

SkyClean

Carbon capture and bioenergy



Let's clean up Earth's atmosphere

The carbon negative paradigm shift

Solving the climate crisis cannot be achieved by reducing CO₂ emissions alone but also requires large-scale application of technologies that can remove CO₂ from the atmosphere. To achieve this, we need a low-cost technology with a huge potential, preferably one that also supplies multiple hard-to-abate sectors with carbon-neutral fuels.

SkyClean is precisely such a technology. The SkyClean process uses pyrolysis to create biochar as well as bioenergy from plant waste. Biochar is a stable material with the dual advantage of effectively removing and storing CO₂, while also serving as a soil enhancer for agriculture. SkyClean's bioenergy production represents a valuable revenue stream, effectively making SkyClean the only commercially viable carbon capture and storage technology available.

Ready to scale and deliver

Stiesdal Fuel Technologies has developed the SkyClean process to create a fully automated unit that can be manufactured by industrial processes. At the core of the technology is a robust pyrolysis reactor capable of transforming almost any kind of biogenic feedstock into biochar and biofuels. The biofuels can be supplied in the form of syngas, high-grade bio-oil, and optionally as downstream refined products such as methanol.

All components of a SkyClean unit are designed for mass production, facilitating rapid ramp-up. With its combination of industrialized low-cost components and relatively low-tech setup, SkyClean is the lowest cost large-scale carbon capture and storage technology available. Adding to this is the soil improvement potential of biochar, which ultimately begs the question: "When can we get started on cleaning up Earth's atmosphere?"

"The lowest cost, large-scale climate mitigation technology"



Transforming plant waste to value streams: The SkyClean process delivers a combination of biochar and hydrocarbons for use as fuel in industrial processes or transportation. The biochar fraction represents CO₂ captured from the atmosphere. Biochar can be spread on agricultural soil to serve as a fertilizer. Here, the carbon captured from the atmosphere is sequestered for centuries or millennia.



Straw pellets for pyrolysis: SkyClean can convert almost any type of organic waste into biochar and fuel. The list of suitable SkyClean feedstocks includes all the major types of waste from agriculture and forestry, enabling the application of the concept on a truly global scale.



SkyClean biochar: The SkyClean process produces high-grade, tar-free biochar suitable for carbon capture as well as for use on agricultural soil as fertilizer and for soil improvement.

Delivering high-impact climate action

How SkyClean works

The core of SkyClean is a pyrolysis process in which organic waste from agriculture and forestry is converted into biochar, gas, and oil by subjecting it to high temperatures without the presence of oxygen.

Dry plant material typically contains approx. 50% carbon that plants have extracted from the atmosphere in the form of CO₂. In the process, half of the carbon content of the bio waste is converted to biochar, and thus effectively removed from the atmosphere, while the other half is converted into carbon-neutral oil and gas, applicable as green fuel in various economic sectors.

Robust and reliable pyrolysis

SkyClean pyrolysis plants are designed for reliability. The operating temperature is kept at a maximum of 650° degrees Celsius. Feedstocks are dried and pelletized, facilitating a smooth and controlled production as well as a uniform biochar product.



Biochar – a boost to sustainable farming

Apart from being a low-cost, high-impact CCS agent, biochar offers a surprising array of advantages to agriculture:

Biochar is effective for soil improvement, particularly sandy or depleted soils.

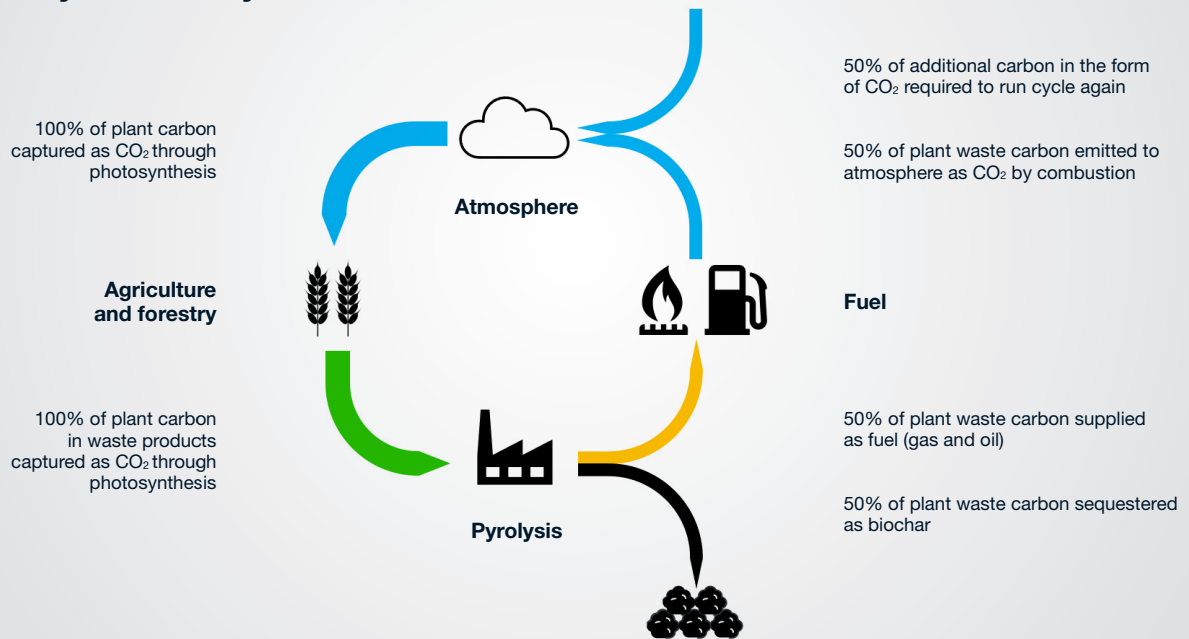
All potassium and phosphorus nutrients in the feedstock are retained in the biochar, adsorbed in mineralized form. The nutrients gradually leech into the soil, acting as conventional fertilizers.

Biochar also reduces leeching of nitrogen, and residues of pesticides and antibiotics are eliminated.



Read more at
www.stiesdal.com

Carbon cycle with SkyClean



A positive paradox: Due to the nature of the SkyClean process, where half of the carbon in agricultural residues is stored as biochar in each cycle, SkyClean achieves the paradoxical but highly beneficial effect of removing more CO₂ from the atmosphere, the more fuel the plant produces.

Storing CO₂ on farmland

The biochar pellet output from the SkyClean process is easily handled and sequestered on farmland with existing farm methods and machinery. It will integrate with farming at any stage of technological development.



A new sustainable fertilizer: Carbon is sequestered for millennia with soil enhancing high-quality biochar.

Multipurpose green energy

The gas and oil produced by the SkyClean process can substitute fossil fuels. For hard-to-abate sectors like heavy industry, agriculture, and transportation, SkyClean fuel is a pathway to game-changing, net-zero emissions.



Heavy Industries: Conversion from fossil fuel combustion to SkyClean fuel combustion will usually require only moderate investment.



Flying on carbon negative SkyClean fuel

One of the ultimate end-products of SkyClean is jet fuel, which is produced in a process that removes carbon from the atmosphere. This means the more fuel is burned, the more CO₂ is removed from the air, a truly paradigm-shifting path to a clean energy future.

Unlike many still-to-be-developed climate technologies, SkyClean is ready to deliver at scale. SkyClean is ready to challenge several of the most challenging problems facing humankind in the climate crisis:

- Potential for large-scale, low-cost, and sustainable removal of CO₂ from the atmosphere.
- Significant reductions of emissions from agriculture, including methane from manure.
- Significant reductions of emissions from heavy industries.
- Offering new pathways to solving the climate crisis without drastic cuts to vital production and living standards.

0.8

Sequestered tons of CO₂ per ton of dry matter feedstock

0.5

Avoided emission tons of CO₂ per ton of dry matter feedstock

250.000

Number of 20 MW SkyClean units needed to remove 10 gigatons of CO₂ annually from the atmosphere.

The Stiesdal approach

At Stiesdal, we define ourselves by our ability to innovate with impact.

The Stiesdal Company was founded with the purpose of developing and commercializing technologies that have major impact on mitigating climate change. This purpose is fundamentally rooted in a conviction that more needs to be done, and that real impact can be achieved through innovation.

The creation of jobs is an additional and highly important purpose of the Company. Our aim is to positively impact and benefit local communities and to think job creation into our activities.

We pursue innovative solutions that are suitable for industrialization in the belief that cost reduction is the strongest single driver of clean technology implementation.

Our approach is therefore the same across all our technologies. To achieve true impact, we always strive for game-changing levels of cost reduction. We continuously challenge ourselves, questioning what it takes for every aspect of every technology to become the cheapest without sacrificing on safety or performance.

We know from experience that volume and scale are the ultimate cost-cutting factors, which is why we optimize all our solutions for standardization and modularization to achieve streamlined industrial processes and mass production.

No new technology leaves our design offices, laboratories or workshops without a clear strategy for industrialization. If an innovative technology promises to make meaningful impact on the decarbonization of society, it must be ready-to-scale from the very beginning. This is the path that gives innovation true impact. And this is what lies in our DNA.



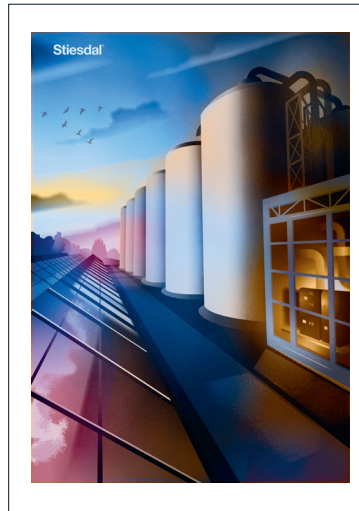
“Innovation with impact. It is in our DNA”



Stiesdal Offshore Technologies

Target: Unlimited low-cost offshore wind energy made globally available.

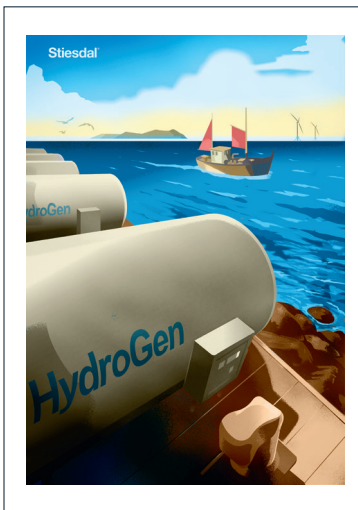
Means: The modular Tetra foundation concept, the world's first industrialized floating wind foundation.



Stiesdal Storage Technologies

Target: Firm power and energy security from renewables.

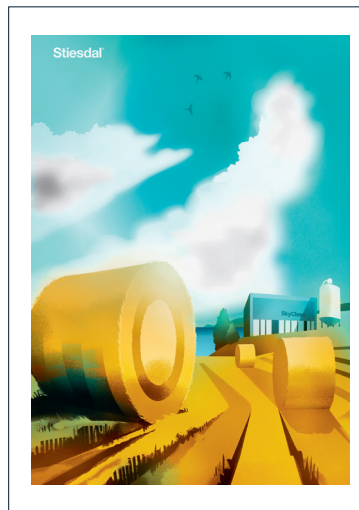
Means: The GridScale thermal energy storage system with 10 hours to 10 days capacity.



Stiesdal PtX Technologies

Target: Application of renewable electricity across all sectors.

Means: The HydroGen electrolyzer unit for low-cost green hydrogen production.



Stiesdal Fuel Technologies

Target: Affordable carbon capture and sequestration.

Means: The SkyClean system combining green fuel production and carbon capture and sequestration.



Stiesdal®

www.stiesdal.com
info@stiesdal.com

©2021 Stiesdal A/S. All rights reserved.
 All specifications in this document are for information only and are subject to change without notice. No expressed or implied representations or warranties regarding the adequacy or accuracy of the information are given. Certain technical options, services and wind turbine models may not be available in all locations or countries.

