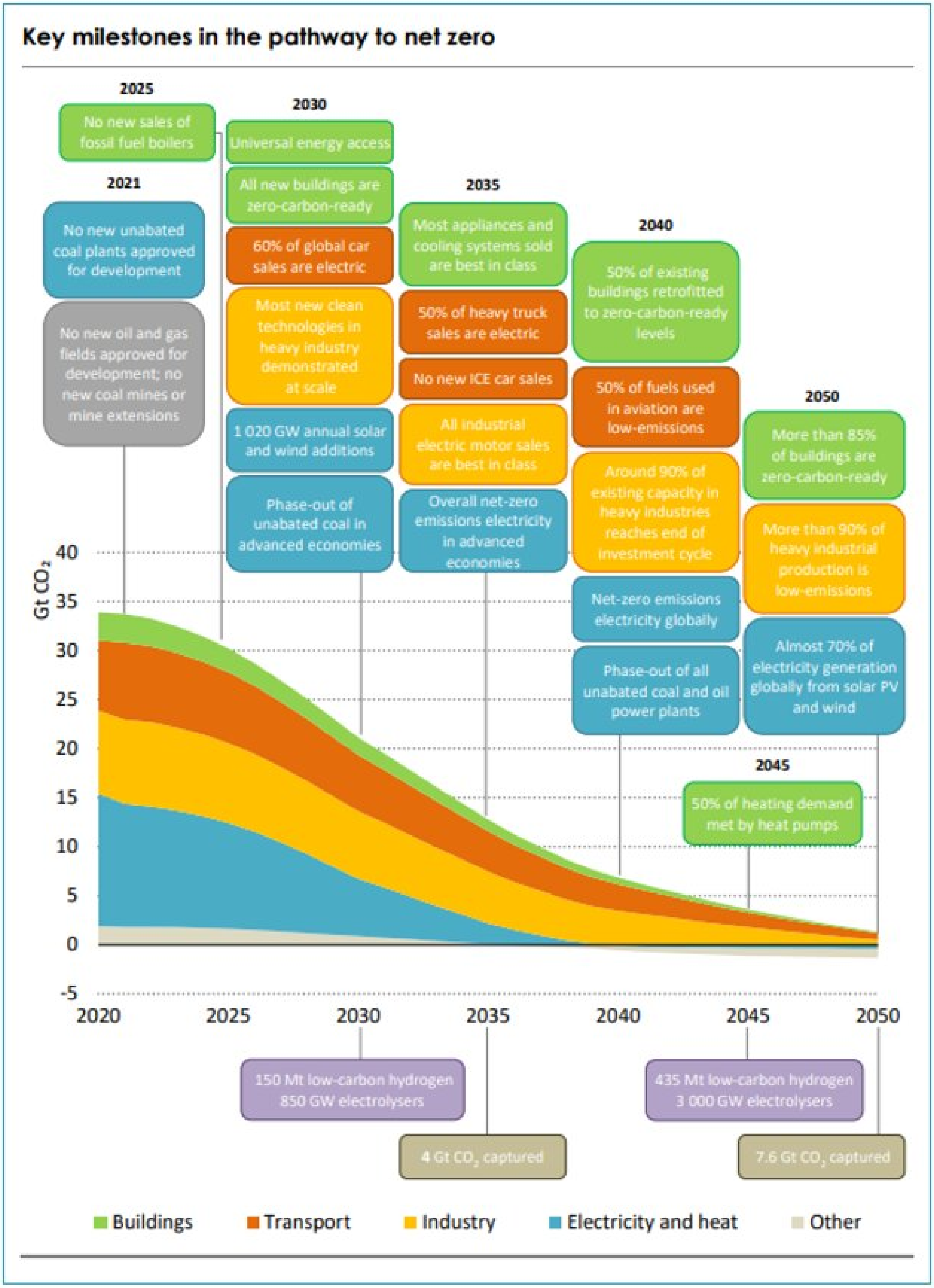
Key milestones in the pathway to net zero
2025
No new sales of fossil fuel boilers
2030
Universal energy access
All new buildings are zero-carbon-ready
60% of global car sales are electric
Most new clean technologies in heavy industry demonstrated at scale
1 020 GW annual solar and wind additions
Phase-out of unabated coal in advanced economies
2021
No new unabated coal plants approved for development
No new oil and gas fields approved for development; no new coal mines or mine extensions
2035
Most appliances and cooling systems sold are best in class
50% of heavy truck sales are electric
No new ICE car sales
All industrial electric motor sales are best in class
Overall net-zero emissions electricity in advanced economies
2040
50% of existing buildings retrofitted to zero-carbon-ready levels
50% of fuels used in aviation are low-emissions
Around 90% of existing capacity in heavy industries reaches end of investment cycle
Net-zero emissions electricity globally
Phase-out of all unabated coal and oil power plants
2050
More than 85% of buildings are zero-carbon-ready
More than 90% of heavy industrial production is low-emissions
Almost 70% of electricity generation globally from solar PV and wind
2045
50% of heating demand met by heat pumps
Gt CO_2
40
35
30
25
20
15
10
5
0
-5
2020
2025
2030
2035
2040
2045
2050
150 Mt low-carbon hydrogen 850 GW electrolysers
4 Gt CO_2 captured
435 Mt low-carbon hydrogen 3 000 GW electrolysers
7.6 Gt CO_2 captured
Buildings
Transport
Industry
Electricity and heat
Other

The graph shows the many actions we must take to cut emissions to a minimum in the years up to 2050. Credit: Net Zero by 2050, A Roadmap for the Global Energy Sector, International Energy Agency, 2021

We are releasing more and more CO_2 into the atmosphere. Now we need to find technologies that can remove what has already been released—in addition to dramatically reducing the emissions. Removing existing CO_2 from the atmosphere, known as historical CO_2, will be a necessary solution if we are to achieve the climate goals, according to the UN Intergovernmental Panel on Climate Change.

If we succeed in creating a large industry based on CO_2 capture, also called "climate-positive technology," Norway can take a leading role.

"The value chain will be able to create new jobs, in addition to having major ripple effects in the districts where the facilities are established. We need to put in place the framework so we can develop this in a way that safeguards the sustainability goals in the UN," says Einar Tyssen, CEO of the industrial company Removr.

In collaboration with SINTEF as a research partner and the technology partner GreenCap Solutions, Removr is now putting in place a large-scale CO_2 capture facility from air.

The solution in development is called Direct Air Capture (DAC) technology. According to the partners, Norway can take on a world-leading role within DAC by using renewable energy sources in combination with cost-effective capture technology.

Pilot in Iceland

Removr is already developing a pilot for DAC technology in Iceland.

Today, Iceland leads the way on CO_2 capture from air. The country uses its naturally good conditions related to clean energy and storage in the basalt formations in the subsurface.

"In Iceland, we get access to both renewable power and storage that makes it possible to demonstrate the technology quickly. At the moment, only in Iceland a full value chain can be realized. This means that the country has become the world's display window for carbon capture from air," says Tyssen.

Zeolite as core technology

The core of the DAC technology is the material zeolites. Zeolites are porous and attract carbon dioxide from gas mixtures in the small pores of the material. In this way, the CO_2 molecules are separated out of the air.

SINTEF has many years of experience with zeolites and the development of technologies that use microporous absorbents.

"Zeolites are found naturally as minerals, but for use in the industry they are most often produced synthetically," says Jasmina Hafizovic Cavka, research leader at SINTEF.

"The material is used in several separation processes, such as purification of water and separation of oxygen from air for use in hospitals. In the context of DAC technology, the extensive use of zeolites is positive in that the materials are not toxic and that they are commercially available on a large scale, which is crucial for the implementation of DAC technology," says Cavka.

Vacuuming the air

With DAC, CO_2 is "vacuumed" directly from the atmosphere, so that the CO_2 concentration and greenhouse effect is reduced. However, the CO_2 concentration in the air is only around 0.04 percent. This is about 300 times lower than what comes from the exhaust gas in a coal-fired power station.

In other words, the concentration of CO_2 must be increased to more than 95 percent. In addition, the greenhouse gas must be stored under ground. This will be done by mixing the CO_2 with water and then storing it in the geological layer under the island: basal formations. After 1-2 years, the mixture will be mineralized, that is converted into stone.

"We build capture facilities that blow large amounts of dried and refrigerated air through a microporous material that captures the CO_2 molecule in the pores. However, since the CO_2 concentration in the air is low, the plants must be large before they will have a significant effect. Our goal is to reach a capacity of 1 million tons of CO_2 per year," says Einar Tyssen.

Large-scale benefits crucial for the economy

The fact that DAC-plants must process large amounts of air, requires a lot of clean energy and large facilities. The biggest challenge in today's DAC technologies is therefore high investment and operating costs.

"To reduce the energy demand and footprint, more research is needed, both on the CO_2 capture materials and optimization of the capture process itself. In addition, standardized life cycle analyses and techno-economic analyses are crucial," says Jasmina Cavka.

Modeling of full-scale rigs

The research team will now start modeling the capture process that will form the basis for the design of a full-scale capture facility. More knowledge about dimensions, the amount of zeolite and the energy consumption is particularly needed.

More information: Net Zero by 2050, A Roadmap for the Global Energy Sector, International Energy Agency, 2021. iea.blob.core.windows.net/asse … nergySector_CORR.pdf

Intergovernmental Panel on Climate Change (IPCC). 2019. Climate change and land: An IPCC special report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems. www.ipcc.ch/srocc/

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