Technologies for Decarbonisation

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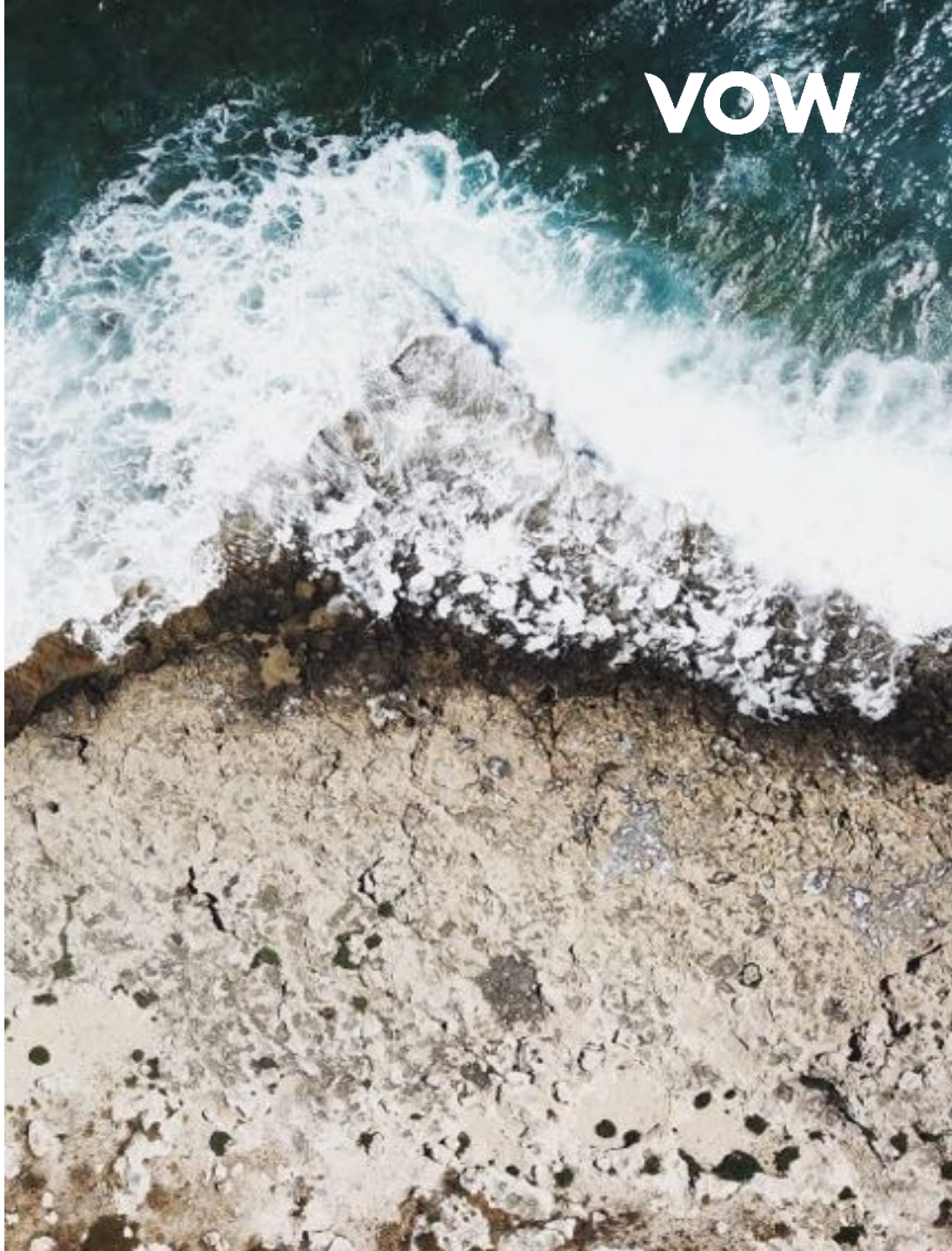
CORPORATE PRESENTATION

SUMMARY

1. Corporate presentation
2. Biogreen technology
3. Biomass applications
4. Sludge and digestate
5. Polymers and plastics
6. Summary



ABOUT VOW AND ETIA

OUR DRIVERS

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

CRUISE INDUSTRY CLIENTS

leading position with 253 systems in operation and 127 systems on order

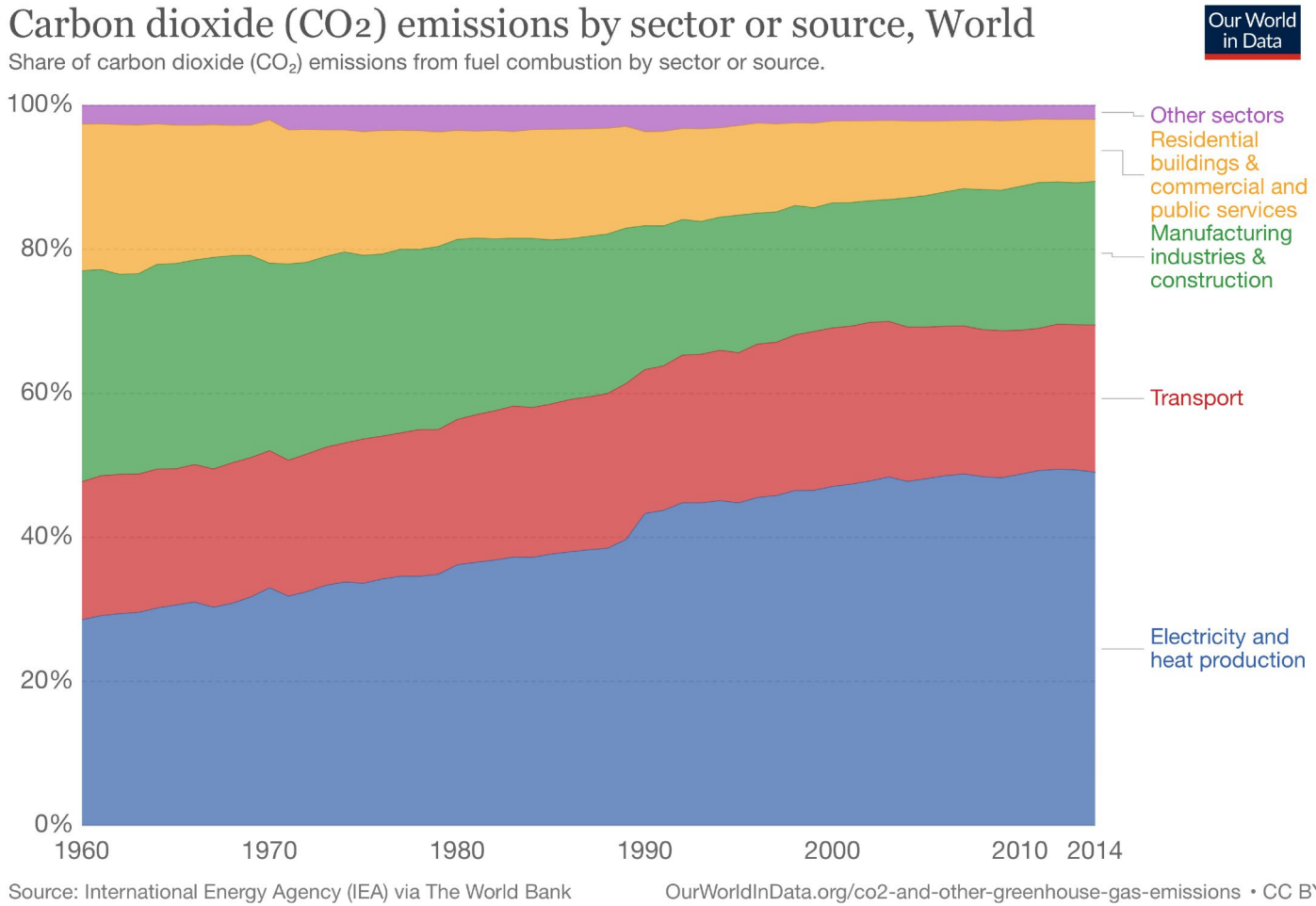
LAND BASED INDUSTRY CLIENTS

leading position with 150 systems in operation and 9 systems on order

IMPORTANT DIFFERENTIATORS

	COMBUSTION - INCINERATION Fumes	GASIFICATION Gas	PYROLYSIS Gas, Liquid, Solid
Objective	To eliminate the waste	To produce syngas from waste	To recycle the waste into chemicals
Main output	CO2, H20	CO, H2, (N2)	CH4, H2, CO, O2, C, OIL
Principle	Complete combution	Partial combustion	No combustion
Energy to run the process	Combustion of the waste	Partial combustion of the waste	External
Syngas production	0	High	Medium to high
Syngas calorific value	-	Low	High
Syngas valorization	-	Heat, steam, electricity, molecule	Heat, steam, electricity, molecule
Oli production	0	0	Medium to high
Oil valorization	-	-	Fuel, green based molecule
Char production (C)	0	Almost 0	Low to high
Char valorization	-	-	Biocoal (fuel) Biochar (soil) Biocoke (Metallurgy) Carbon black,…
Added value output	($) (Heat)	$$ (Syngas)	$$$ (Syngas, liquid, solid)
Impact on carbon footprint	0 (CO2 emission)	+ (if CO and CO2 captured)	++ (C sequestration)

SOLUTION RELEVANT TO THE PROBLEM



Carbon sequestration (biochar)

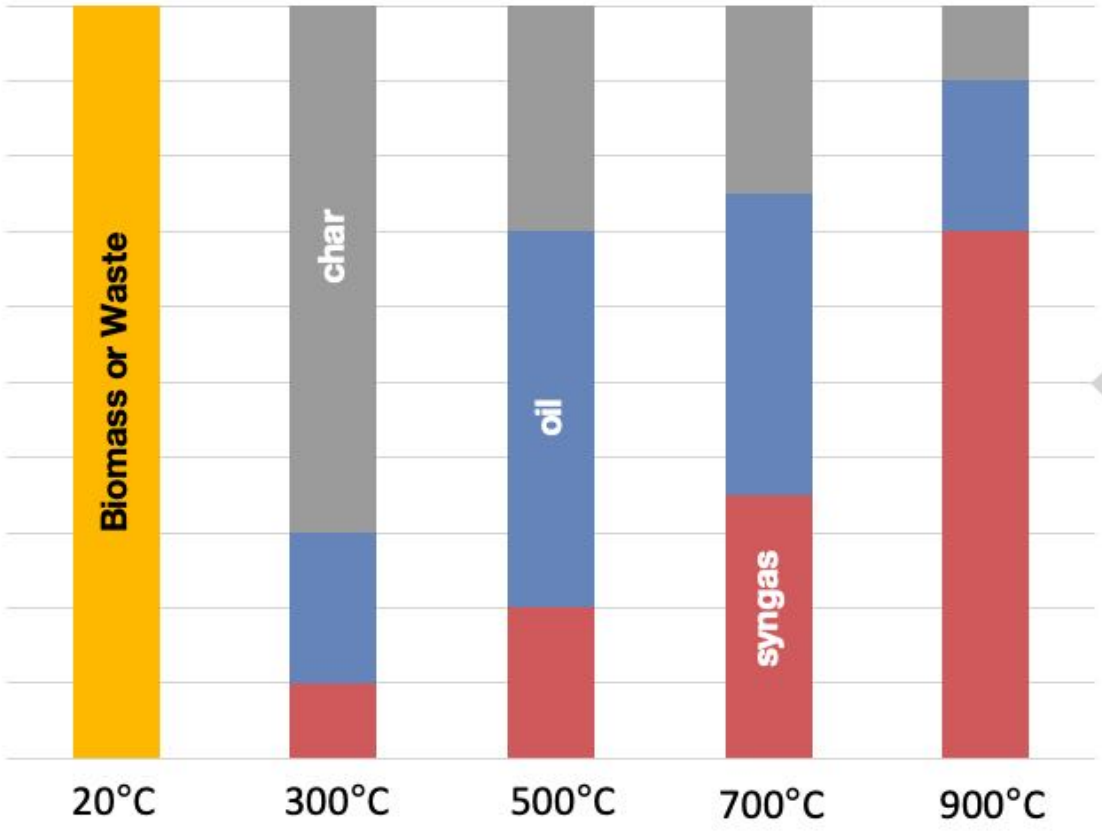
Recycling (sorting)

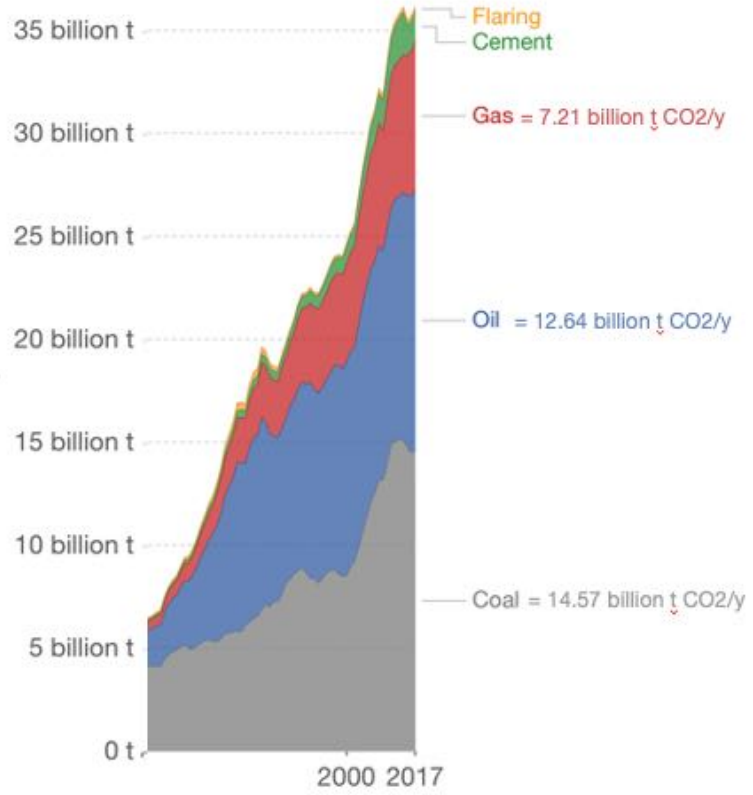
Biomass & waste to chemicals, food sanitation

H2 and CH4 from waste

Syngas and electricity Liquid fuel
Biofuel (biocoke, biocoal)
Renewable energy
Energy storage

IMPACT TOWARDS RENEWABLE ENERGY





Pyrolysis can allow to convert waste to substitute fossil solid, liquid and gas fuels - depending on operating conditions

TECHNOLOGY

SALES STRATEGY

BIOGREEN: SPIRAJOULE INSIDE

Spirajoule - Electrically heated screw conveyor

Process temperature **easily adjusted** up to 850°C (1200°C under development)

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

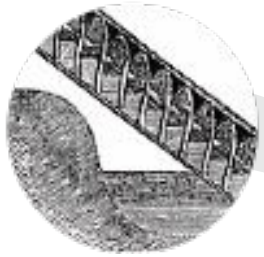
A precise, continuous and homogenous treatment for high quality final products

MAIN APPLICATIONS:

HEATING IN CONTROLLED ATMOSPHERES

Oxidising conditions (power to heat)

Reducing conditions (pyrolysis)



Electrified

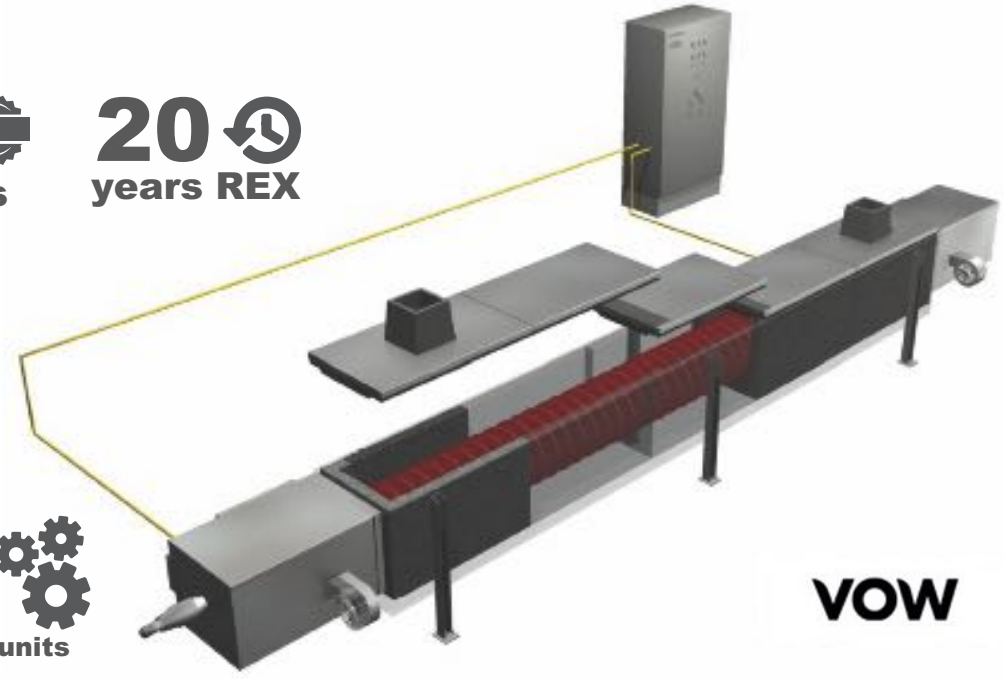
Joule effect
Screw as a resistance heater

Archimedes – 287 BC
Screw conveyor

ETIA – 1999
Electrically heated screw conveyor

10 patents

20 years REX



150 installed units

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SALES STRATEGY

KEY FEATURES

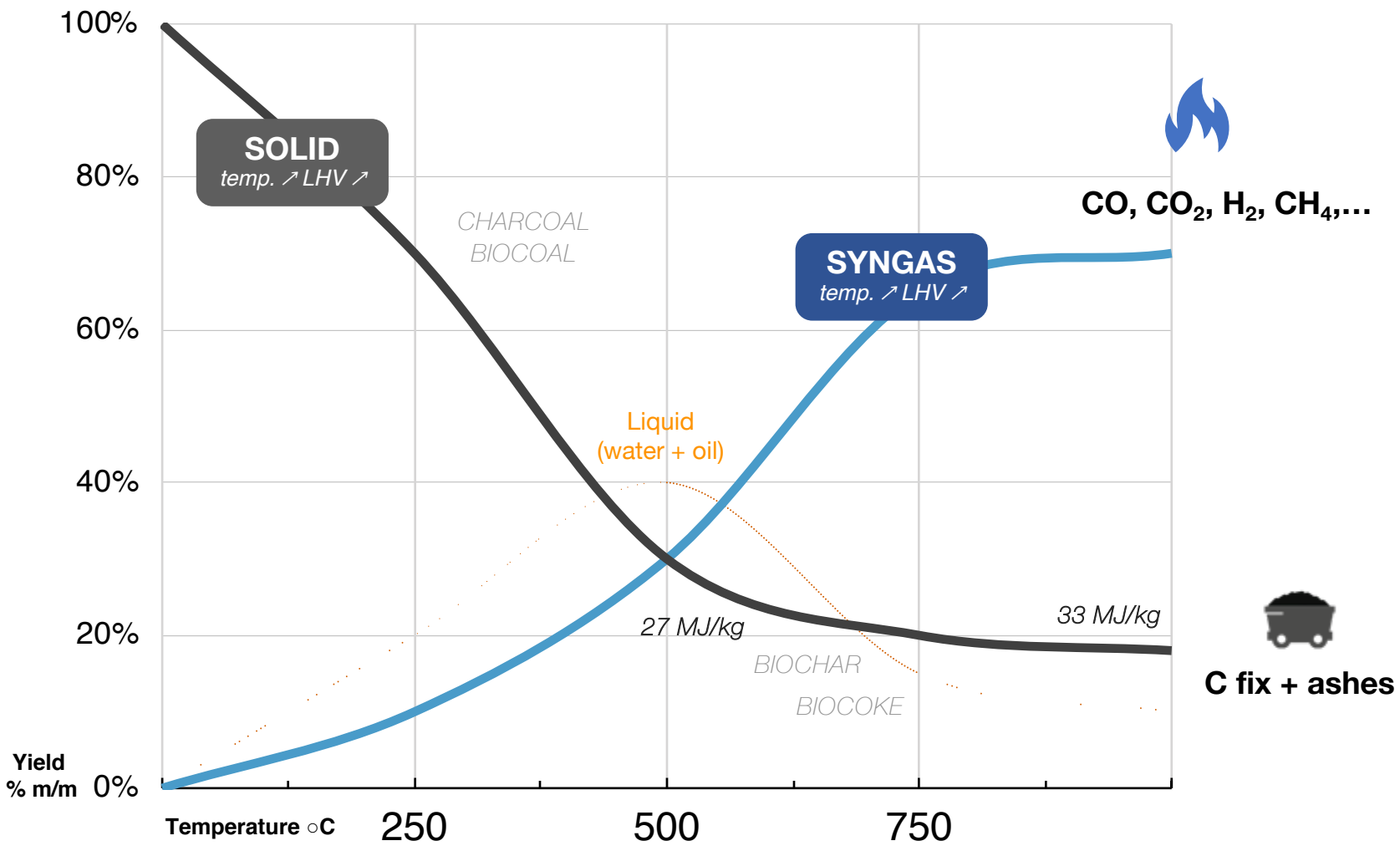
- Complete solution for your business
- Strong business model
- Wide range of feedstock
- Powered by electricity
- Precision of treatment
- Adjustable operating conditions
- Track record of over 15 years

Biogreen®
Continuous pyrolysis since 2003

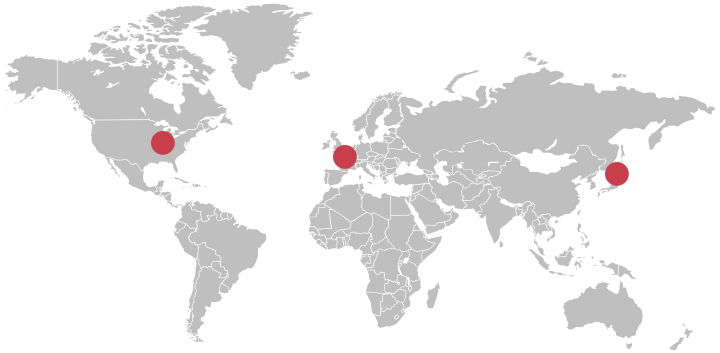
SALES STRATEGY

IMPLEMENTATIONS

FINE TUNED PROCESS CONDITIONS



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.

BIOMASS TREATMENT

CORPORATE PRESENTATION

CARBON NEGATIVE SOLUTION

CO_2 saving

Transport avoidance

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

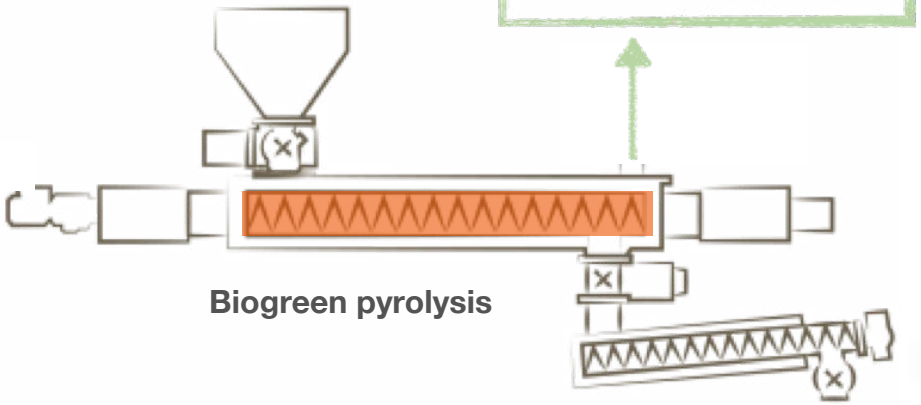
combustion chamber
steam generator

SYNGAS
mixture of condensable
vapours and calorific gas

CO_2 saving

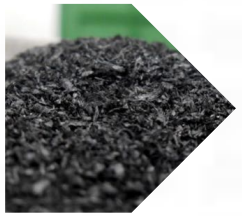
STEAM PRODUCTION
Replacement of natural gas
Heat production (from syngas): **22 500 MWh/y**
2,5 millions m3 of natural gas (fossil) avoided
4 000 tonnes/year CO_2 saving

electricity



Biogreen pyrolysis

Biochar cooling



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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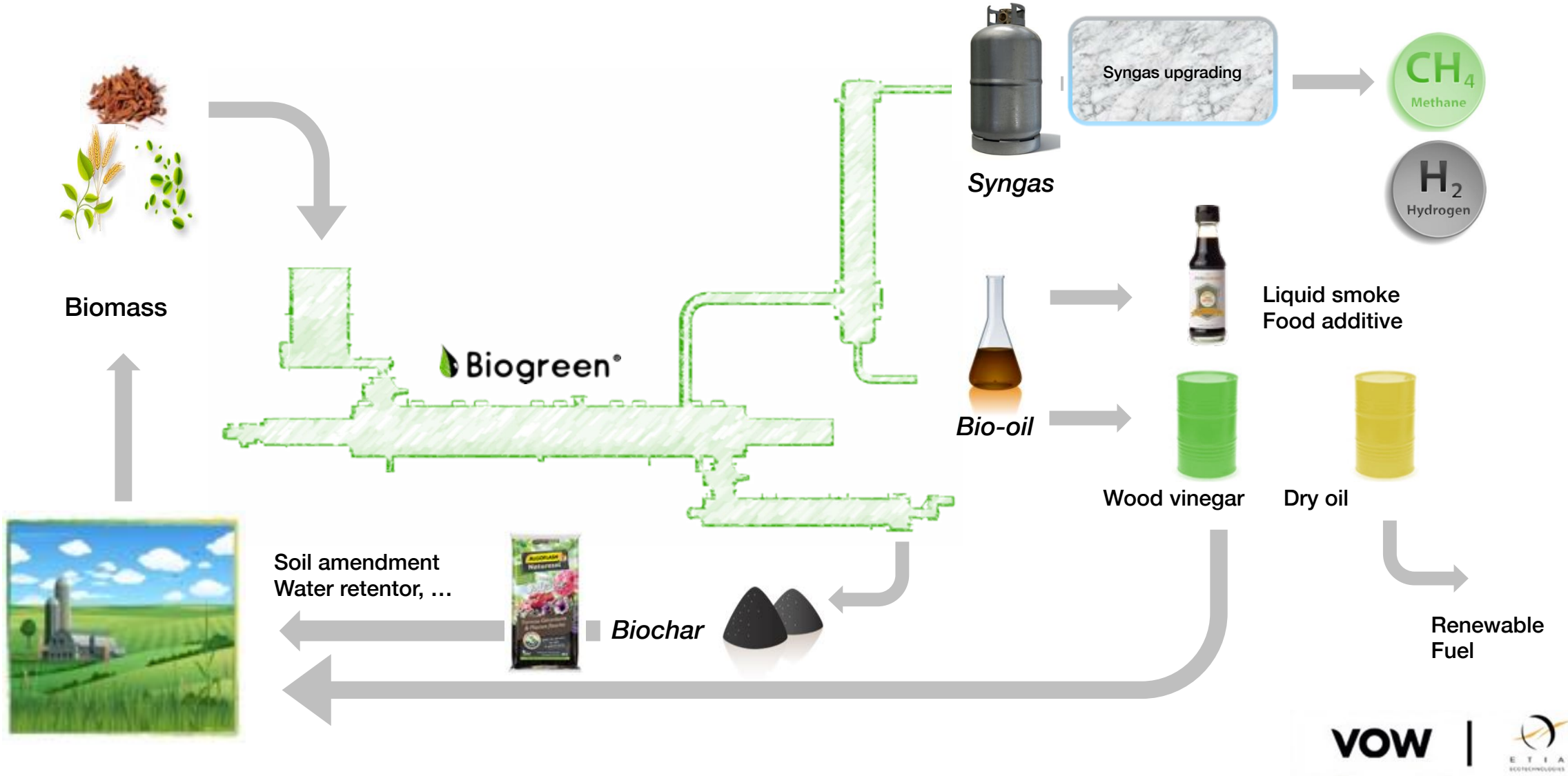
MULTIPLE APPLICATIONS



BIOCHAR FOR AGRONOMY

anses

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RÉPUBLIQUE FRANÇAISE

HYDROCHAR® guaranteed composition:

Dry matter min.	80%
Vegetal coal min.	80%
Organic carbon min.	64%
Capacity of water retention (v/v) min.	85%
Granulometry	0.125 - 4 mm

Packaging:

Supplied in bulk form or pellet:
- Buckets : 0.5 up to 2 liters
- Bags : 5 liters
- Big bags : 1 up to 1,5 m3

			Application method	Time of the application
Direct soil application	Trees planting or transplants of plants	1,5% m/m i.e. 15 kg for 1 m³ of soil	Uniform and homogenous mixture applied into the soil, to the planting hole.	Plantation and transplantation
	Plant division, fruit, vegetable, floral, ornamental species of plants	1 up to 4,5% m/m i.e. 100 up to 450 g. for 1 linear m.	Placement in the planting rows, 10 cm. width applied with 10 cm. depth	Before the division or seeding
	Grass seeding	1 up to 5% m/m i.e. 500 à 2500 g per m² of soil	Mixed with the top 5 cm. of the soil	Before the seeding
Mixing with growing media	Plant division, planting of various crops	1 up to 5% m/m i.e. 5 up to 25 g per liter of media	Application in uniform mixture with the growing media substrate.	Before seeding, division or planting
Mixing with organic additive	Soil preparation	1,5 up to 8 t/ha/year i.e. 40 t/ha of mixture with 20% (m/m) Hydrochar®WB1	Application to the soil amendment or incorporating into the soil.	At the moment of soil preparation
	Soil upgrading	0,5 up to 4 t/ha/year i.e. 20 t/ha of mixture with 20% (m/m) Hydrochar®WB1	Application to the soil amendment or incorporating into the soil.	At the moment of soil preparation

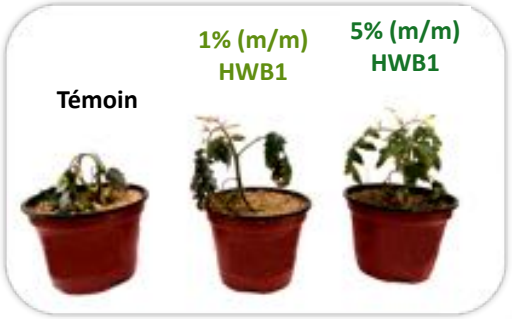
(*) based on dry soil, density 1 g/cm3

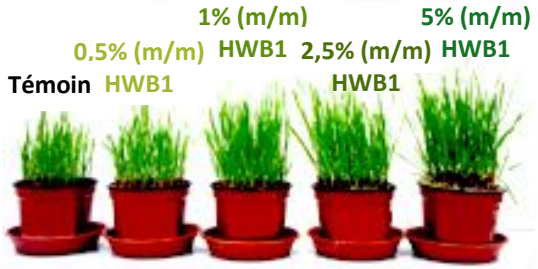
ETIA - Innovative & sustainable solutions for industry
ETIA S.A.S. | Carrefour Jean Monnet - Lacroix Saint-Ouen | BP 20101 - 60201 Compiègne, France

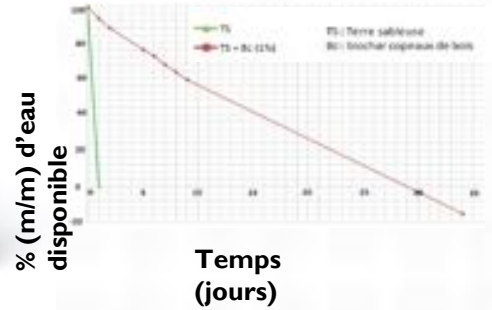
- 1st 100% biosourced water retenter
- 1st biochar authorized by the french regulation
- 1st biochar with ECOCERT certification

APPLICATIONS:

- To the soil (sowing, transplanting, planting)
- Mixed with an organic soil
- Mixed with a growing medium







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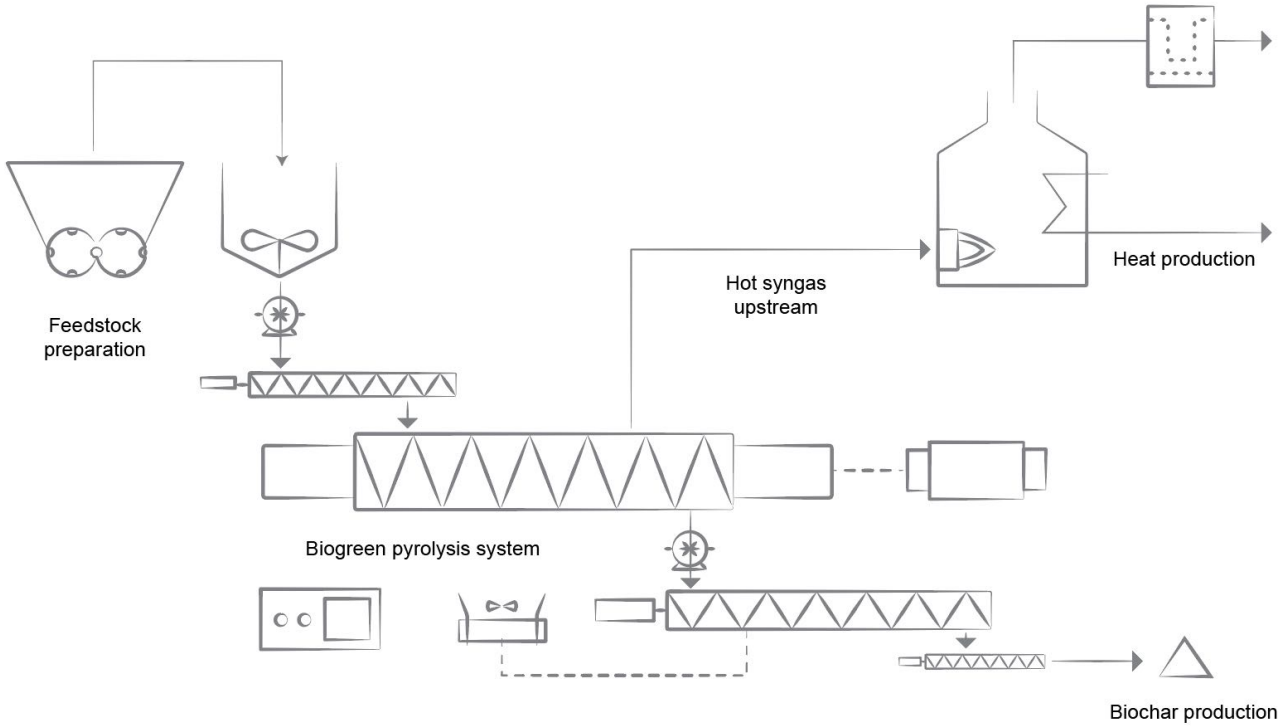
CORPORATE PRESENTATION

BIOCHAR PRODUCTION

CONVERSION OF GARDEN WASTE INTO VALUE

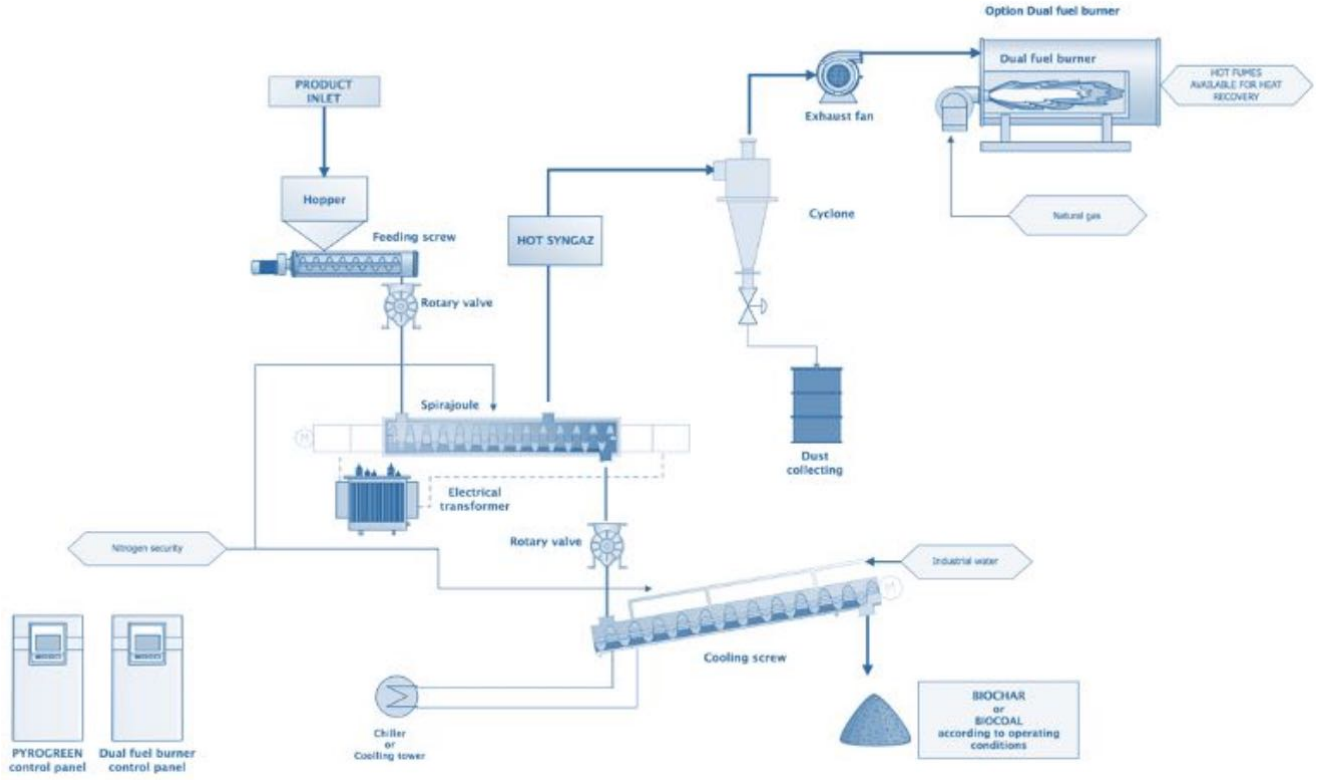


VALUE RECOVERY FROM WASTE – CARBON SEQUESTRATION – CIRCULAR ECONOMY WITHIN THE REGION

CORPORATE PRESENTATION

BIO-COKE PRODUCTION

DECARBONIZATION OF METALLURGY SECTOR

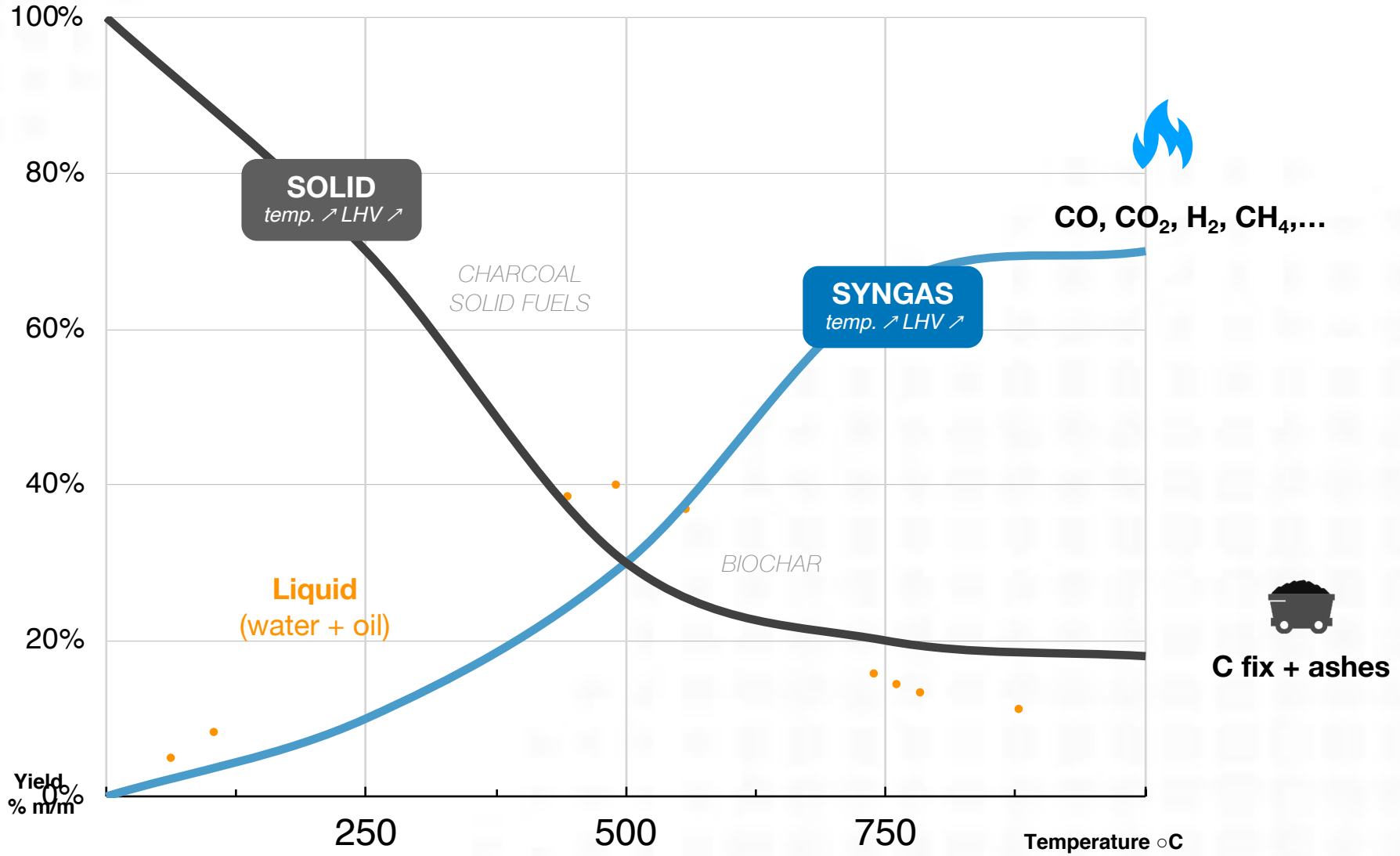


HIGH CARBON CONTENT BIO-COKE – REDUCTION OF CO_2 EMMISSION FROM STEEL MANUFACTURING – SUBSTITUTION OF FOSSIL FUELS

BIO COKE PRODUCED - EXAMPLE

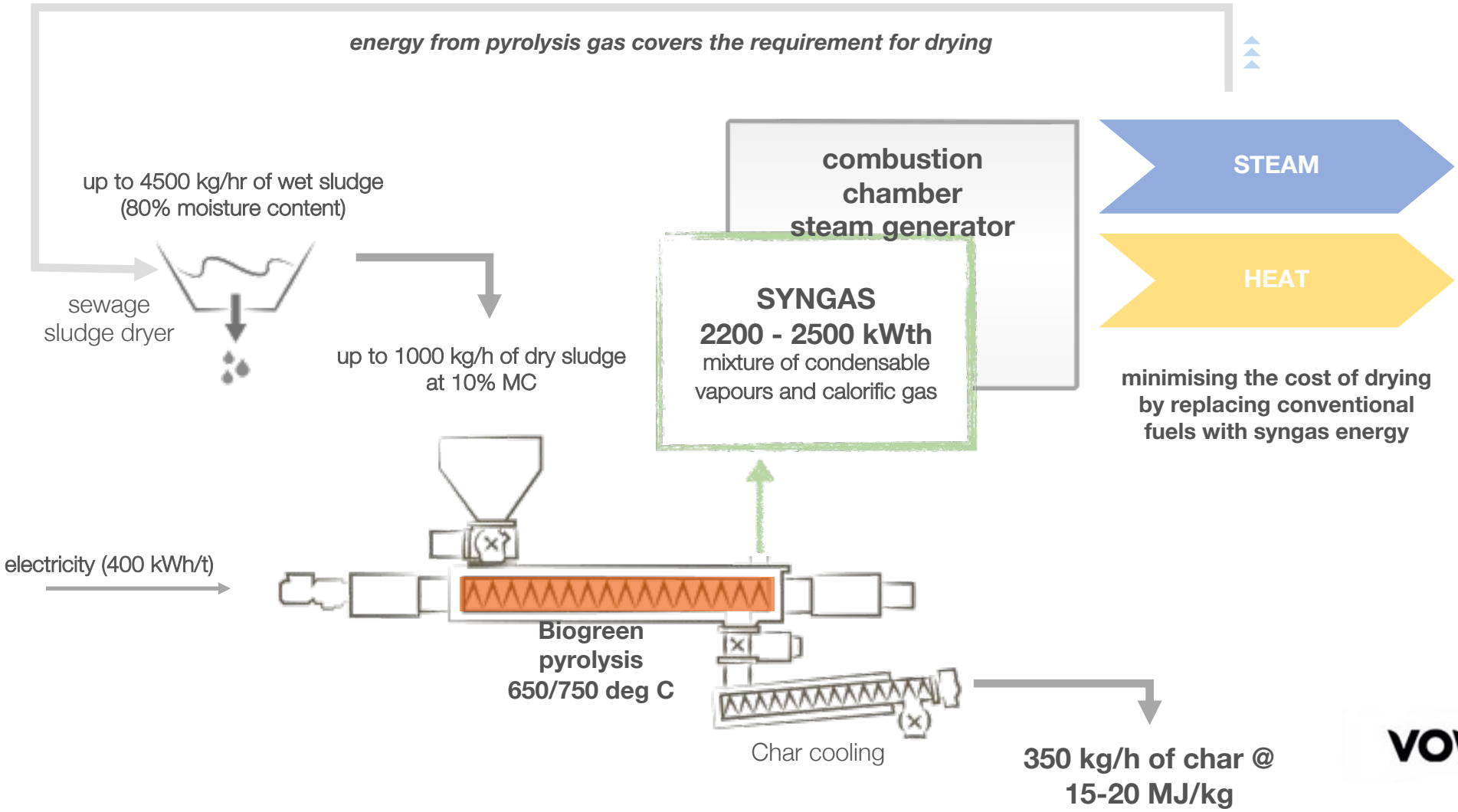
		Pine tree 550	Pine tree 750
Dry residue	%	94	99,997
LHV as received	MJ/kg	26,9	32,9
HHV dry basis	MJ/kg	29,5	33,25
LHV dry basis	MJ/kg	28,8	33,03
Carbon content	%	78,7	91,7
Hydrogen content	%	3,4	1,04
Nitrogen content	%	0,44	0,4
Ash content d.b.	%	4,1	5,6
Total sulfur	%	0,017	0,065

Pyrolysis: process regulated by operating conditions

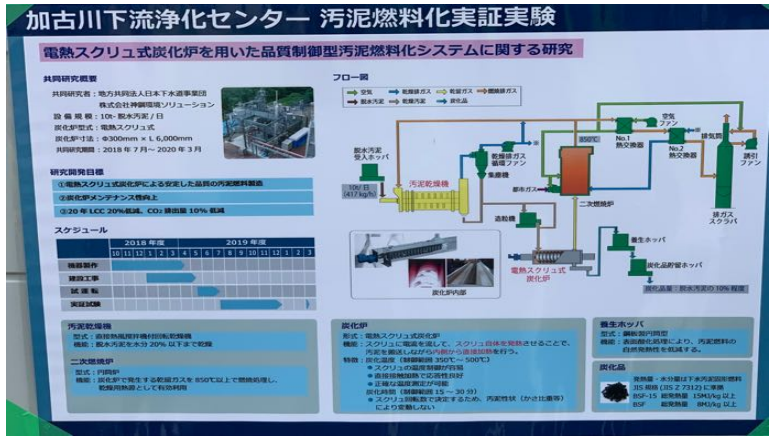


SLUDGE AND DIGESTATE

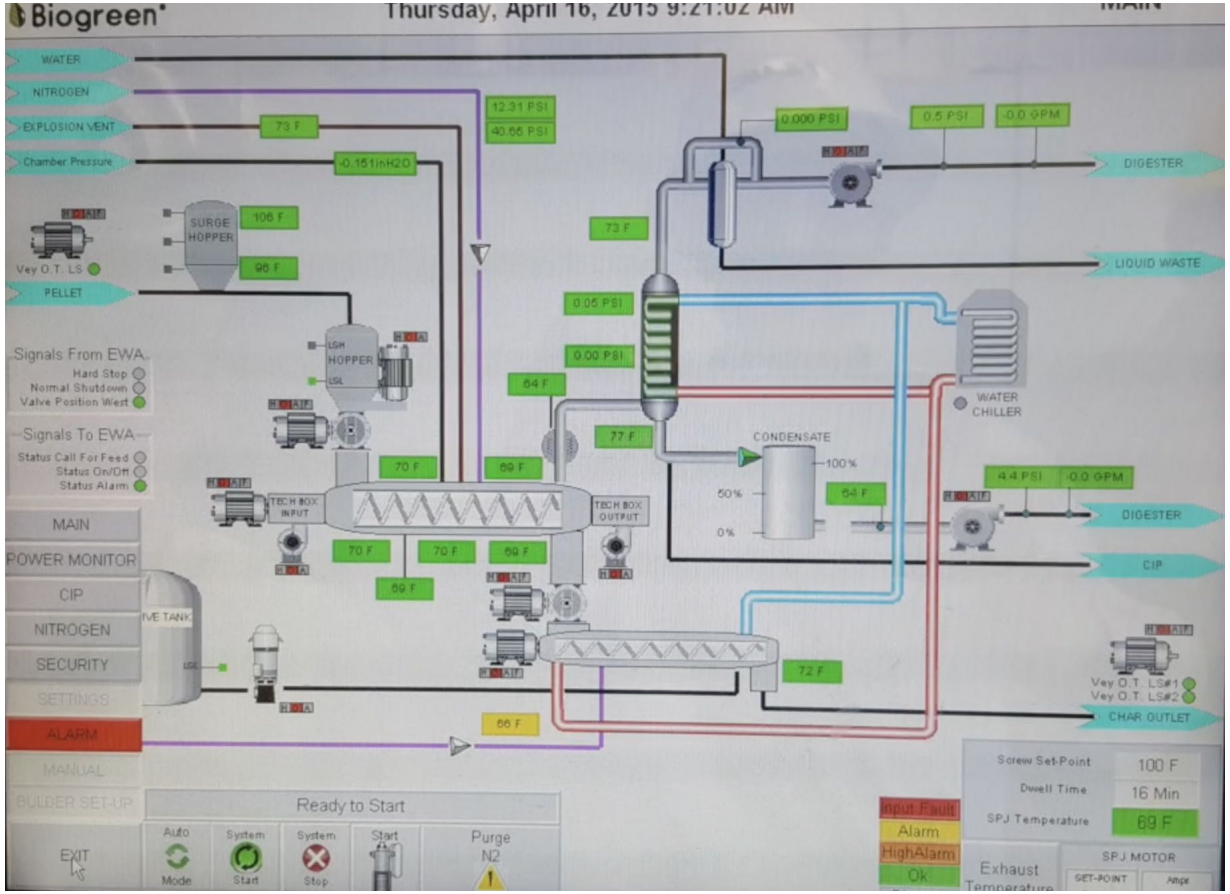
SEWAGE SLUDGE TO SYNGAS AND BIO COAL

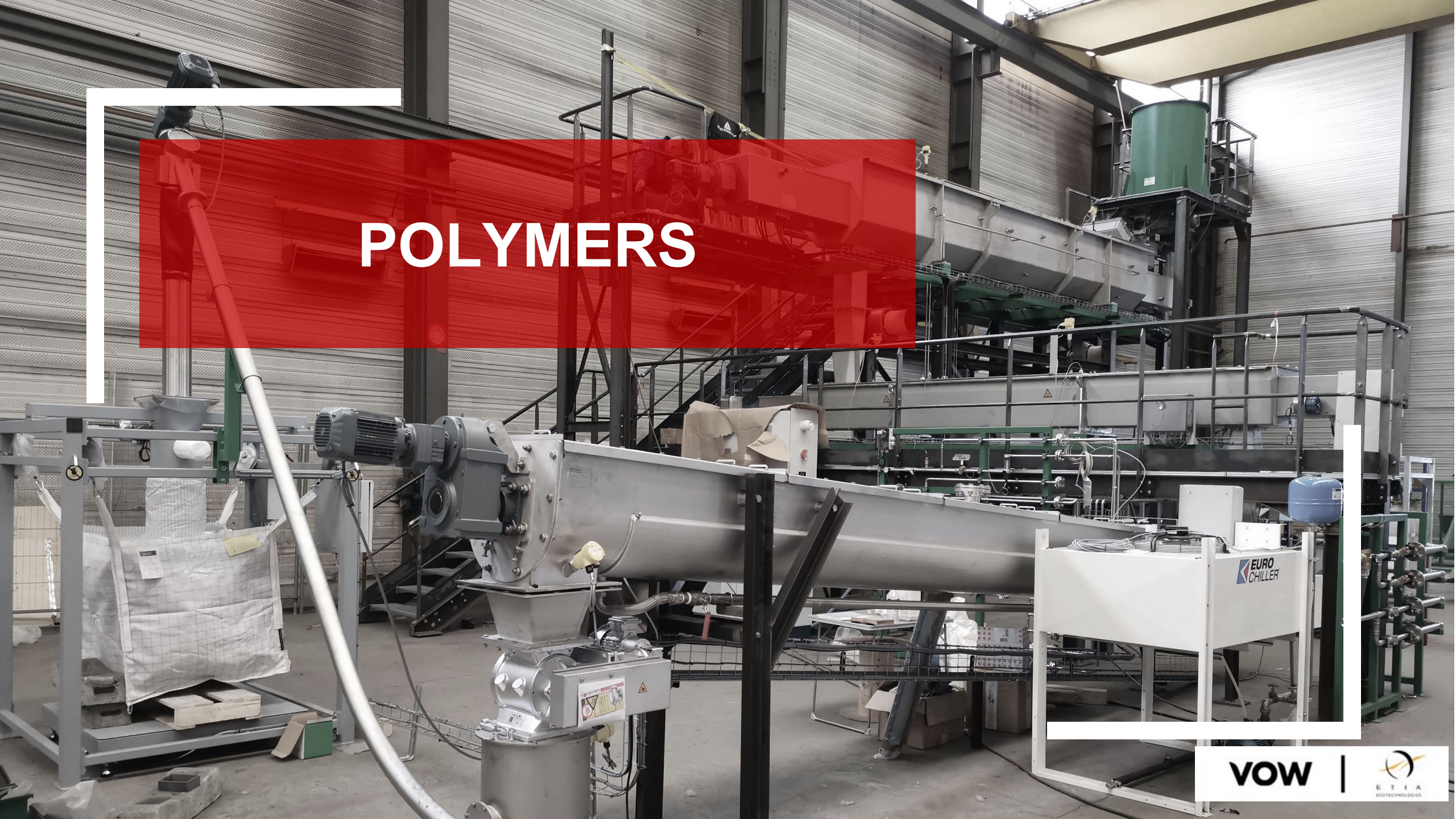


INDUSTRIAL PLANT IN JAPAN



SEWAGE SLUDGE AND DIGESTER

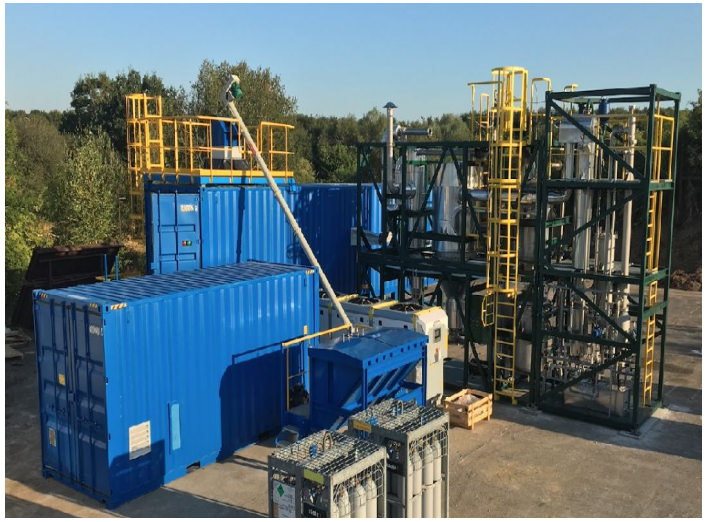


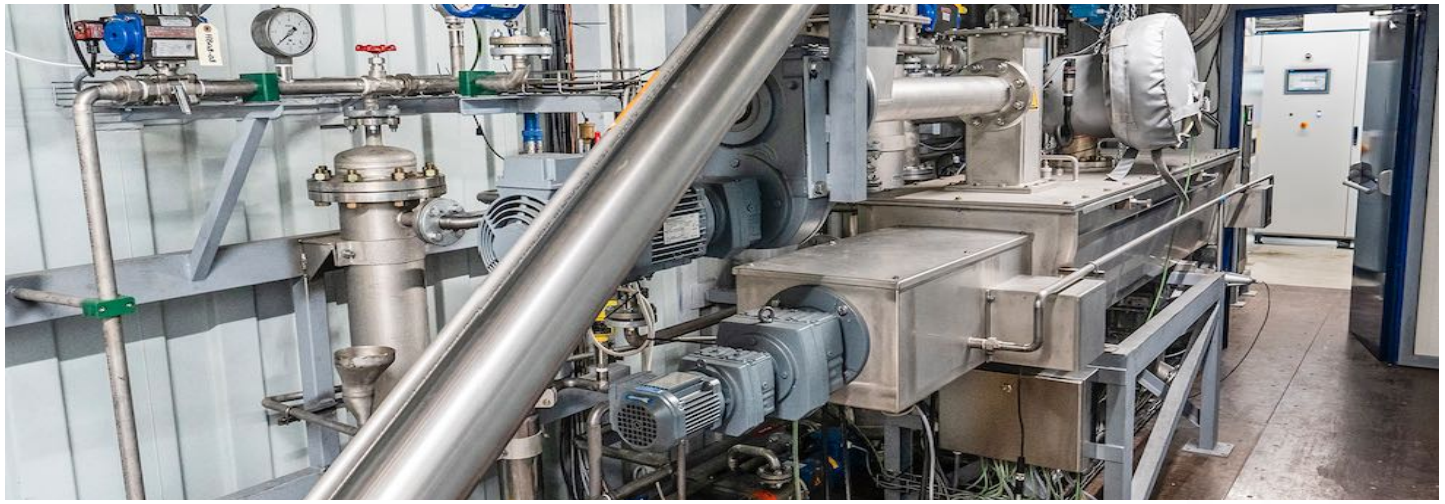


POLYMERS

CORPORATE PRESENTATION

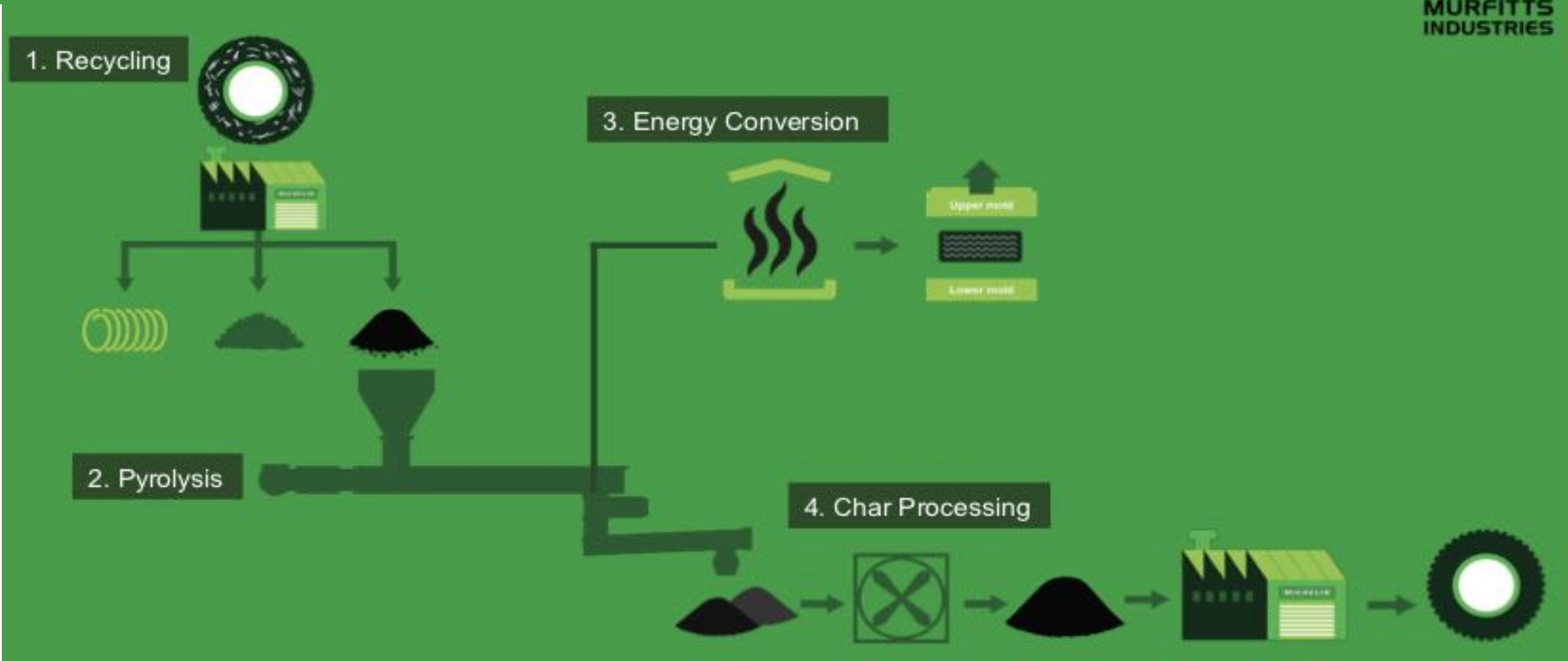
GIVING WASTE VALUE





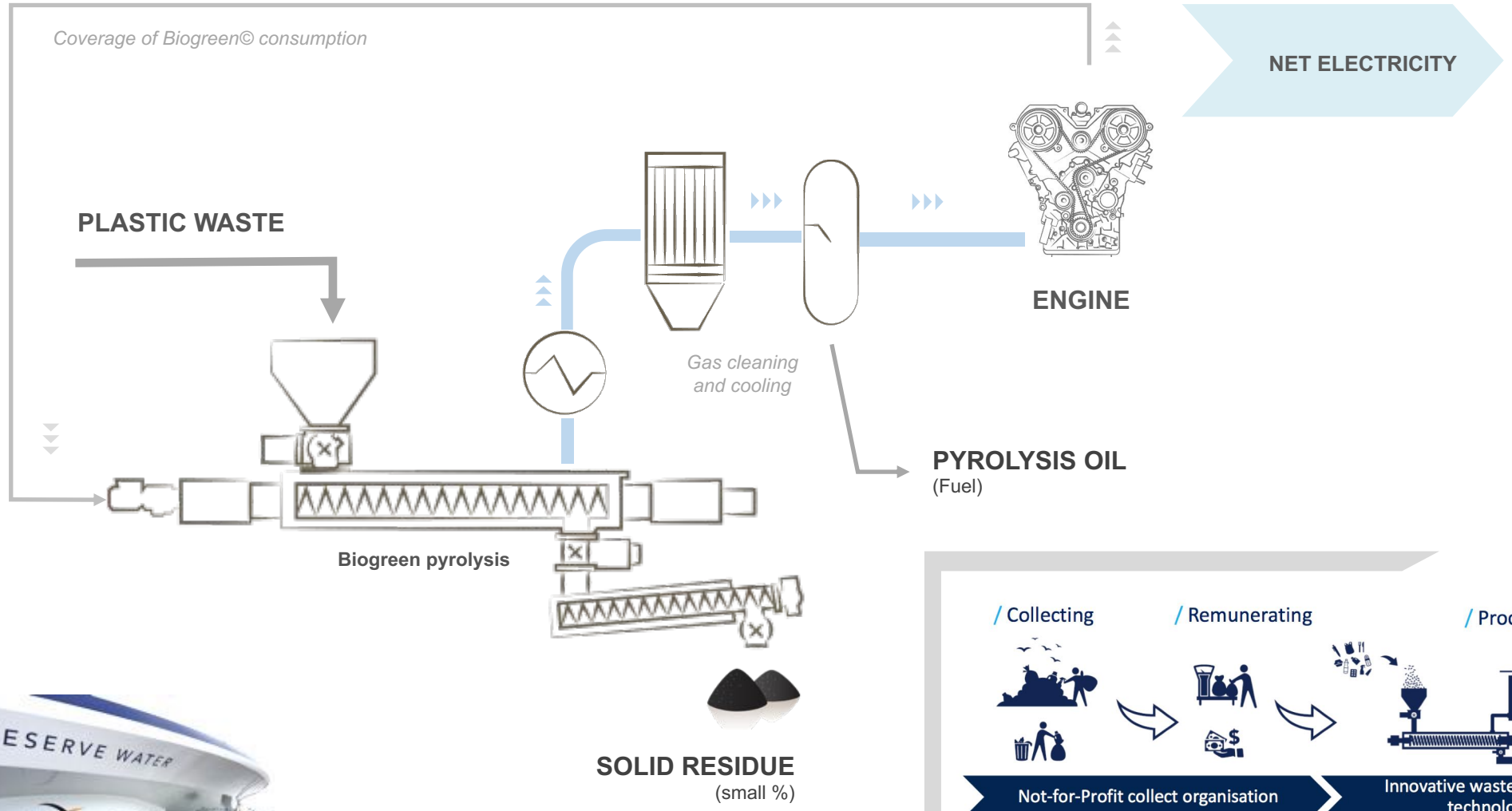
DECARBONIZE AND ENERGIZE WEBINAR

CONVERTING END OF LIFE TIRES INTO ENERGY AND RCB

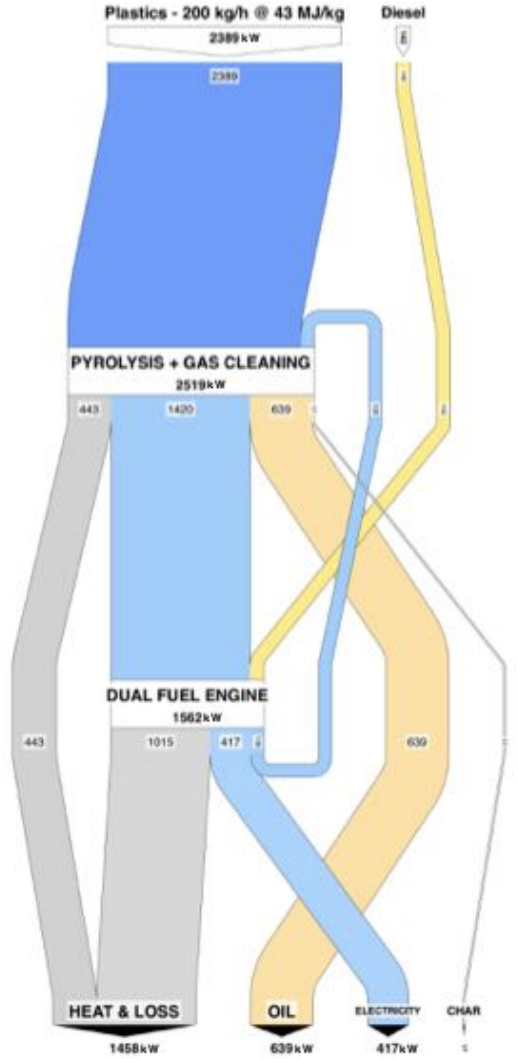


DECARBONIZE AND ENERGIZE WEBINAR

EXAMPLE: PLASTICS TO ELECTRICITY



FIRST DEMONSTRATION PLANT

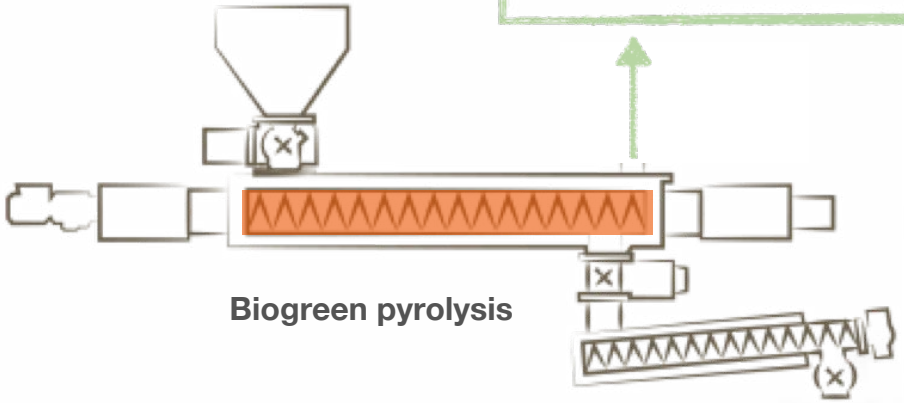


PLASTICS TO HEAT

Non-recyclable plastics

10 MWh/t

Electricity 400 kWh/t



Biogreen pyrolysis

Char cooling

CHAR

combustion chamber steam generator

SYNGAS
mixture of condensable vapours and calorific gas

9 MWh/t

STEAM / HEAT

minimising the cost of facility operation by replacing conventional fuels with syngas

OUR APPLICATIONS

Minerals treatment

Heat for variety of applications: calcination, dehydration of minerals, catalyst regeneration, devolatization, sterilisation of inorganic powders and many more

Biocoal

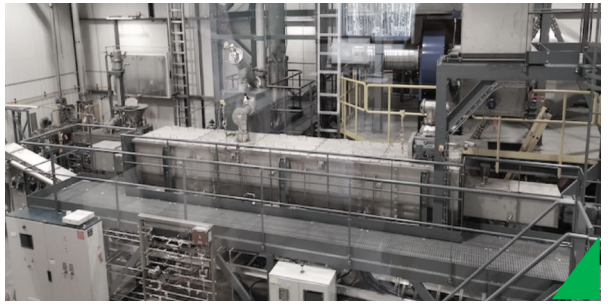
Replacing fossil coal in power plants by biocoal coming from biomass

First industrial demonstration unit in Japan to produce biocoal from sewage sludge

Biocoke

Replace the fossil coal by biogenic fuels (biocoke) in metallurgy industry as a reducing agent

First pilot plant implemented in Sweden, another two machines under production



Biochar

Creation of a circular economy with biomass and agriculture residues while keeping carbon in soil
Producing first certified biochar in France for water retention (Hydrochar WB1)

Bio-oil

Producing biooil to create liquid flavours and food aromas. Industrial machines in operation with the first implementation done in 2003

Wood vinegar under development

Bio-methane and hydrogen

Producing biomethane or/and hydrogen from biomass that cannot be used directly in the digesters

First pilot plant under evaluation

Plastics to molecules (CH4 + H2)

Conversion of plastics into gas molecules like methane or hydrogen

First pilot (R&D) under development and evaluation

End of Life Tires treatment

First pilot (proof of concept) realized and successful

First industrial plant under construction

Minerals treatment application

Dehydration of nanocoated $Ca(OH)_2$

- 1 MWh of energy storage
- module of dehydration
  $Ca(OH)_2 => CaO + H_2O$
- module of rehydration
  $CaO + steam => Ca(OH)_2$

VATTENFALL

Press release

11.04.2019

Salt as energy storage: Vattenfall launch pilot project at heat plant in Berlin

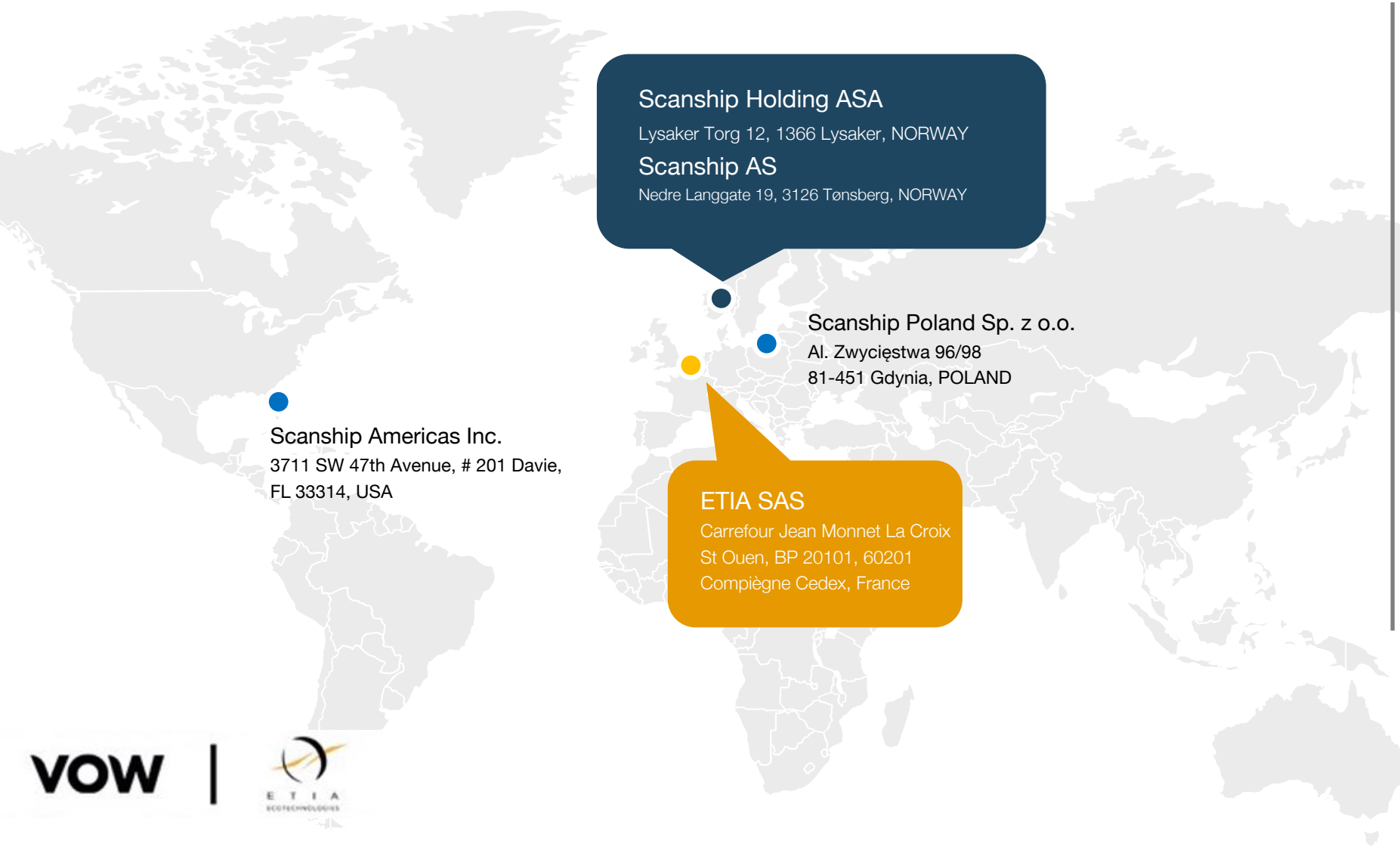
Vattenfall, together with the Swedish company SaltX Technology, will test how renewable wind and solar power can be stored in salt. In experiments, SaltX's patented technology has proven to be able to store up to ten times more energy and for much longer periods than water. The technology will be tested for the first time on an industrial scale at a pilot plant in Vattenfall's Reuter thermal power plant in Berlin.

The pilot plant at the Reuter thermal power plant in Spandau, Berlin, has a total storage capacity of 10 MWh and was officially commissioned today.

"In the next few months, we will collect important data to get answers to the question of whether and how this type of plant can be used in our business. Some questions are how large amounts of salt can be used, how quickly the storage medium reacts and how the process can be controlled," said Markus Witt, responsible for the project at Vattenfall Wärme Berlin AG.

DECARBONIZE AND ENERGIZE WEBINAR

LEARN MORE – CONTACT US



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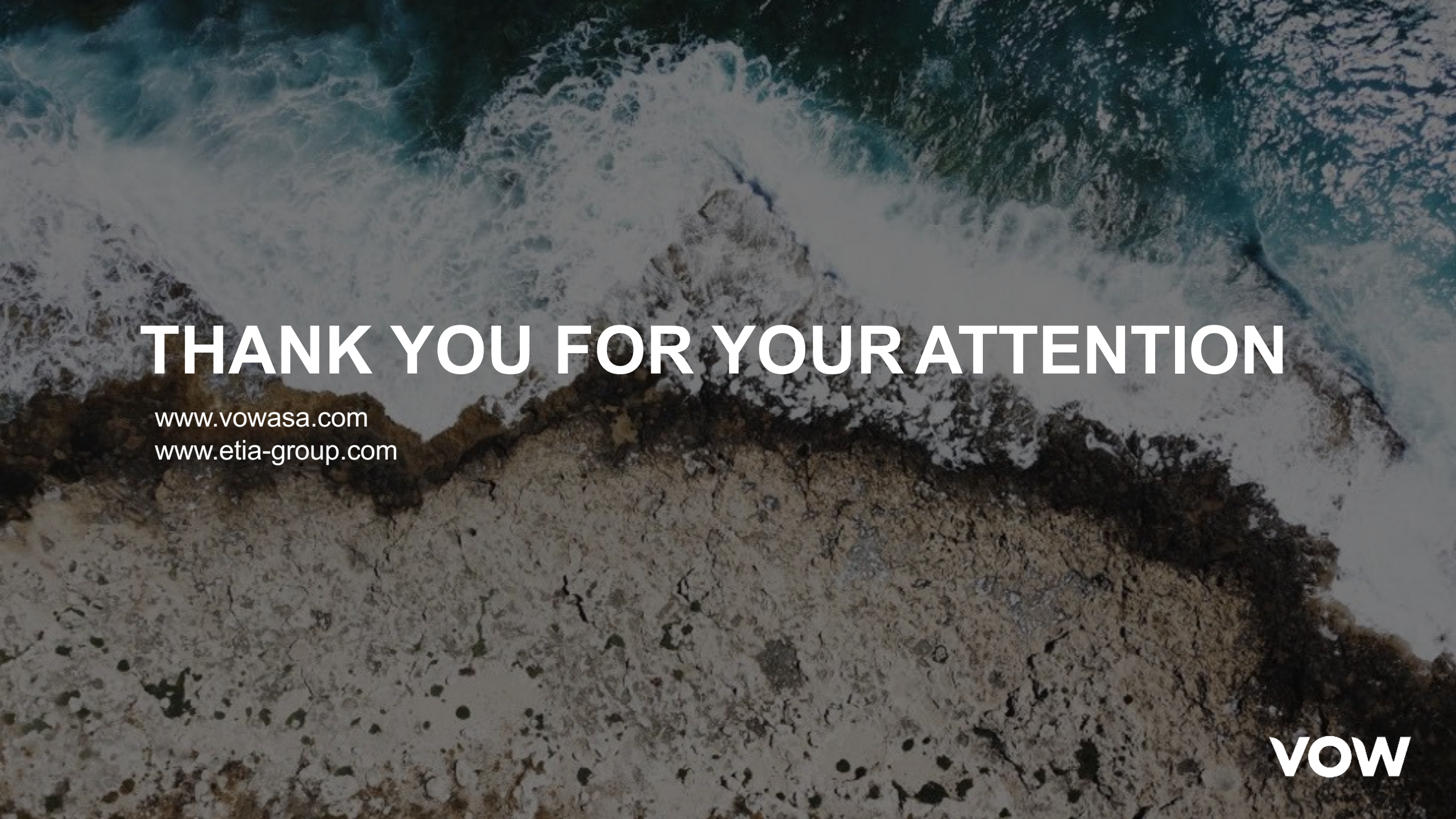
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