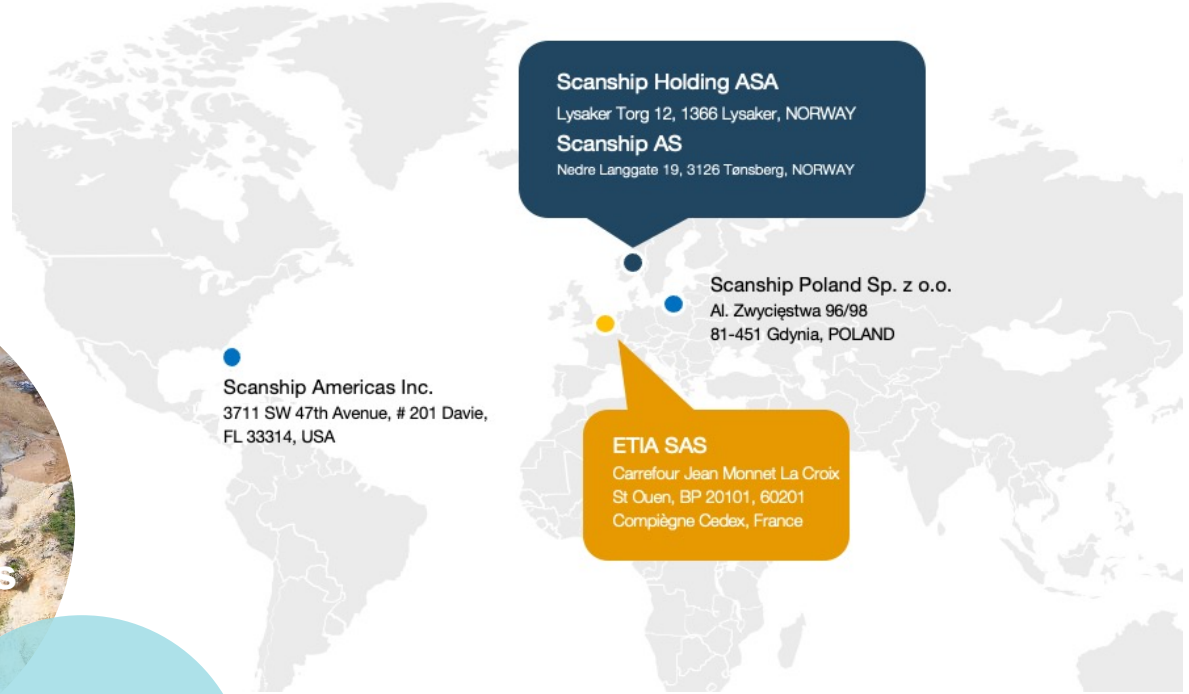
Technologies for Decarbonisation

www.vowasa.com

CORPORATE INTRODUCTION

ABOUT OUR GROUP

VOW ASA
www.vowasa.com
Stock listed company
Employees approx. 150
Revenue approx. 42 m€



BIOGREEN INTRODUCTION

IMPORTANCE OF CARBON REDUCTION

Corporate Social Responsibility

Carbon mitigation strategies and roadmaps to become climate neutral becoming a cornerstone activity for industrial groups

Fossil fuel independence

Increasing effort towards elimination of coal and natural gas in the industry driven by both price uncertainty as well as sustainability

Future is electric

Growth of the renewables providing easy access to low carbon electricity and prioritizing it as main energy source

Carbon tax increase

Considered as most powerful tool to combat the climate change, carbon tax is increasing rapidly

Waste generation

Increasing amount of waste and residues resulting from activities and demanding efficient valorisation

CUSTOMERS

Sustainable tourism

Reduction of CO_2 emissions, Reaching CO_2 Neutrality

Industry 4.0

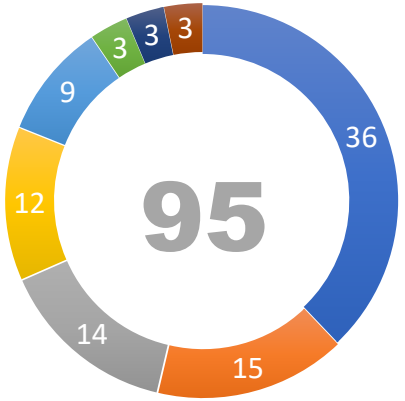
Preventing foodborne illness

Circular economy solutions to recover valuable resources and eliminate pollution

Clean Ship	Biomass and Waste Valorization - Industry Decarbonization	Chemical Recycling of Plastics & Polymers	AI Waste Sorting Robotics	Food Safety
NCL NORWEGIAN CRUISE LINE	REPSOL	ArcelorMittal	Unipetrol CHLEN GROUP	SICON. DEDICATED TO PERFORMANCE	naturactiva
MEYER TURKU	envigas	Lindum	TINFOS	PICVISA OPTICAL SORTING	Dilmah
Carnival	NSR	KOBELCO	CITEO	mi MURFITTS INDUSTRIES	OP PLASTIC CAPPING	ACTEMIUM	THE CEYLON SPICE CO
msc FINCANTIERI	CIRCULARCARBON				

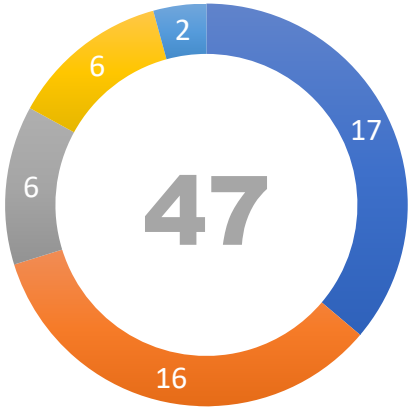
VOW

MULTIPLE SOLUTIONS DELIVERED



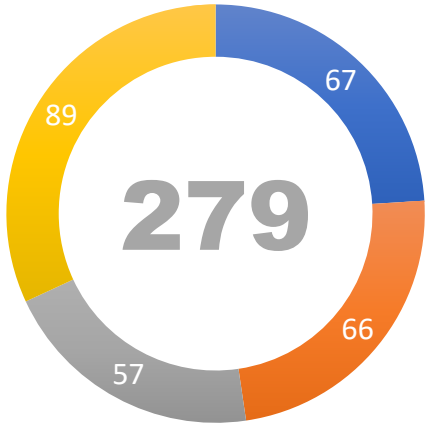
FOOD TECHNOLOGY

- Spices
- Other food
- Herbs
- Flour
- Vegetables
- Liquid smoke
- Nuts
- Seeds



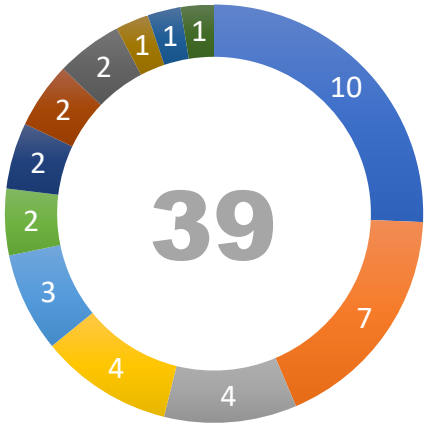
PYROLYSIS AND CALCINATION

- Plastics and polymers
- Biomass
- Other
- Sludge
- Calcination



CRUISE TECHNOLOGIES

- Garbage Handling
- Foodwaste
- Sludge Handling
- Advanced Wastewater Purification



AUTOMATION AND ROBOTICS

- Automotive
- Railway
- Other
- Packaging
- Steel
- Aeronautics
- Cables
- Nuclear
- Pharmaceuticals
- Energy
- Textiles
- Waste

TECHNOLOGY

BIOGREEN: SPIRAJOULE INSIDE

Spirajoule - Electrically heated screw conveyor

Process temperature **easily adjusted** up to 850°C

Industrial and proven technology

Simple, easy to operate

Robust, low maintenance

Plug flow system, homogenous treatment

Fossil free technology

Flexible: capacity to reach each product specifications

A precise, continuous and homogenous treatment for high quality final products

MAIN APPLICATIONS:

HEATING IN CONTROLLED ATMOSPHERES

Oxidising conditions (power to heat)	Reducing conditions (pyrolysis)

Electrified

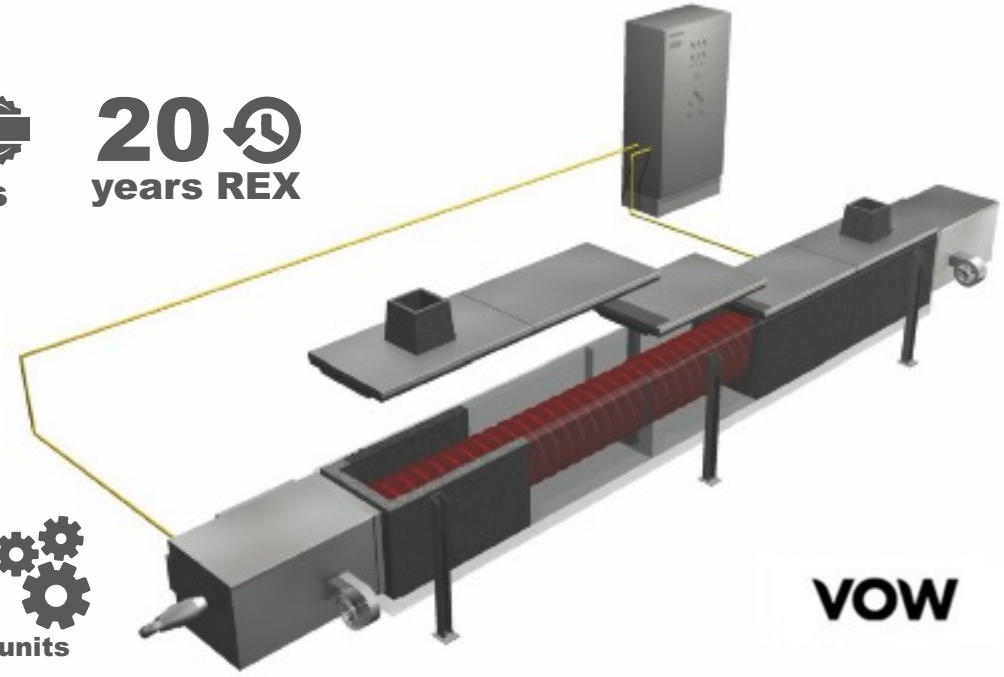
Joule effect
Screw as a resistance heater

Archimedes – 287 BC
Screw conveyor

ETIA – 1999
Electrically heated screw conveyor

10 patents

20 years REX



150 installed units

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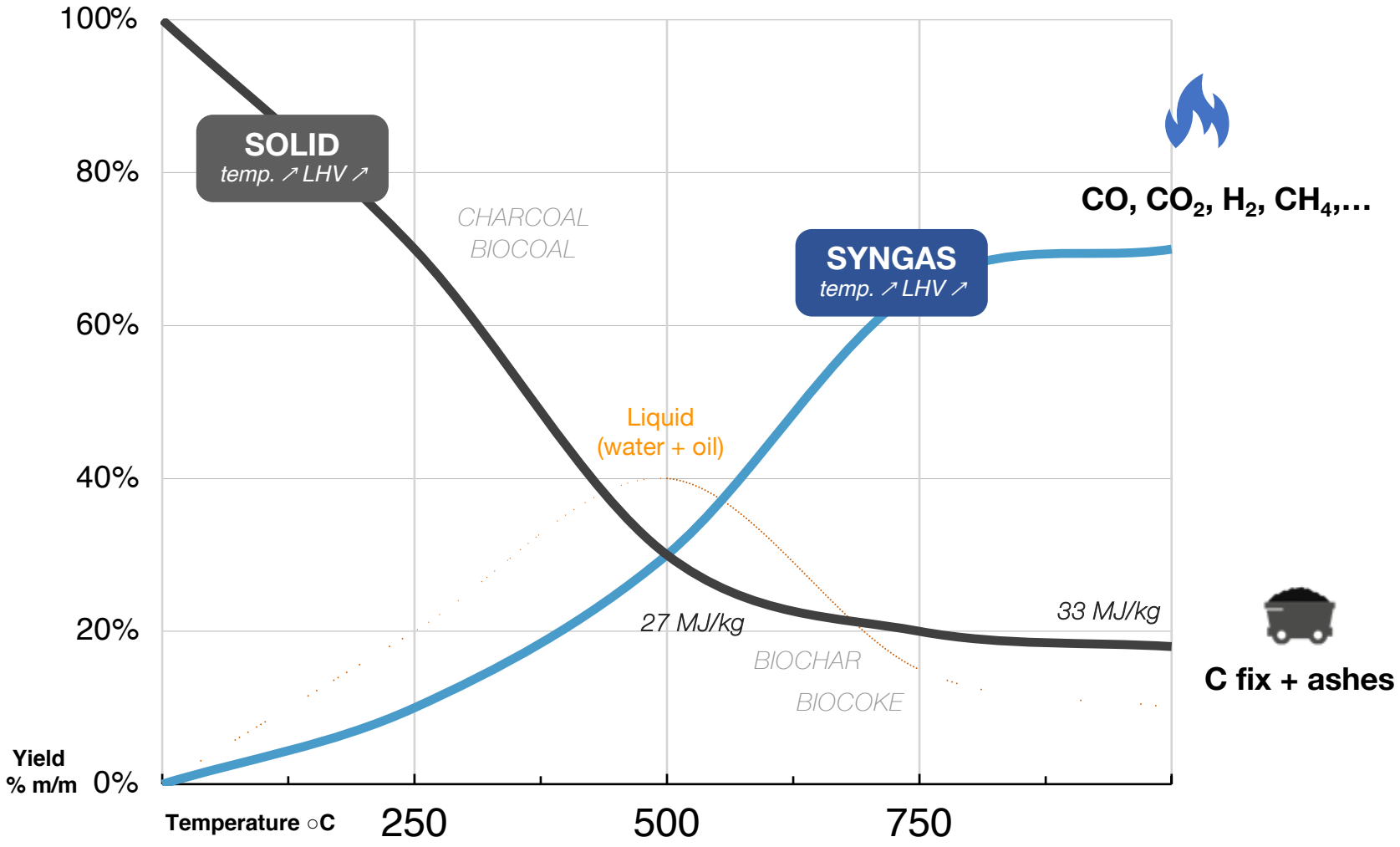
CORPORATE PRESENTATION

FINE TUNED PROCESS CONDITIONS



HIGH QUALITY PRODUCTS

Technology to optimise your product characteristics

Torrefied bagasse

Solid fuel replacement
Density 0.8 (800 kg/m3)
LHV 16 MJ/kg (vs. 13 MJ/kg raw material)

400 ºC / 10 min.

Carbonised olive pomace

Solid fuel replacement
Density 0.7 (700 kg/m3)
LHV 26 MJ/kg (vs. 18 MJ/kg raw material)

550 ºC / 10 min.

Hydrochar WB10

Soil amendment
Water retention 85%
Total carbon > 65%
Granulometry 0.125 - 4 mm

550 ºC / 15 min.

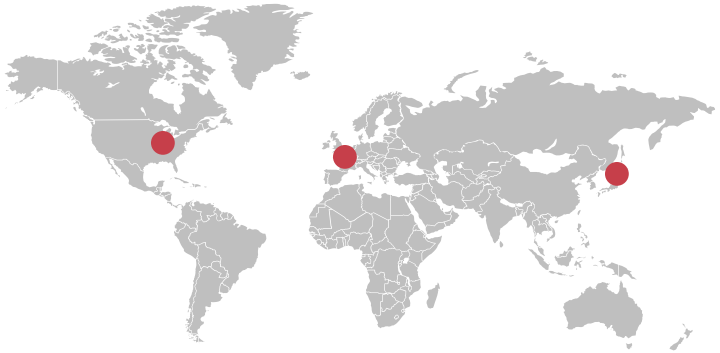
Biochar from HT pyrolysis

Activated carbon precursor
Total carbon 92%
ash 4%
LHV 33.03 MJ/kg (vs. 19 MJ/kg raw material)

800 ºC / 15 min.

CORPORATE PRESENTATION

TESTING CENTERS



Our strategy: world-wide competence centers.

Around 100 tests each year since 2009

Process performance measurement

Analysis of the feedstocks and syngas composition

Mass and energy balance of the process

Performing the small scale thermochemical process on pilot equipment provides the information necessary for designing industrial unit according to performance and business model validation

BIOGREEN PRODUCT RANGE

FROM PILOT SCALE TO INDUSTRIAL PLANTS

RnD units

Mobile and stationary pilot equipment for testing and development of new bio-based products

Containerised units

Compact, plug & play equipment for simple installation and easy configuration on site.

Stationary plants

High capacity equipment for stationary applications, often several machines operating in parallel.

IMPLEMENTATIONS

CASE STUDIES

VALUE PROPOSITION

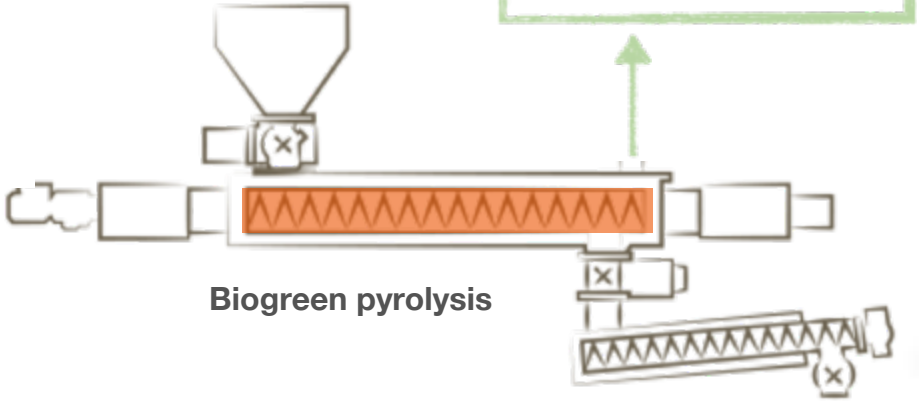
CARBON NEGATIVE SOLUTION

CO_2 saving

Transport avoidance

Dry biomass
(approx. 10% MC)
7500 tonnes/a

electricity



Biogreen pyrolysis

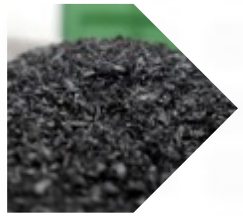
Biochar cooling

combustion chamber
steam generator

SYNGAS
mixture of condensable
vapours and calorific gas

CO_2 saving

STEAM PRODUCTION
Replacement of natural gas
Heat production (from syngas): **22 500 MWh/y**
2,5 millions m3 of natural gas (fossil) avoided
4 000 tonnes/year CO_2 saving



CO_2 saving

BIOCHAR PRODUCTION
Carbon sequestration
Biochar production
1500 t/y biochar | 1 tonne of biochar sequesters
2.5 tonnes of CO_2
3750 tonnes/year CO2 saving

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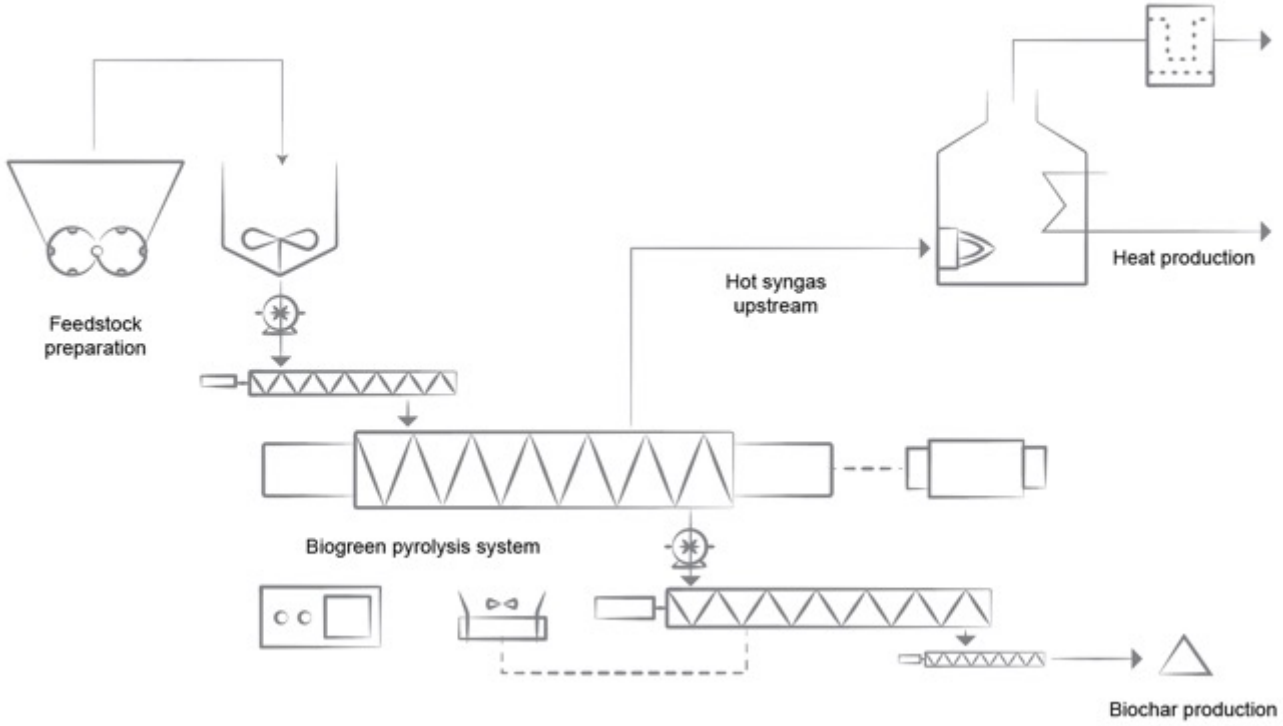
Customer testimonial:
“By using the Biogreen solution, approx. 7000 tons of wood waste will become approx. 1500 tons of biochar sequestering approx. 3000-4200 tons of CO2 annually.”

CORPORATE PRESENTATION

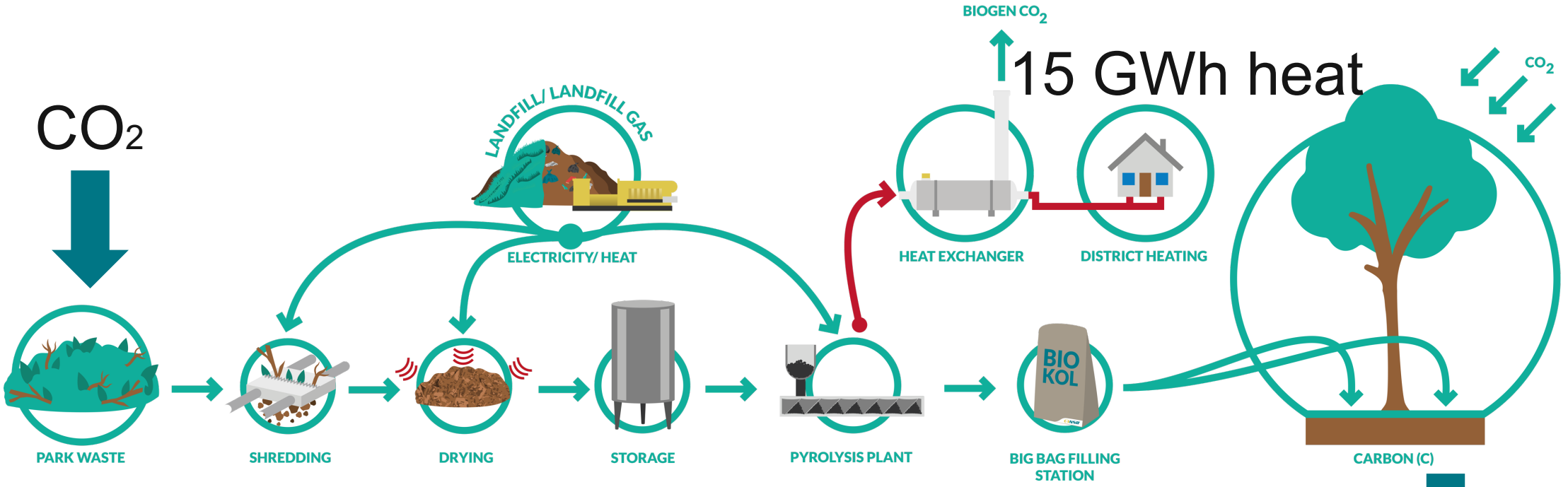
BIOCHAR PRODUCTION

CONVERSION OF GARDEN WASTE INTO VALUE



VALUE RECOVERY FROM WASTE – CARBON SEQUESTRATION – CIRCULAR ECONOMY WITHIN THE REGION

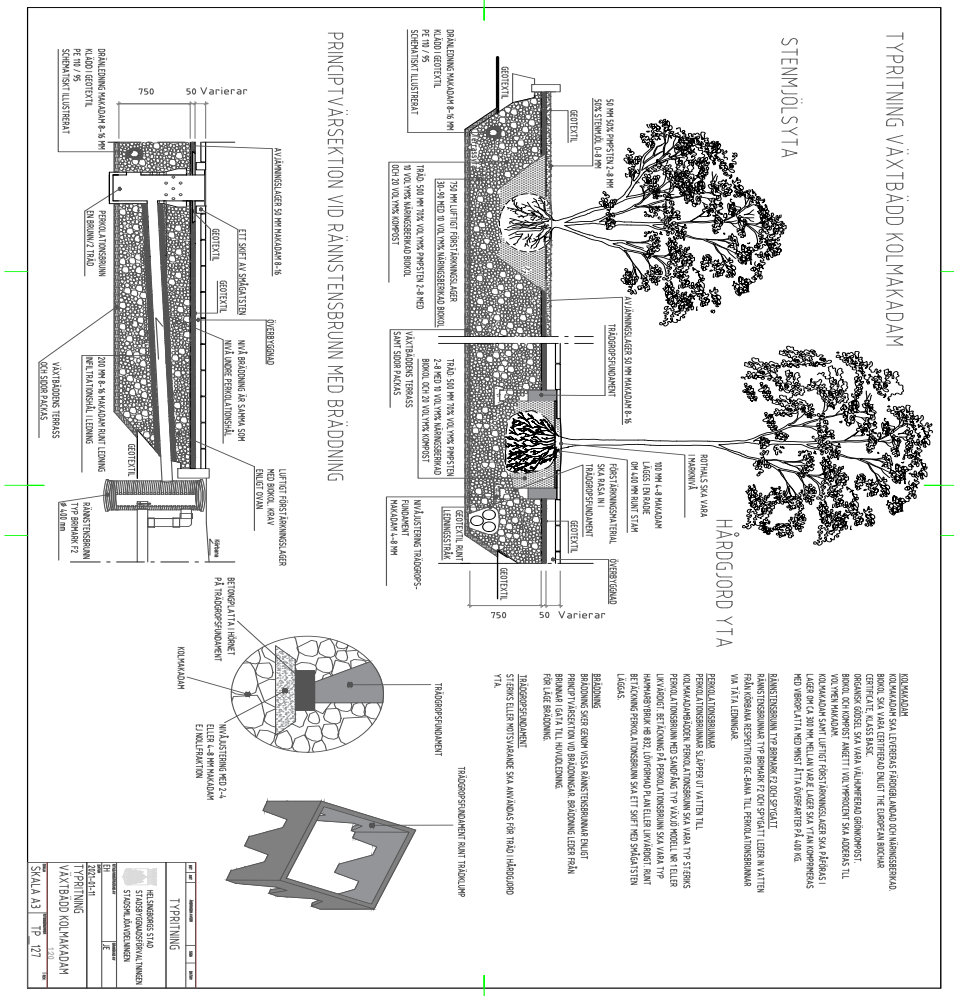
Beyond circularity – CO_2 sequestration

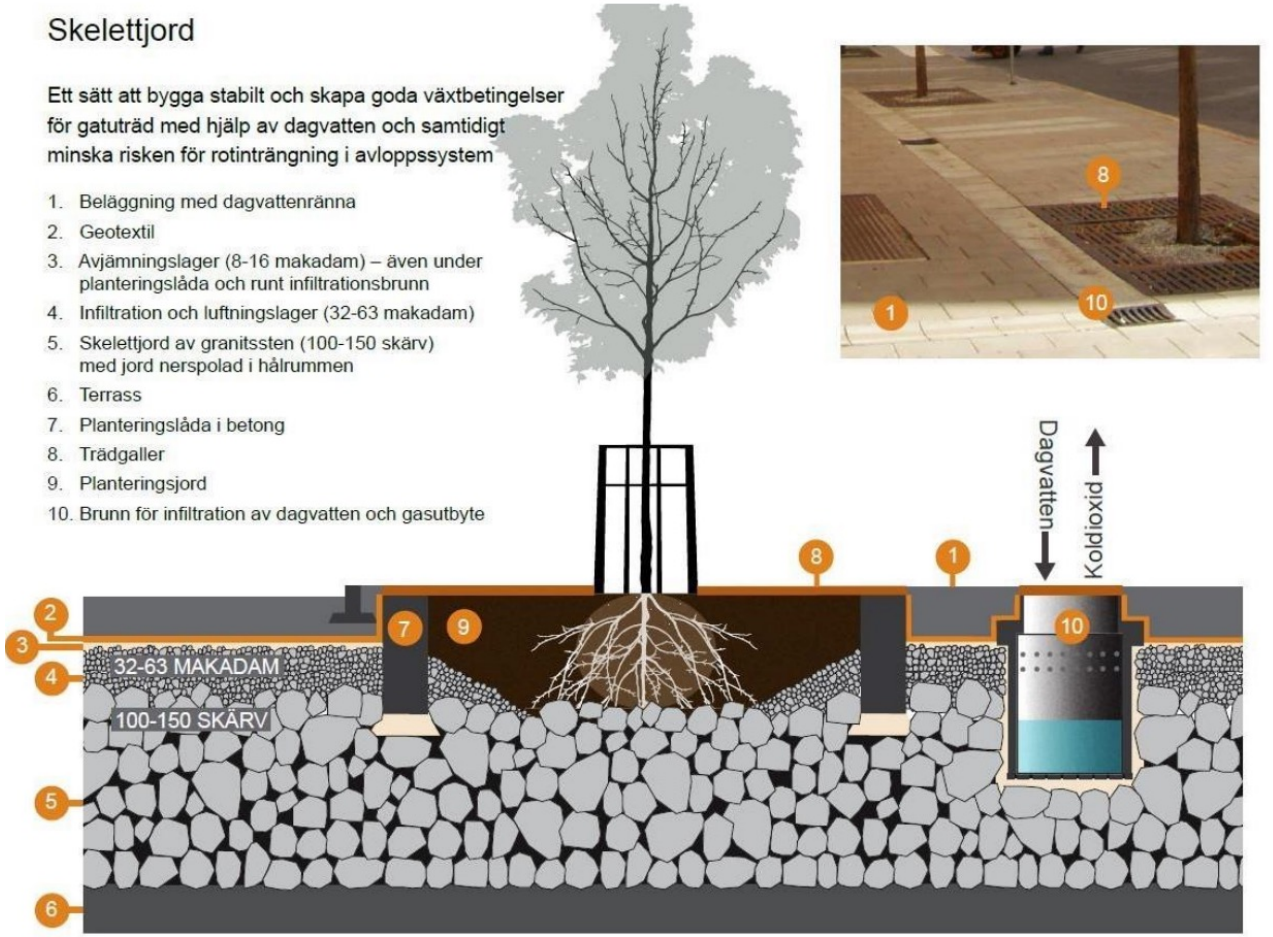


1500t biochar

3000t carbon sink

Primary market – Structural organic soils





What else can biochar be used for?

IKEA | H22

Sustainable growth in collaboration with the local waste plant

The IKEA involvement at H22 is growing, each day, quite literary. And now with the help of biochar it will grow even better in the newly founded flower beds that will surround the IKEA pavilion Magasinet in the harbor. As trials are being done right now, we are ensuring that fantastic midsummer flowers will blossom in 2022 as well as creating a carbon sequestration, funnily enough.

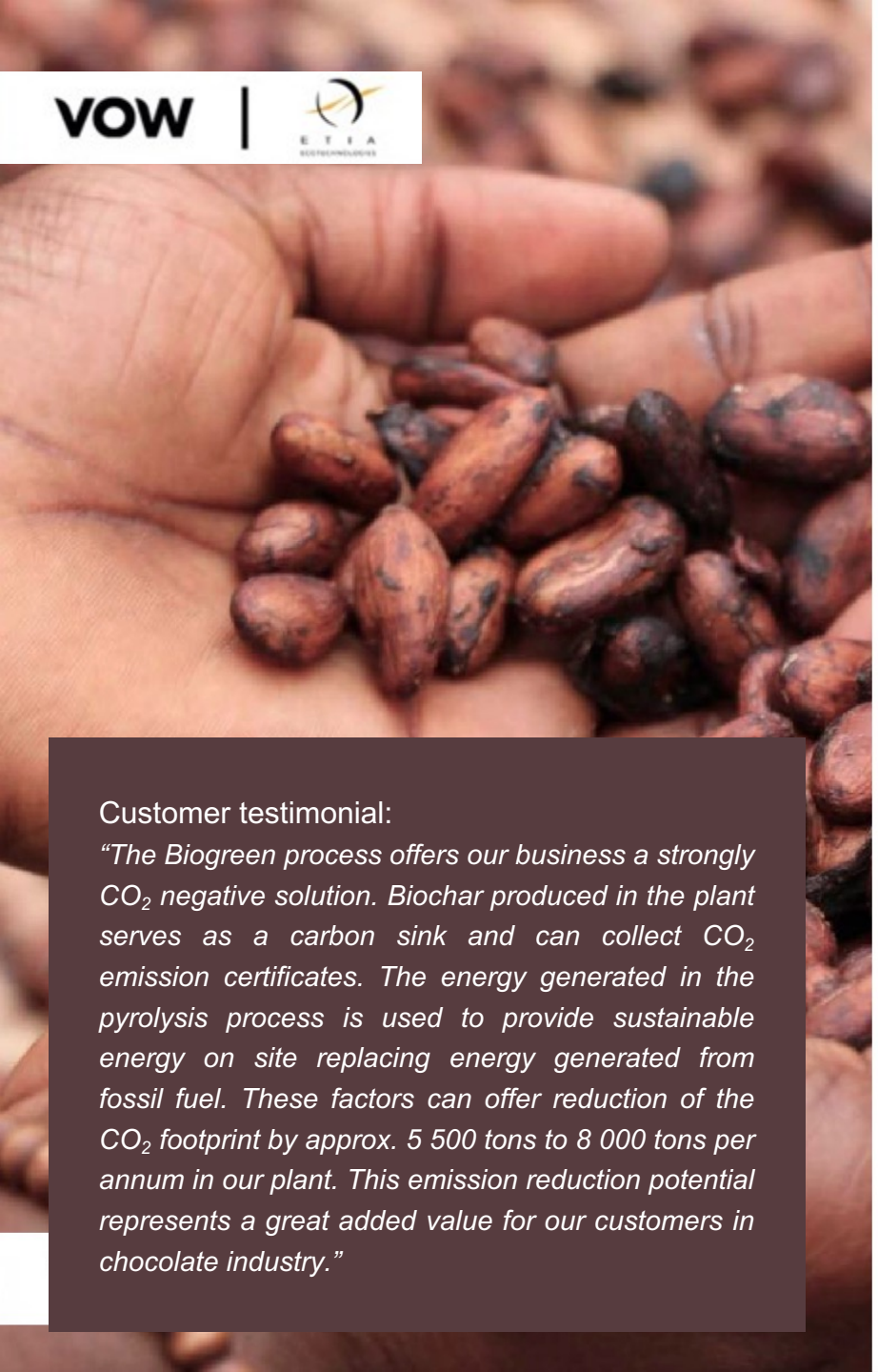
24 JUN. 2021

https://h22.ikea.com/

Peat substitution – Re-cycled Soils

CO2 neutral concrete

Chemical stabilization of soils



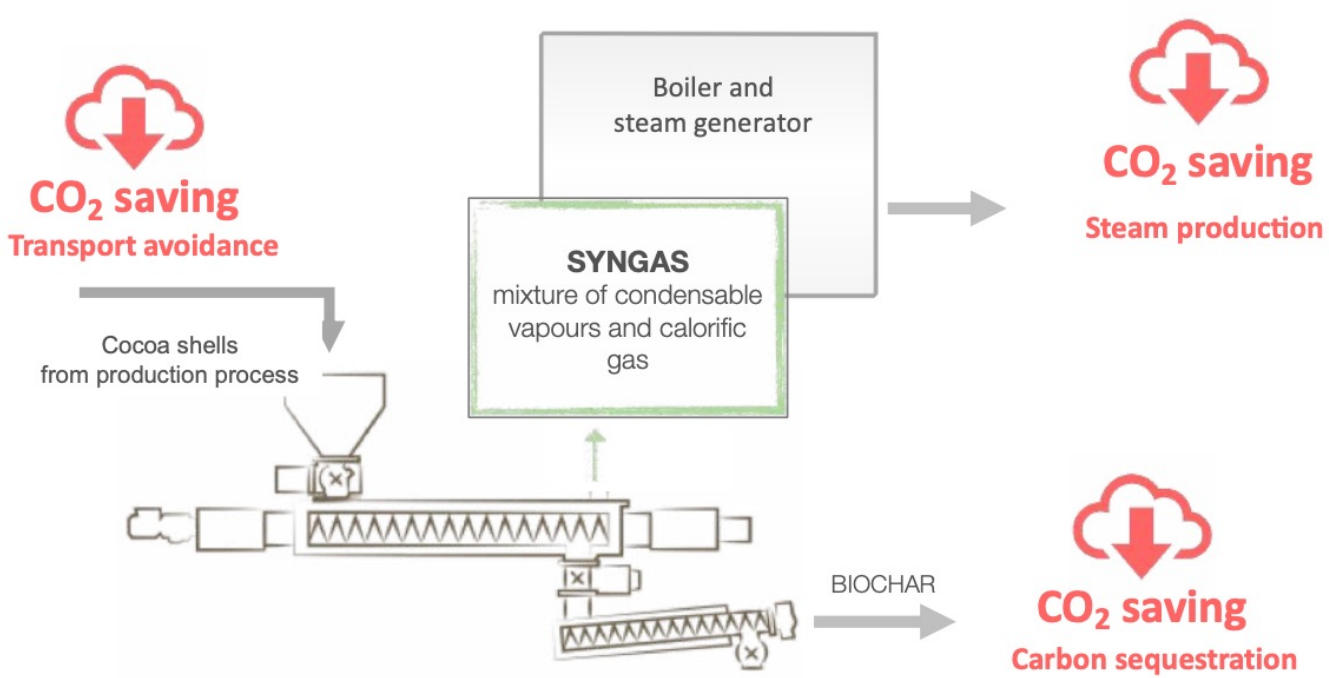
Customer testimonial:

"The Biogreen process offers our business a strongly CO_2 negative solution. Biochar produced in the plant serves as a carbon sink and can collect CO_2 emission certificates. The energy generated in the pyrolysis process is used to provide sustainable energy on site replacing energy generated from fossil fuel. These factors can offer reduction of the CO_2 footprint by approx. 5 500 tons to 8 000 tons per annum in our plant. This emission reduction potential represents a great added value for our customers in chocolate industry."

BIOGREEN INTRODUCTION

BIOCHAR AND STEAM

DECARBONIZATION OF FOOD SECTOR (GERMANY)



VALUE RECOVERY FROM RESIDUES – CARBON SEQUESTRATION – CIRCULAR ECONOMY

LAUNCHING VOW GREEN METALS

And the Follum plant

- **Business idea** | Build, own and operate full scale plant based on Vow's process technology
- **Production** | Biocarbon to replace fossil coke as a reducing agent in the metallurgical industry in Norway, as well as providing CO2 neutral gas for district heating and low-carbon fuels
- **Setup** | Base for development of fully standardized and replicable facilities
- **Financing** | Through Enova grants pending approval, debt and equity

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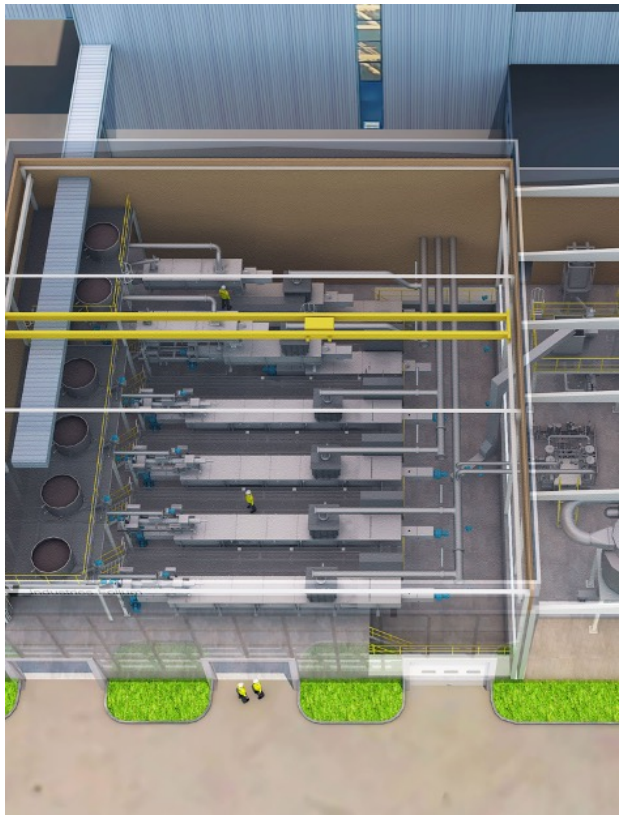
TECHNOLOGY PRESENTATION

FOLLUM PLANT



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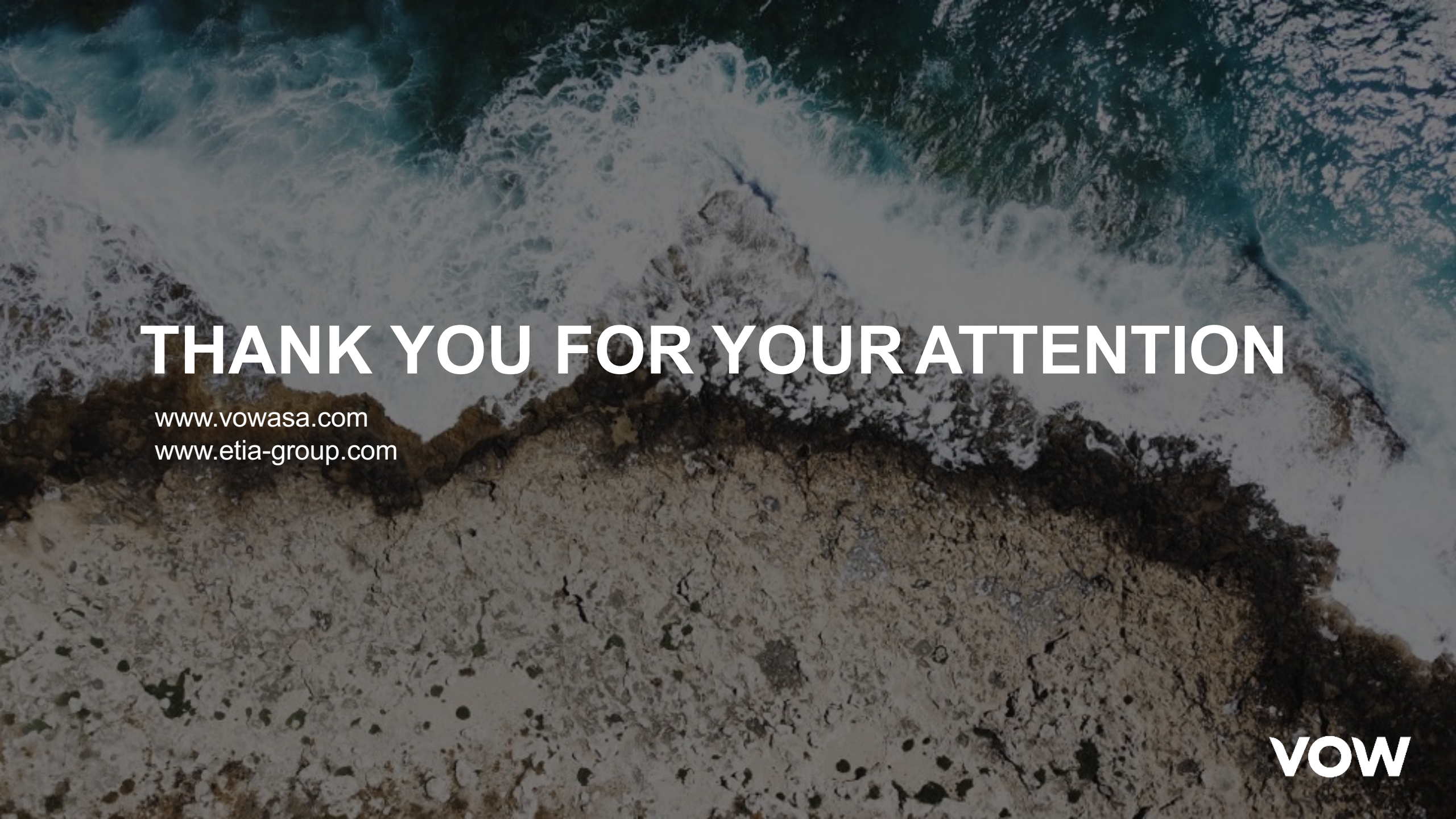
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