HYBRID CARBON CAPTURE TECHNOLOGY

The Hybrid Carbon Capture Technology developed by ARK Capture Solutions is a patented solution designed to capture low-concentration point source flue gases in the range of 4 to 15 percent CO_2. These low-concentration sources represent more than 50 percent of global CO_2 emissions and come from the power sector as well as industries such as steel, glass and petrochemicals.

ARK has developed an end-to-end process that covers the entire capture chain, from raw flue gases to delivering >99% concentrated CO_2 that meets even the most stringent transportation specifications. The technology does not require heat or chemical additives. The system can operate autonomously with minimal staffing needs.

Thanks to its compact footprint, the commercial scale unit can be integrated onto most existing industrial sites without major modification.

Although the technology is optimized for low-concentration flue gases, it can also handle higher CO_2 concentrations without any performance loss. Thanks to its modular design, the system can process multiple inlet streams at different concentrations and direct the captured CO_2 to several outlet streams as needed. This flexibility allows the solution to be adapted to a wide range of customer requirements and industrial configurations.

ARK Capture Solutions – Hybrid CO_2 capture

TECHNICAL ASPECTS (all % are volume-based)

Point sources: Steam-methane reforming, cement/lime, steel blast furnace, refineries, waste incineration/biomass power plant, pulp & paper, and Iron and Steel.

CO_2 concentration range: 4-98% with a primary focus on 4-15%

CO_2 capture efficiency: up to 100%

CO_2 purity: up to 99.9%

Min. feed gas pressure: atm. pressures

Max. feed gas temperature: 750 °C

Typical scale: Small to large scale (5,000 – 3,000,000 tCO_2/yr)

Primary energy source: Electricity

Impurity tolerance: High tolerance

FUNCTION IN CCU VALUE CHAIN

- The technology **can handle raw flue gases** and can go up to liquid phase of CO_2; it doesn't require extra pre-treatment or compression.

LIMITATIONS

- Current results are demonstrated at pilot scale on site and neural network simulations. An industrial demonstration unit is being built (1kt/y – Start-up: Q4 2026).

ENERGY

- Electricity is the only source of energy. However, in case of fatal heat on site, heat could also be partially integrated.

CONSUMABLES

- Data below is for 13% CO_2 concentration in raw flue gas, with a recovery rate of 90% and an outlet purity of 99.9%, offering hand-to-hand treatment, from the stack to the pipe. Significant lower consumptions can be achieved in scenarios with higher concentrations, lower recovery rates or lower purities.

Energy and Consumables

Parameter	Value
Electricity (kWh/tCO_2)	440
Other consumables	-NA-

COSTS

The levelized cost of capture for a 1Mtpa capture plant with the scenario described above: €80/tCO_2, 25% coming from the CAPEX, 75% coming from the OPEX. Levelized cost is expected to go down by 30% in the coming years thanks to technological improvements. Levelized cost will be reduced if the flue gas has limited impurities, does not require a 99.9% purity or a 90% recovery rate.

CAPEX: €20/tCO_2

Main CAPEX: Not available.

OPEX: €60/tCO_2

Main OPEX: Electricity.

CO_2 capture cost: €80/tCO_2

Depends on scale, CO_2 concentration, flue gas impurities, recovery rate, CO_2 purity requirements.

CO_2 avoidance cost: Not available.

ENVIRONMENTAL

The environmental footprint of the installation will heavily depend on the energy mix used. Based on the average intensity of the Belgian mix (130gr CO_2 eq./kWh), it would represent 58kg of CO_2 per ton captured for the 440kWh/tCO_2 scenario, knowing that the energy footprint is the main part of the process emissions.

CO_2 footprint: 58 $kgCO_2eq/tCO_2$

Includes only emissions from electricity. Based on 130 kg-CO_2/MWh_e in Belgium.

Spatial footprint: 1 ha for 1 Mtpa unit.

Environmental issues: Not available.

ENGINEERING

Maturity: TRL 6, intermediate pilot being tested on industrial sites. Final pilot will be tested as of 2026 before first commercial contract by 2027.

Retrofittability: Feasible, thanks to its small footprint

Scalability: High (modular)

Process type: Physical separation using hybrid technology with cryogenic as the last step.

Deployment model: Only centralized.

Technology flexibility: High, no need of other technologies to be able to deal with different flow or concentration requirements.

TECHNOLOGY PROVIDERS

- Hybrid carbon capture by **ARK Capture Solutions,** Belgium.

INNOVATIONS

The two technologies suitable for low-concentration today are (1) amine-absorption and (2) anti-sublimation. While the amine-absorption is a well-known process, the anti-sublimation remains at a low TRL and will probably experience issues dealing with solid CO_2 on an industrial scale.

BENCHMARK or ALTERNATE PROCESS

Not available.

NOTE

The detailed information about the process are not shared on purpose. However, the credibility of ARK is backed by strong support from the industry, the background of the founders and the team, the intellectual property, the current partnerships with universities and research centers and the ongoing projects.

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REFERENCES

Information provided by ARK Capture Solutions.
https://www.arkcapturesolutions.com/

PARTNERS

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