Your Trustworthy and Reliable Partner
in the International Business of Energy and Environment

Introduction of IBE Corporation

IBE Corporation

June 2022

CONTENTS

IBE Corporation – CEO Message

IBE Corporation
International Business of Energy

Byung Nam Kim
President & CEO

Dear IBE Corporation's customers,

We would like to express our appreciation for your kind attention for our company.

In order to service, support and contribute to potential business partners who wish to make use of our extensive experience and network of experts in field of Energy and Environment in the global market, IBE Corporation is founded.

IBE Corporation's services include;

- Consulting, strategic planning, feasibility study, engineering, supervision, financing arrangement for the project
- Sale promotion of the plant and equipment
- Organizing support to establish a competitive group composed of IPP Investors, EPC contractors, major equipment suppliers and O&M companies in the global market

Base on wide and in-depth experience, knowledge, and network, we are sure that IBE Corporation will be your trustworthy and reliable business partner in order to enhance your competitiveness and benefits in the fiercely competitive global market.

Yours faithfully,

IBE Corporation - Company Profile

IBE Corporation
International Business of Energy

Name of company	IBE Corporation
Representative	Byung Nam Kim
Business commencement	15 November 2012
Business address	(Geumbok Bldg 1301), 18, Wiryeseng-daero, Songpa-gu, Seoul, 05545, Republic of Korea
Business type	Professional consulting service Sales Representative
Business item	Professional engineering & consulting, Sales representative for Energy & Environment

IBE Corporation – Cooperation Advantage

IBE Corporation
International Business of Energy

Wide Global Business Network at Home and Abroad includes;

- IPP Investor
- Project Developer
- EPC Contractor
- Major Equipment Supplier
- O&M Company

Wide Ranging Expertise Includes;

- Project Development
- Sales & Marketing
- Engineering & Consulting
- Project Execution
- Outsourcing

Organizing Support from IBE Corporation

- ❖ Enhanced your competitiveness and benefits in the fiercely competitive global market
- ❖ Provide you with Sustainable Competitive Advantage

IBE Corporation
International Business of Energy

Exclusive Sales Representative

Turboden Turboden S.p.A.	ORC System	
	Large Heat Pump	
	Gas Expander	
STEC Shanghai Triumph Energy Conservation Engineering Co., Ltd.	Waste Heat Recovery Power Plant	
	WHR Boiler	Corp. with HBG
	Biomass Boiler	Corp. with Nantong
	Electrostatic Fabric Filter	Corp. with Xikwang
	Carbon Capture Utilization and Storage	CCUS
BWE Burmeister & Wain Energy	Biomass Fuel Conversion	100 - 500MW
	PF Firing Biomass Boiler	50 - 500MW
	PF + WCVG Firing Biomass Boiler	50 - 200MW
	WCVG Biomass Boiler (Water Cooler Vibrating Grate)	10 - 50MW
STET ST Equipment & Technology	Triboelectrostatic Separator	Fly ash carbon separator

clean energy ahead
TURBODEN
a group company of MITSUBISHI HEAVY INDUSTRIES, LTD.

OUR MISSION

We provide reliable, advanced, environmentally-friendly solutions that maximize the value of renewable sources and energy efficiency.

40 YEARS OF A VIABLE SUSTAINABILITY

40 YEARS viable sustainability

SINCE 1980

Turboden is an Italian firm and a global leader in the design, manufacture, and maintenance of **Organic Rankine Cycle (ORC) systems**, highly suitable for distributed generation, which produce electric and thermal power exploiting multiple sources.

Thanks to its long experience in the energy efficiency sector, today Turboden expands its solutions offering with **gas expanders** and **large heat pumps**.

MILESTONES

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'60-'70 — Prof. Mario Gaia makes experience in the field of ORC within his research group at Politecnico di Milano.

1976 — 1st ORC prototype.

1980 — Prof. Mario Gaia founds Turboden.

1998 — 1st ORC biomass plant.

'90-2000 — Turboden enters geothermal, waste heat recovery and solar markets.

2000-2009 — Turboden becomes leader in Europe with its biomass plants.

2013 — MHI acquires the majority of Turboden.

MITSUBISHI HEAVY INDUSTRIES, LTD.

2019 — Turboden launches new products, LHP and EXP

2020

10 YEARS

	1990	2000	2010	2020
ORC SIZES AVAILABLE	300 kW	1 - 2 - 4 MW	5 - 8 - 10 MW	20 MW
ORC PLANTS INSTALLED	1	100	220	400+

GLOBAL AND PROVEN EXPERIENCE

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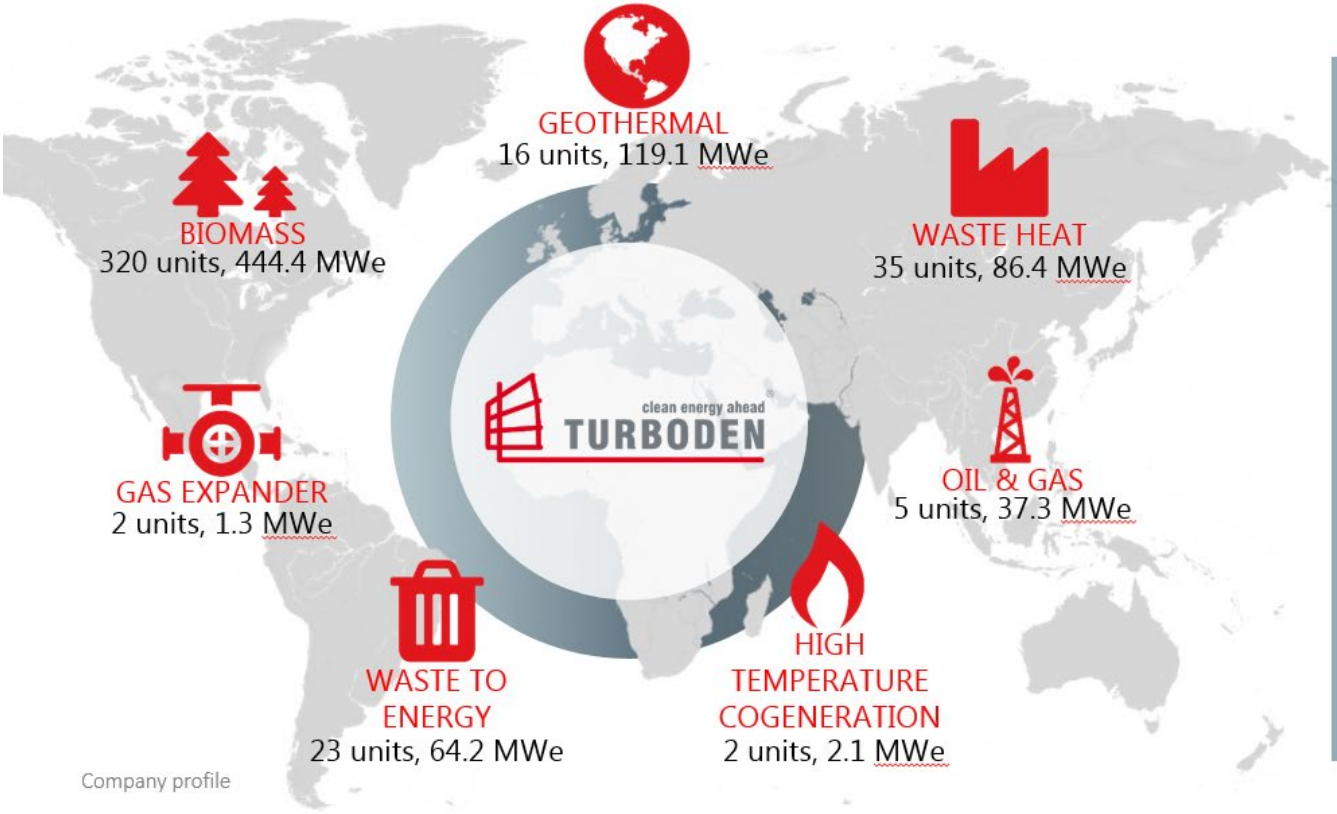


Company profile

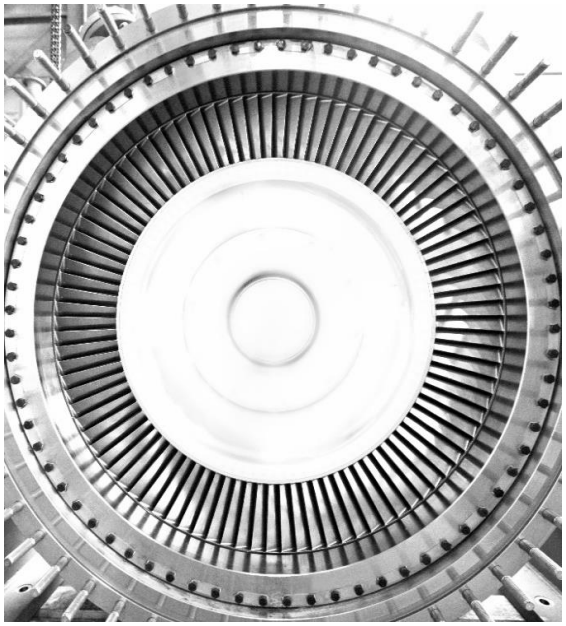
Experience in over
50
countries

With
400+
installations

Electric power generated
25 thousand
GWh

Cumulative operation time
19 million
hours

Last update: September 2021
* including two hybrid power plants



ORC SYSTEM

Turboden holds the know-how of the ORC technology thanks to its 40-years experience and over 60 turbine models for combined heat and power ORC plants, that are flexible to exploit different sources like geothermal, many kind of biomass, waste heat from industrial process or gas turbines, urban waste and natural gas.

KEY POINTS

- Large range size up to 20 MWe per single shaft
- Different applications: geothermal, biomass, waste heat recovery, waste to energy, Oil & Gas, combined cycles, high-temperature cogeneration
- Generate profit by valorizing a renewable source or waste heat
- Reduce specific production cost by decreasing energy demand
- Improve company sustainability
- Reduce CO_2 emissions

LARGE HEAT PUMP

Large Heat Pumps (LHPs) are at the forefront of the strategy for the electrification of heat in an increasingly decarbonised power grid. Through the supply of LHPs, Turboden wishes to play a broader role in the decarbonisation of the district heating sector and of some energy-intensive industrial processes.

KEY POINTS

- Large-scale: output from 3 MWth to 30 MWth per unit
- High-temperature lift (ΔT up to 80°C and more)
- High-temperature output (including steam generation)
- Various fields of application: geothermal, biomass, waste heat in energy-intensive industries, waste to energy, power plants

GAS EXPANDER

Turboden gas expander is a solution to enhance the energy efficiency of a natural gas network infrastructure, producing electricity by taking advantage of the reduction of gas pressure from the delivery level to the one required by users, be they residential or industrial.

KEY POINTS

- Design based on 40+ years of experience, leveraging Mitsubishi Heavy Industries support
- Long experience in the energy efficiency sector
- Profit generation while reducing the gas pressure
- Solution for natural gas network decarbonisation
- Unmanned installations, thanks to technology features
- Turn-key equipment capabilities
- Over 60 Turboden turbine models within the 400 power plants fleet

ORC MAIN COMPONENTS

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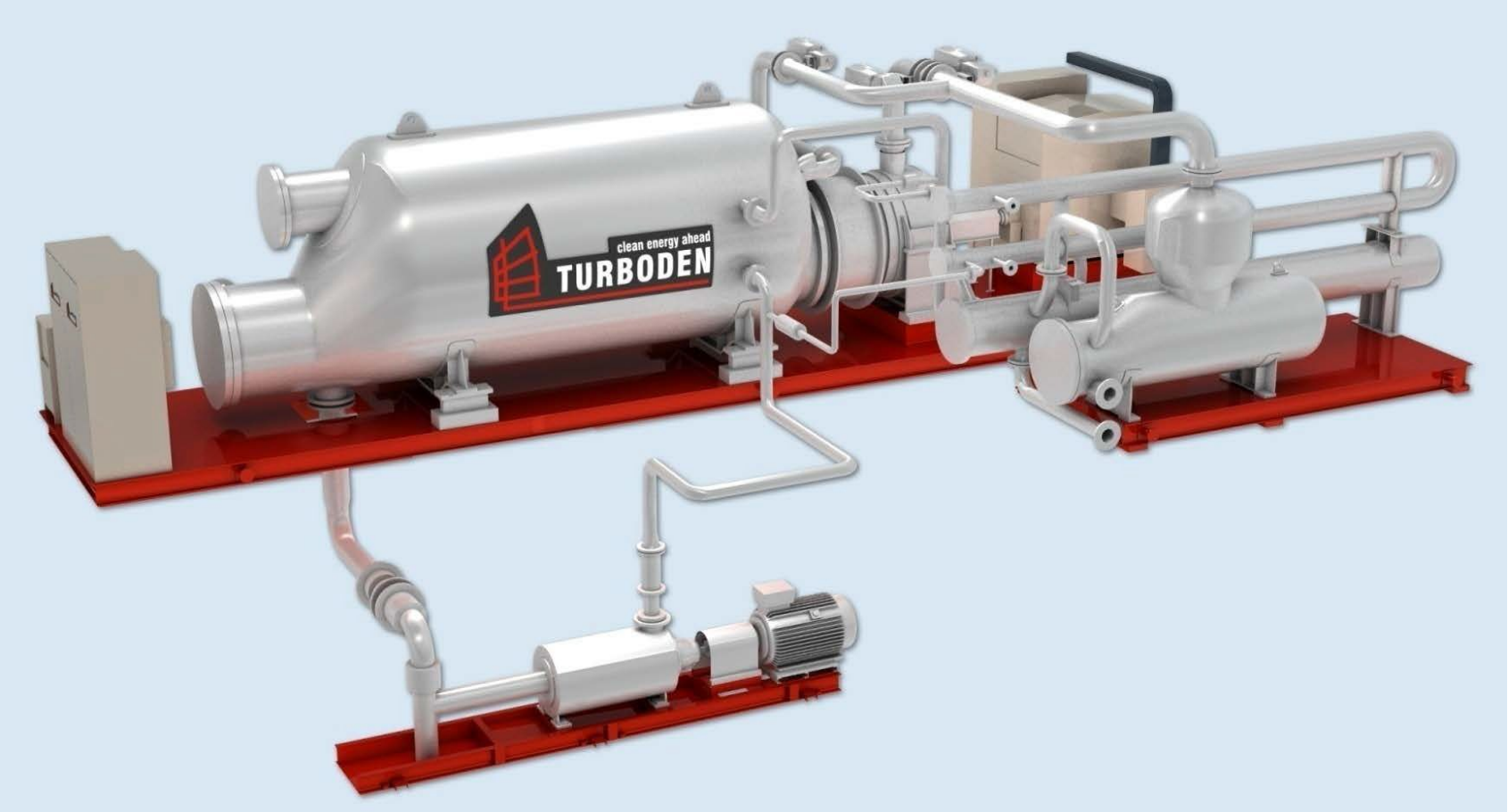

TURBODEN – ORC System

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ORC PRINCIPLE OF OPERATION

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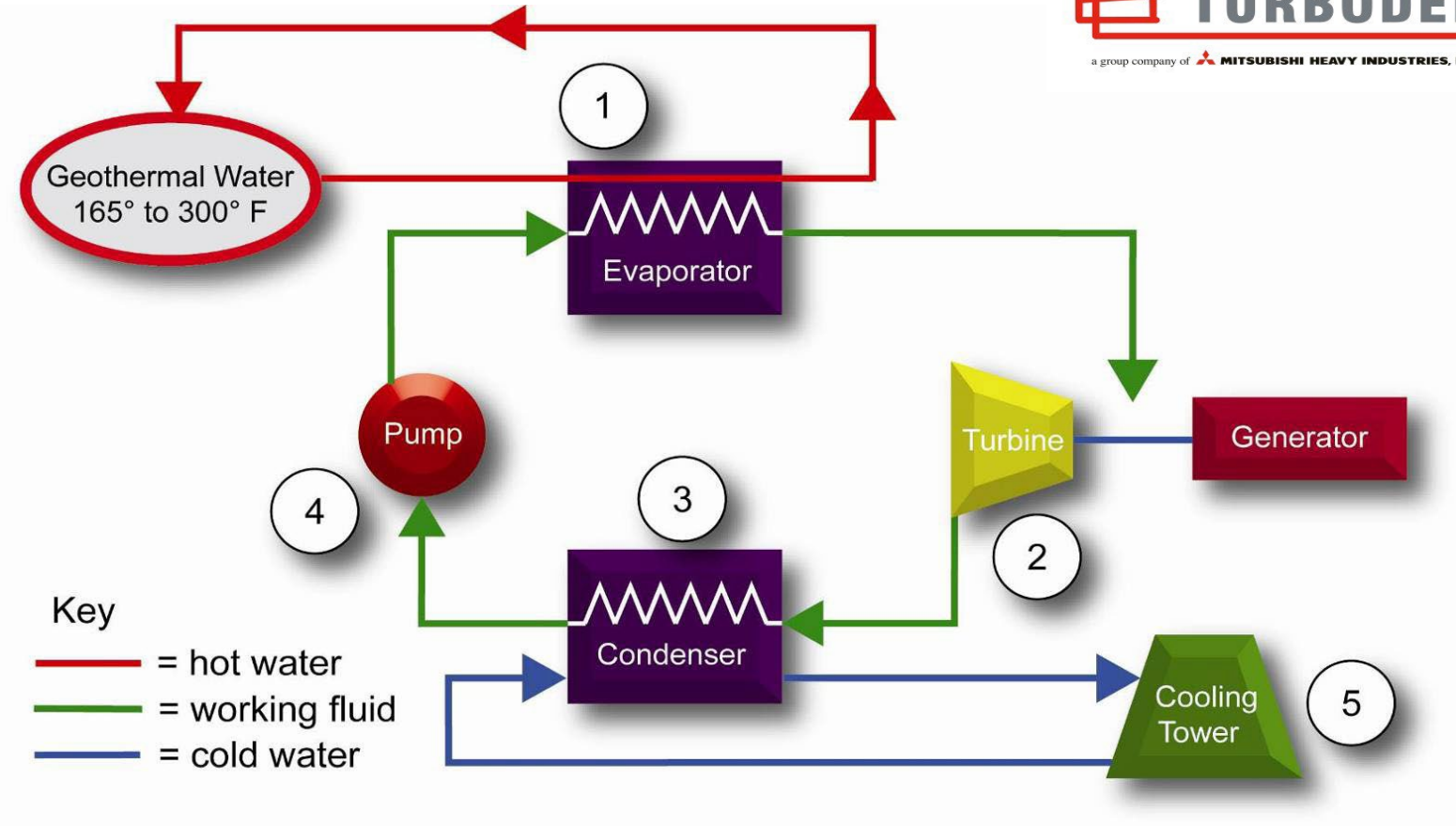


Heat In – CLEAN Power Out

ORC Operational advantages

Simple start-stop procedures

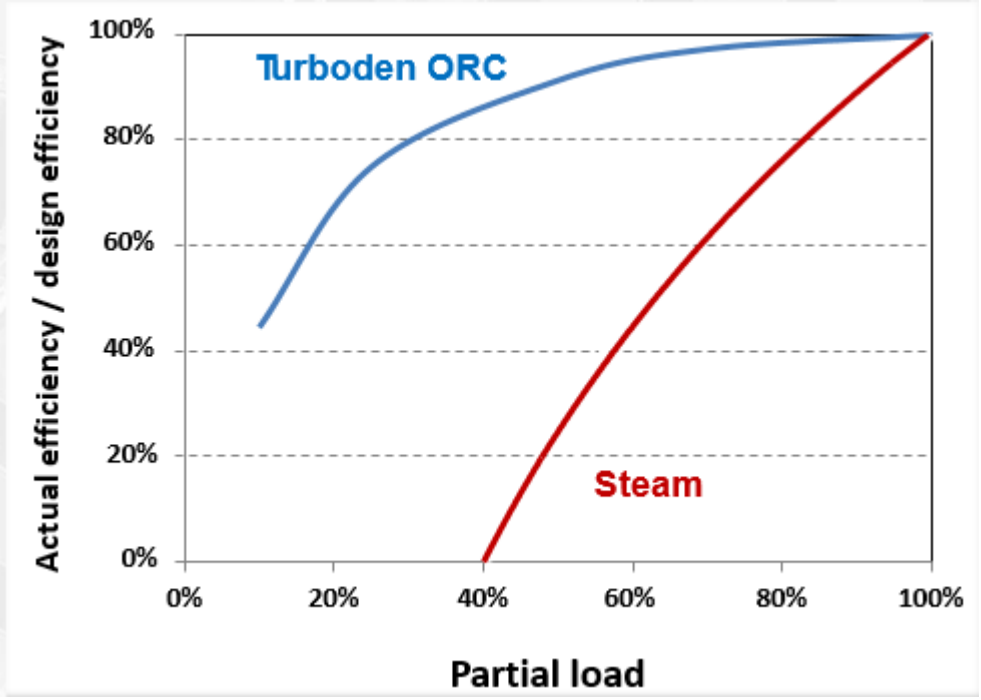
Quite operation (low pressure, low rpm)

High Availability (>98%)

Partial load operation down to 10%

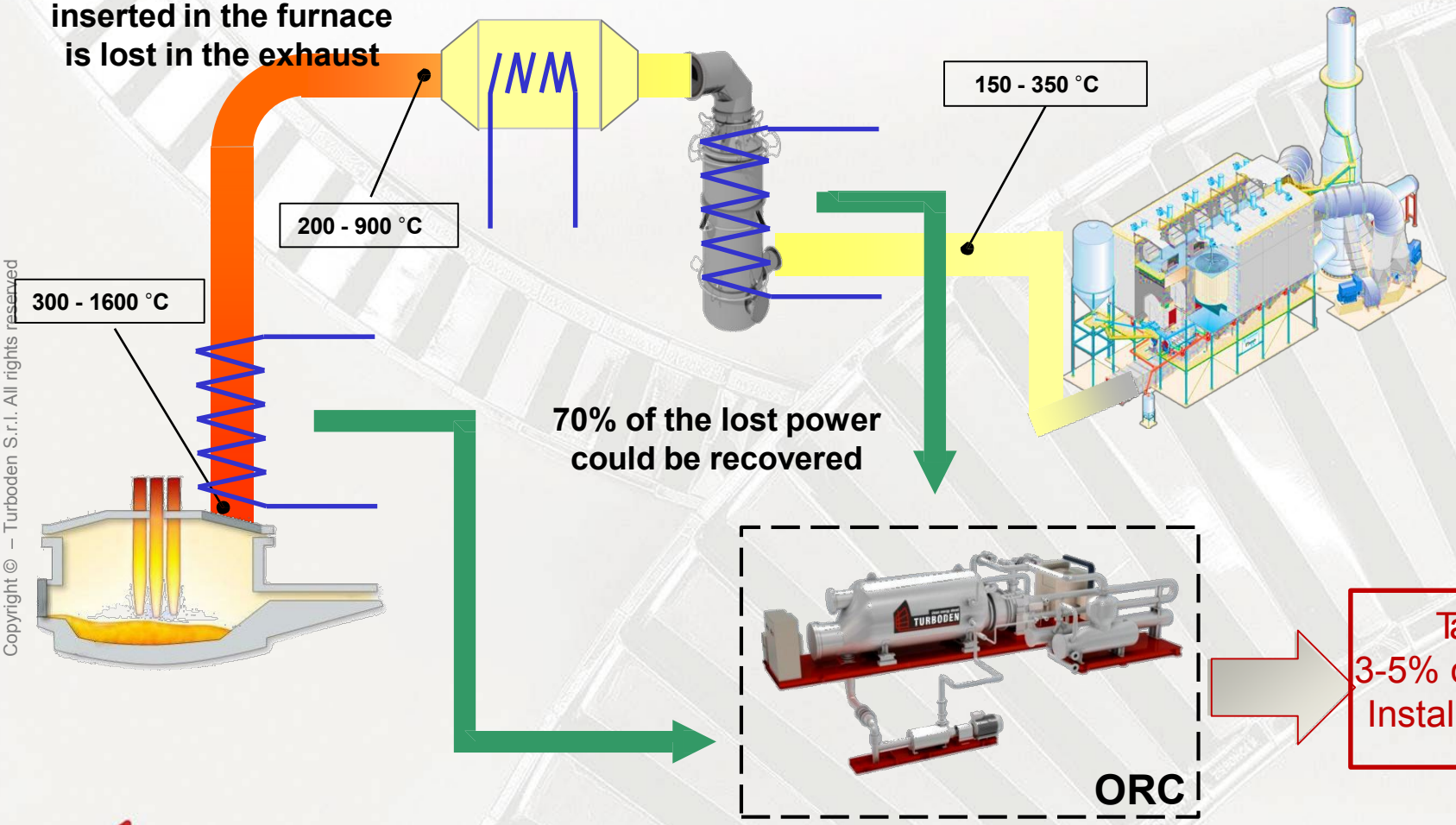
Demonstrate very good part load behaviour (see curve)

Are remotely monitored



Heat recovery from Electric Arc Furnace

25% ÷ 30% of the power inserted in the furnace is lost in the exhaust



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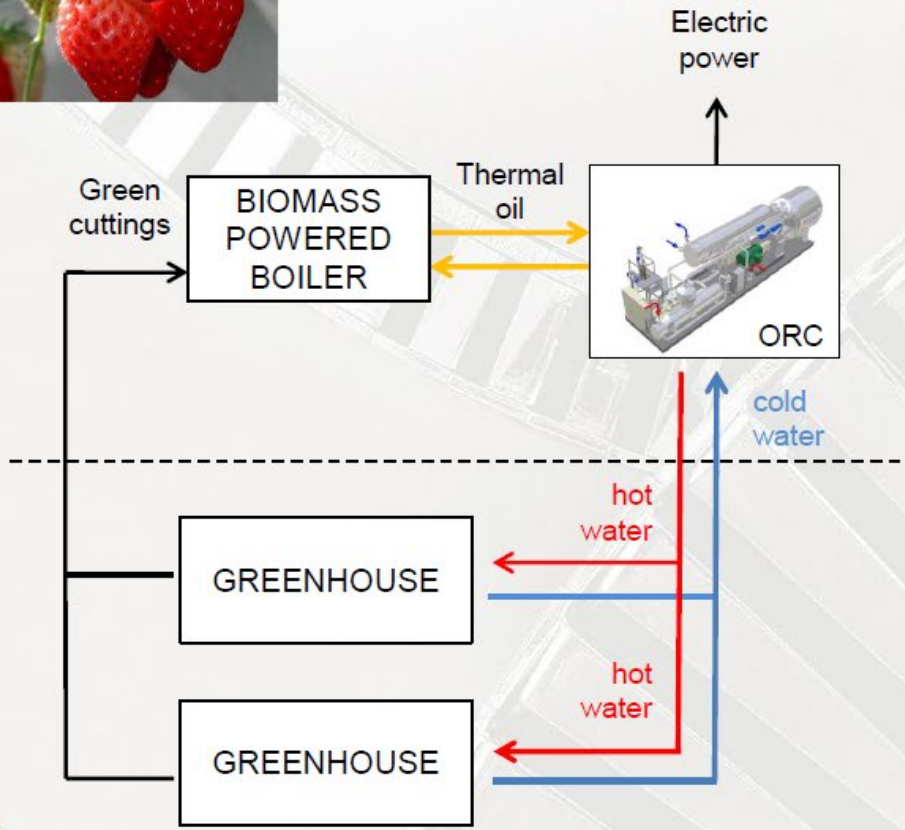
A PRATT & WHITNEY POWER SYSTEMS COMPANY

Greenhouses



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CHP IN AN EGG PRODUCTION FACILITY

POULTRY MANURE
70% humidity
300 ton/day

Drying system

Fluidized Bed Combustion

Thermal oil heat exchanger

Turboden 22 CHP

ORC water condenser

2.3 MWe
(133 + 20 USD/MWh)

TURBODEN
SCOPE OF SUPPLY

50°C

70°C

About 20% humidity after drying

11 MWth enter the ORC system

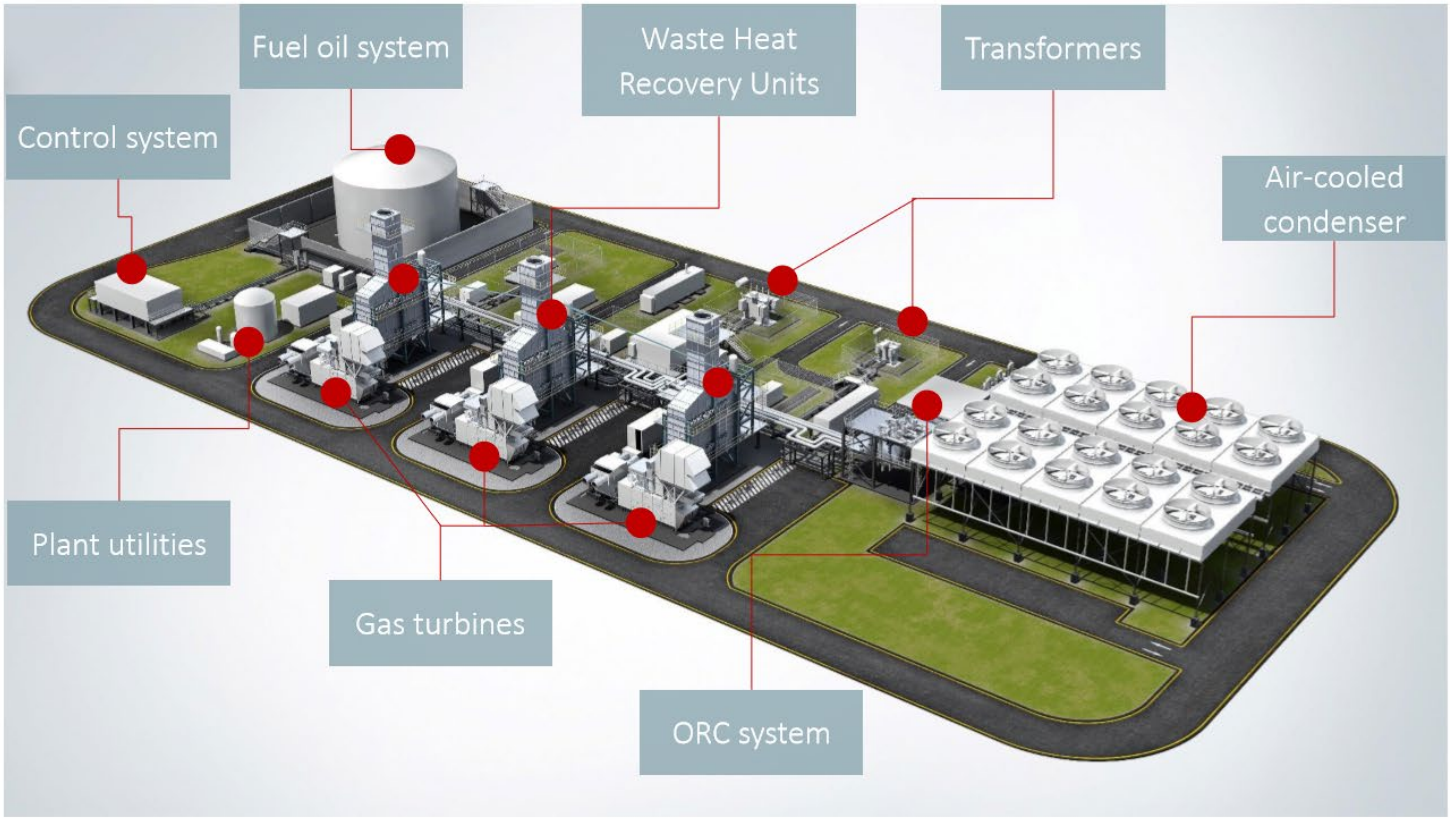
8,5 MWth supplied as hot water at 70°C for drying purposes

12 Waste to energy

3 x SGT-400 Heat ReCycle plant overview

Client value

- Designed for reduced CAPEX and OPEX
- High power-density (MW/m2)
- Automated operation and high safety standards
- Proven and reliable power generation



TURBODEN – Large Heat Pump (LHP)

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TURBODEN LARGE HEAT PUMPS

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Large Heat Pumps (LHPs) are at the forefront of the strategy for the electrification of heat in an increasingly decarbonised power grid. Through the supply of LHPs Turboden wishes to play a broader role in the decarbonisation of the District Heating sector and of some energy-intensive industrial processes.

Output from 3 MW_{th} to 30 MW_{th}

High temperature lift
(ΔT up to 80°C and more)

High-temperature output
(including steam generation)

TURBODEN – Large Heat Pump (LHP)

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EXAMPLE: INDUSTRIAL FACILITY

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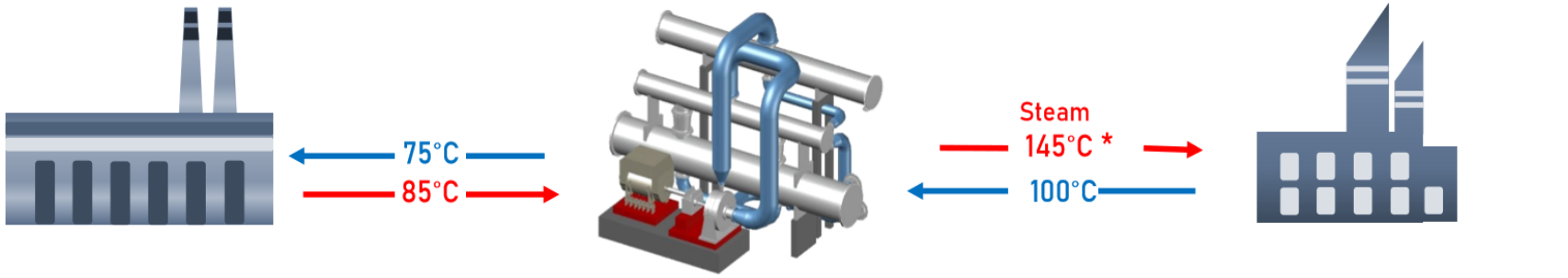
The Large Heat Pump generates large quantities of steam exploiting a colder energy source that would otherwise be wasted, eventually dissipated by cooling towers. Hence, a downstream industrial process can benefit from this new higher-grade source of heat.

* NOTE: *the steam temperature can be increased and reach 170°C through the installation of an additional heat exchanger. Thus obtaining superheated steam.*



INDUSTRIAL SITE

Input: 9,12 MW_{th}

LARGE HEAT PUMP
COP 3,1

Input: 4,4 MW_e

DOWNSTREAM INDUSTRIAL PROCESS

Output: 13,5 MW_{th}

TURBODEN – Large Heat Pump (LHP)

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EXAMPLE: CHEMICAL PLANT

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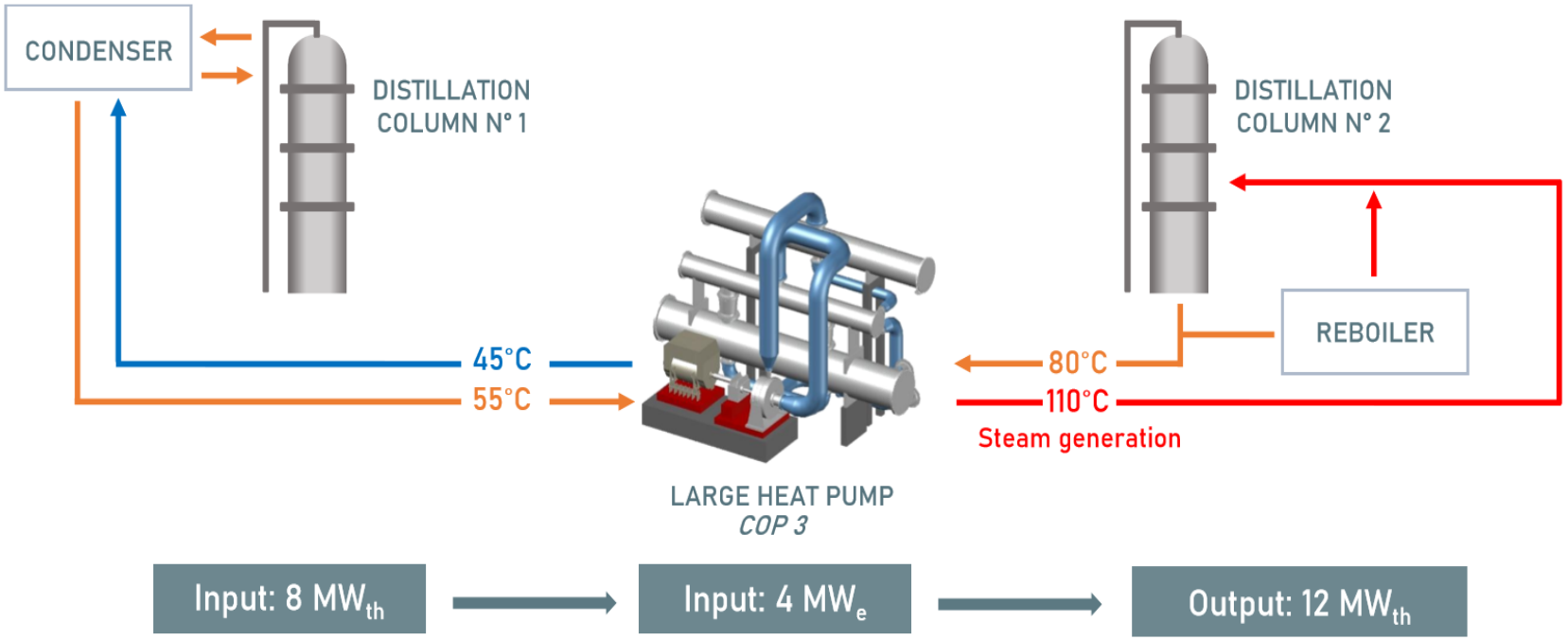

- COP tends to be lower due to higher lift, hence more challenging
- May require special (more costly) materials
- Year-round (potentially >8,000 hrs_{eq}/y) waste heat valorisation thanks to internal re-use

TURBODEN – Gas Expander

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THE CONFIGURATION

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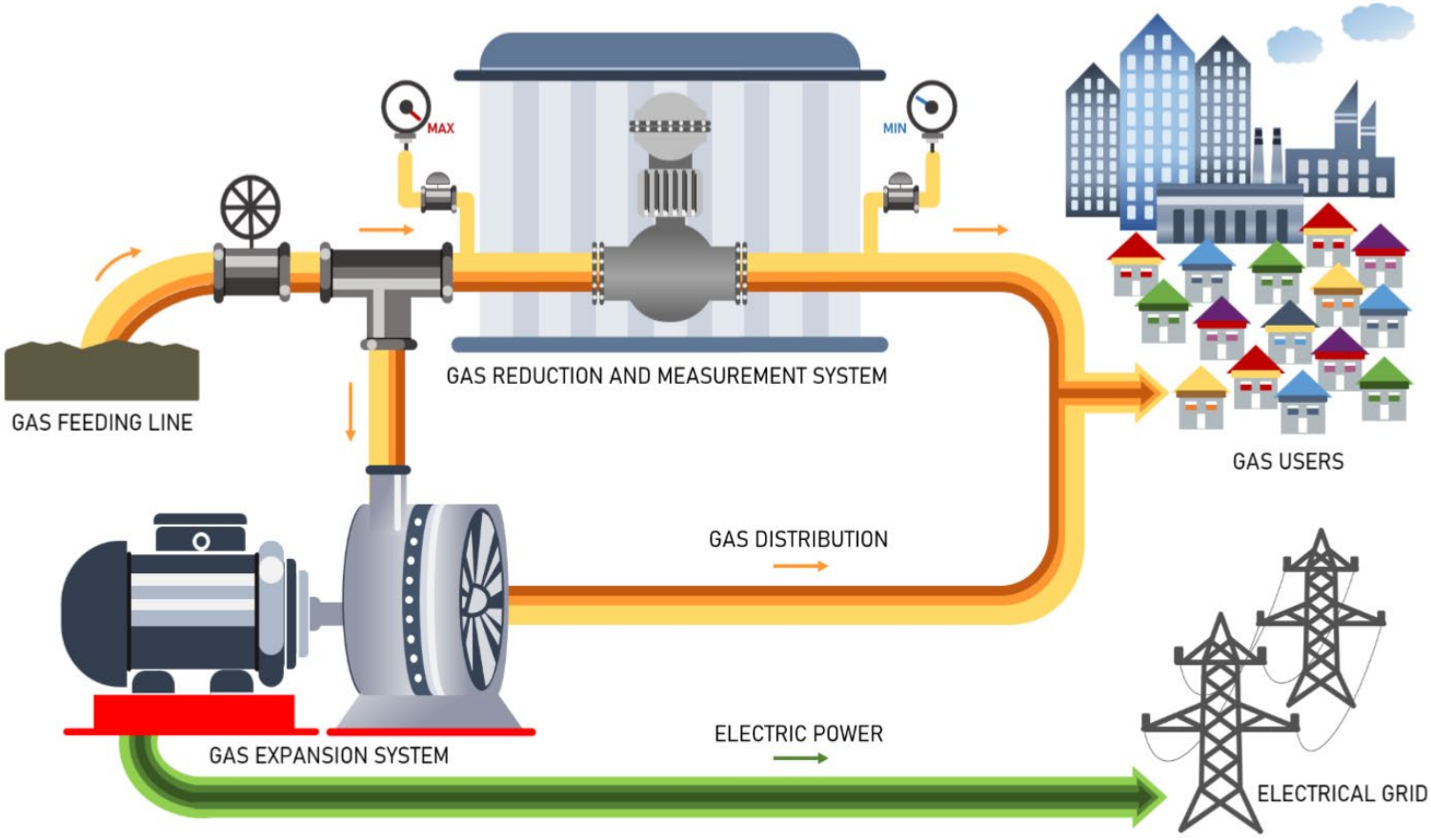

TURBODEN – Gas Expander

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SYSTEM LAYOUT

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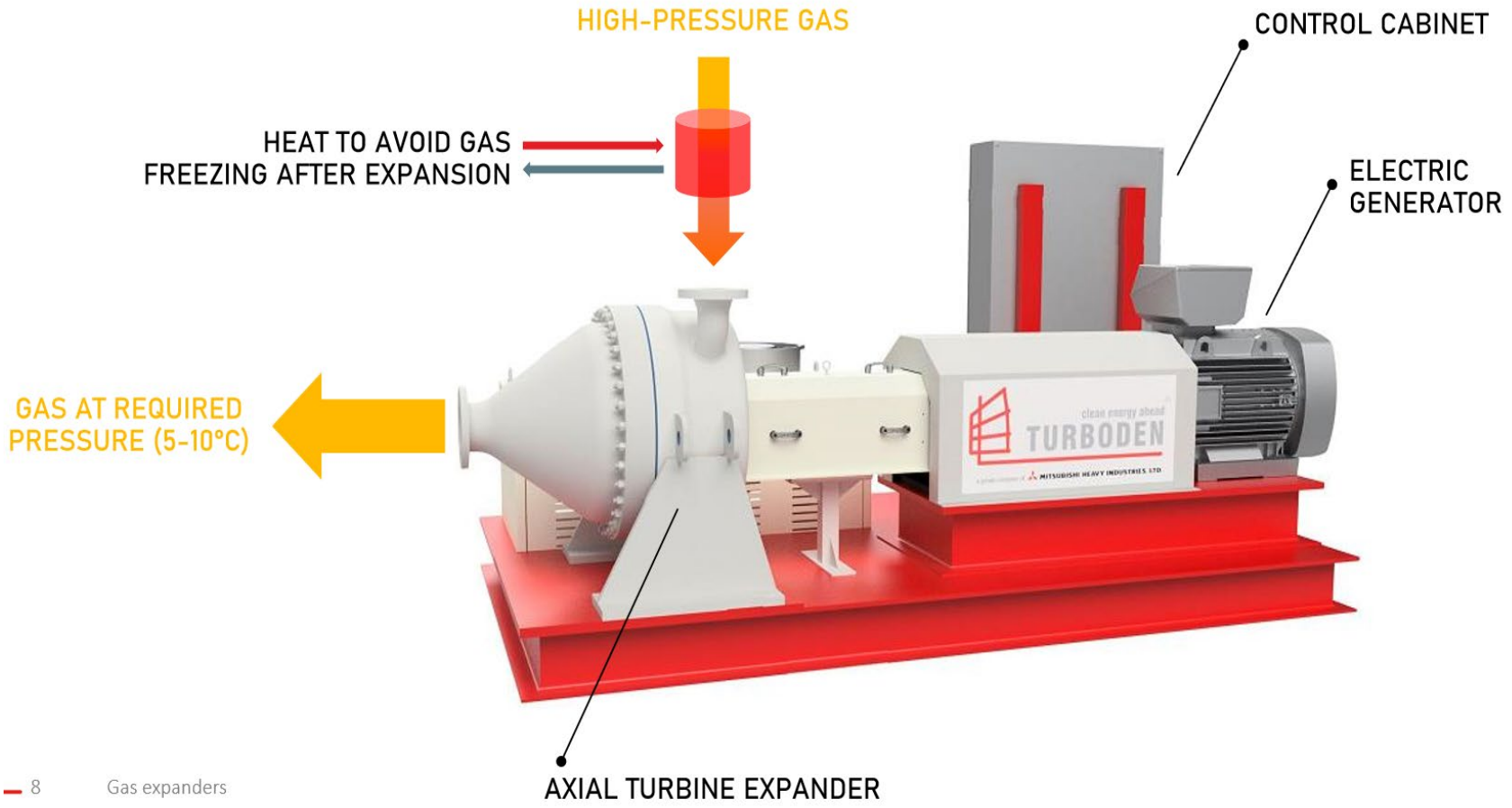

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a group company of MITSUBISHI HEAVY INDUSTRIES, LTD.

OUR VISION

We believe in a viable sustainability, where renewables, excess heat and waste become the main sources for clean heat and power generation, thus playing a key role in the global decarbonisation path.

上海凯盛节能工程技术有限公司
Shanghai Triumph Energy Conservation Engineering Co., Ltd.

STEC

Shanghai Triumph Energy Conservation Co., Ltd.

Background

- In Nov 2008, China Triumph International Engineering Co., ltd. (CTIEC) and Mitsubishi Corporation signed the Comprehensive Strategic Cooperation Agreement to deepen the cooperation in Energy Conservation fields.
- In Jan 2009, CTIEC and Mitsubishi Corporation established the joint ventured company named Shanghai Triumph Energy Conservation Co., ltd. (STEC), which is a High Technology Enterprise in Shanghai.

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MITSUBISHI

STEC

- Relying on the world-class technical team and technology platform built by CTIEC and introducing the advanced management and worldwide network by Mitsubishi Corporation, STEC is specialized in Waste Heat Recovery Power Plant, Biomass Power Plant, Urban Household Waste Power Generation with Rotary Kiln, Carbon Capture Energy Saving Technology, Smart Operation and Maintenance Services.

- Domestic and International Market:
  More than 60 General Contracting Project references in China, and 15 General Contracting Project references in Japan, Korea, Turkey, Indonesia, Pakistan, Uzbekistan, Columbia, Nigeria, Tanzania market.

STEC – WHR Power Plant , Cement

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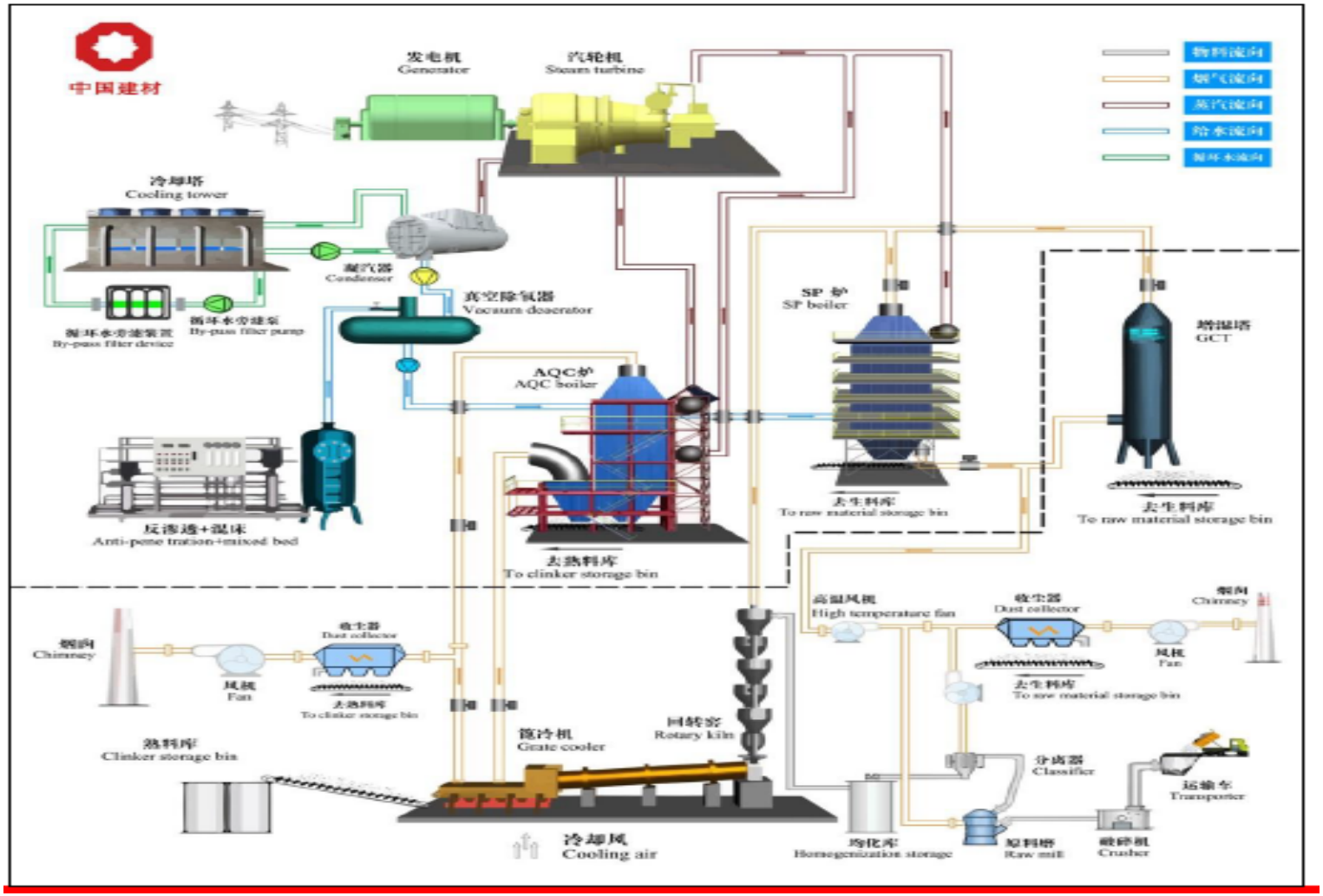
Waste Heat Recovery Power Plant – Cement Kiln



STEC – WHR Power Plant, Cement

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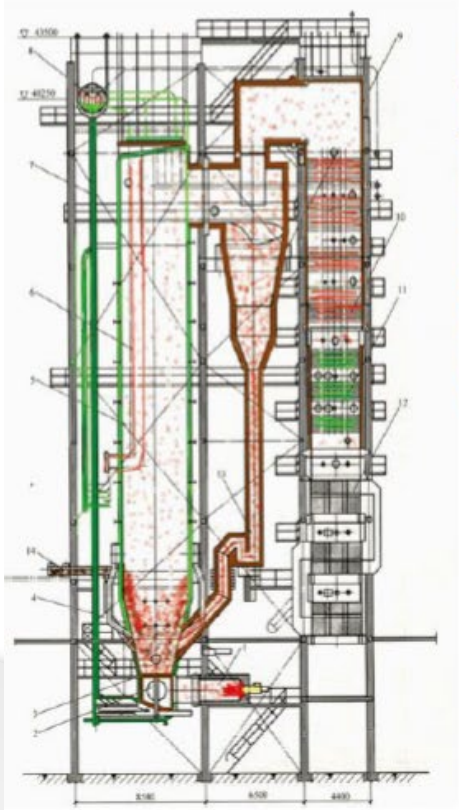
Waste Heat Recovery Power Plant – Cement Kiln

To exploit advantages at the cement engineering and glass engineering of the parent company named CTIEC, STEC has developed pure low-temperature waste heat power generation technologies for new pre-calciner cement line over 1000t/d as well as glass production line over 300t/d, with capacity from 2000kW(2MW) to 30000kW(30MW). The company has accumulated rich experience in WHR systems' design and turn-key project in the industries of cement, glass and steel, etc.

STEC – Biomass Power Plant

Biomass Power Plant



Biomass is the fourth largest renewable clean energy source in the world. Currently, the main Biomass fuel for power generation are crop waste, timber, timber waste, straw, trees, etc. Shanghai Triumph Energy Conservation Engineering Co., Ltd. (STEC) has get many domestic and overseas performances through technical research and application in recent years. In November 2017, STEC successfully signed and EPC contract of 6x10MW Biomass Power Plants in Indonesia with Indonesia biggest plywood manufacturer – HASKO Group.

STEC – Carbon Capture Storage (CCS)

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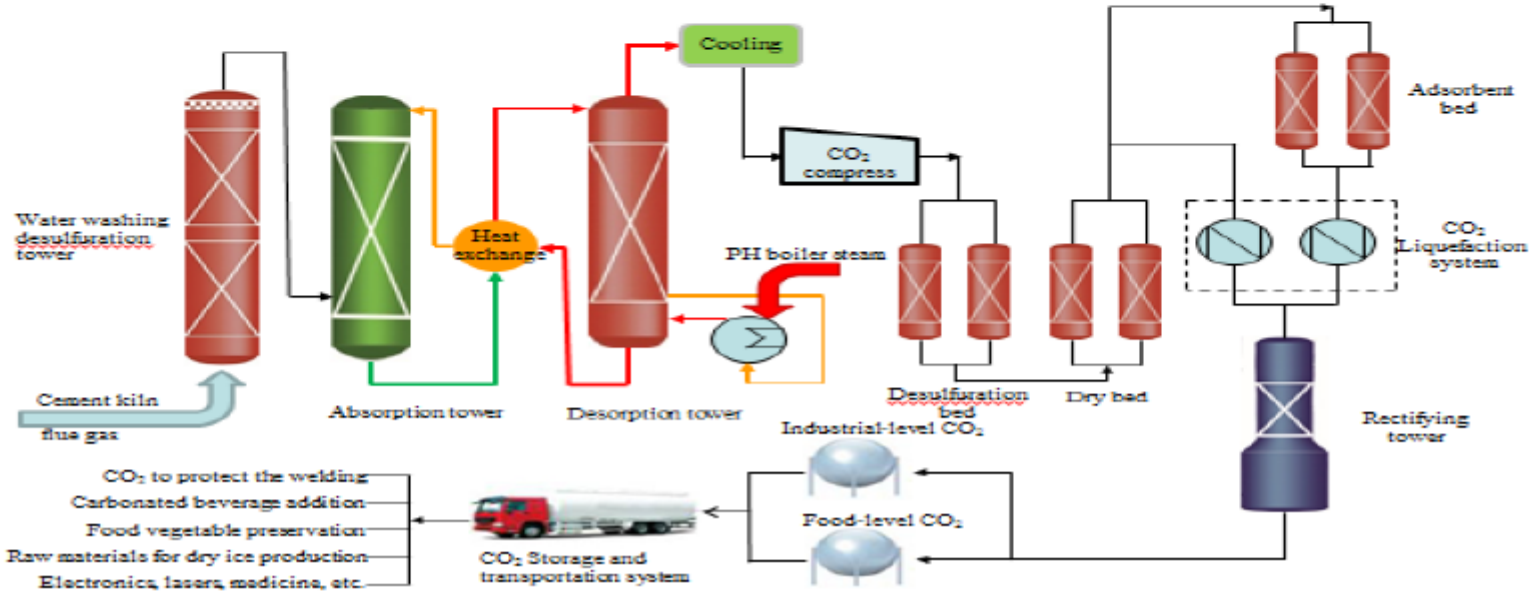
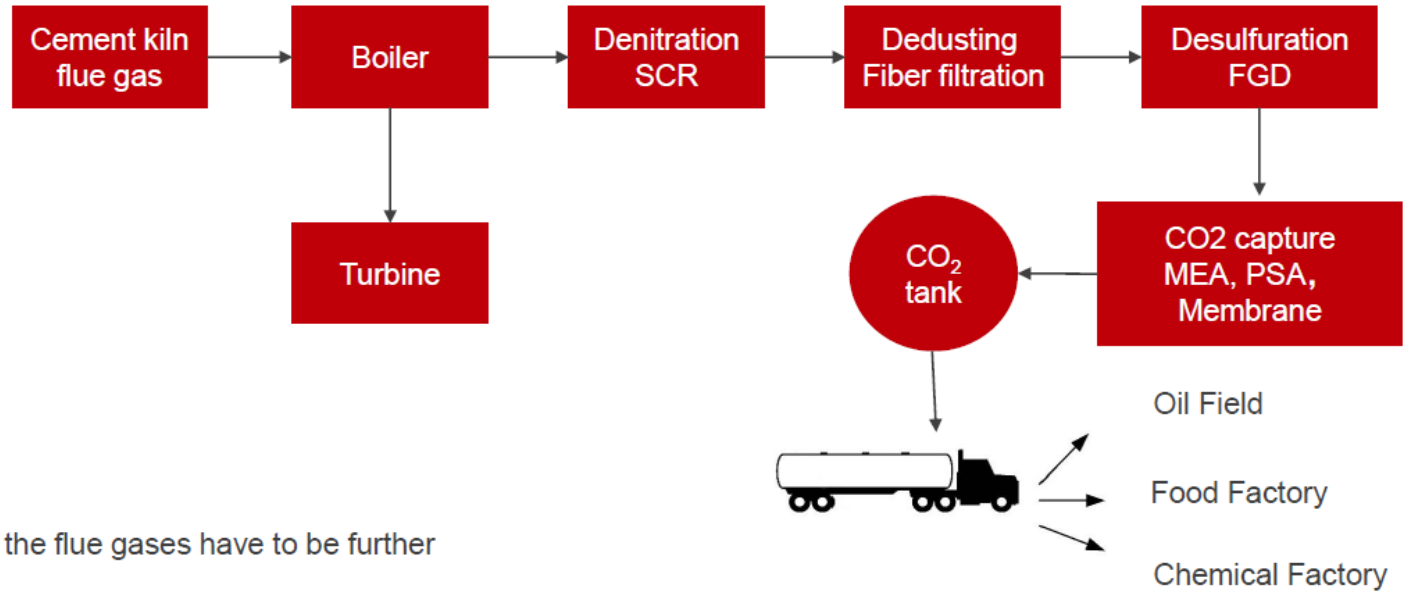
The project adopts the latest international technology to ensure the advanced, safety and stability of the equipment. There are a lot of CO2 in the flue gas of cement kiln/ glass kiln, the technology of carbon capture and storage (CCS) uses the flue gas of glass kiln as the raw material to produce different grades of CO2 liquid through CO2 capture, compression, purification and liquefaction. The equipment has the advantages of less land occupation, simple process, high level of automation, low operation cost and good economic benefits. The project belongs to the recycling of renewable resources by reducing the emission of SO2 and NOx in the exhaust gas while reducing the carbon emission.



STEC – Carbon Capture Storage (CCS)

Cement Kiln Carbon Capture Flue Gas Pretreatment



To capture CO2, the flue gases have to be further treated.

SOX and NOX with lower concentration, as well as proper temperature, are required.

STEC – Electrostatic Fabric Filter

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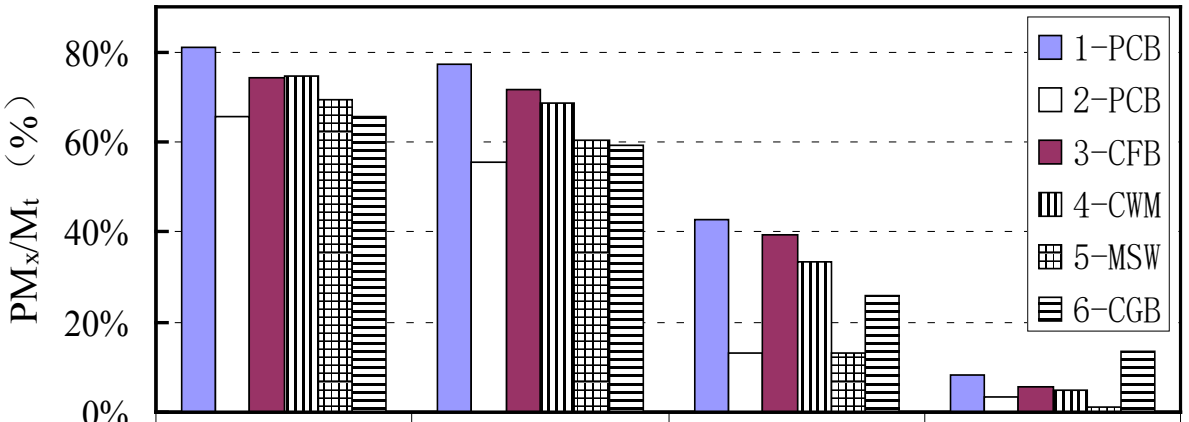
Why Electrostatic Fabric Filter is recommended

Can meet the most strict environmental requirements:

The emission of Hybrid Filter is better than bag-filter, especially more effective in colleting dust with diameter less than PM10 and PM2.5.



	PM17	PM10	PM2.5	PM1
1-PCB	0.810	0.771	0.427	0.082
2-PCB	0.656	0.554	0.131	0.034
3-CFB	0.742	0.717	0.396	0.057
4-CWM	0.745	0.685	0.333	0.048
5-MSW	0.695	0.602	0.130	0.010
6-CGB	0.655	0.591	0.258	0.133

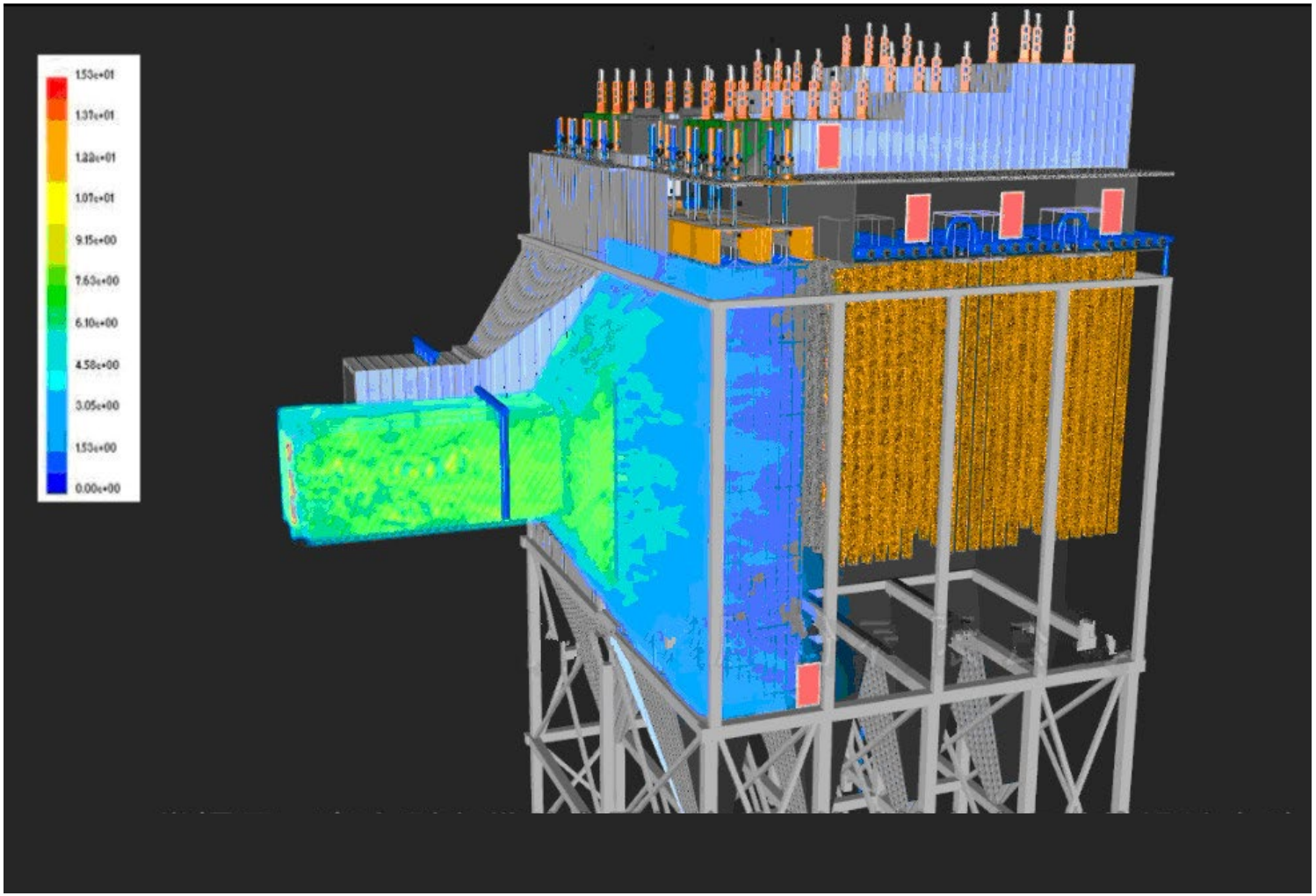
No.1, 3, 4 Electrostatic Fabric Filter

Bag Filter
(Efficiency: ～ 13%)

Electrostatic Fabric Filter
(Efficiency: ~ 40%)

STEC – Electrostatic Fabric Filter

Study on modify ESP into Electrostatic Fabric Filter



In December 12, 2015, nearly 200 contracting parties of United Nations Framework Convention on Climate Change agreed to Paris Agreement, which would make arrangements for post-2020 global actions on climate change.

China made commitment to reaching CO2 emission peak before 2030.

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CREDIT, INNOVATION
AND TO BE THE BEST

Shanghai Triumph Energy Conservation Co., Ltd.

BWE – Biomass Power Plant

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BURMEISTER & WAIN ENERGY

REFERENCES: FUEL CONVERSION

Bio Conversions Won, Lost & Cancelled

UNIT	COUNTRY	SIZE	YEAR	CUSTOMER	FUEL BEFORE	FUEL AFTER	FRACTION	STATUS
UPPSALA 1	SWEDEN	130 MWt	2018	VATTENFALL	COAL	WOOD DUST	100%	WON
YEOUNGDONG 2	SOUTH KOREA	200 MWe	2018	KOEN	COAL	WOOD DUST	100%	LOST
DANGJIN 8	SOUTH KOREA	100 MWe	2016	HYUNDAI	GAS	WOOD DUST	100%	OPEN
KØGE 1	DENMARK	-	2014	DONG	COAL	WOOD DUST	10%	WON
AVEDØRE 2	DENMARK	415 MWe	2014	DONG	COAL	WOOD DUST	100%	WON
RUGELEY 2	ENGLAND	500 MWe	2012	GDF SUEZ	COAL	WOOD DUST	100%	CANCELLED
RUGELEY 1	ENGLAND	500 MWe	2012	GDF SUEZ	COAL	WOOD DUST	100%	CANCELLED
AMAGER 1	DENMARK	90 MWe	2009	DONG	COAL	WOOD DUST	100%	WON
HERNING 1	DENMARK	80 MWe	2009	DONG	COAL	WOOD DUST	100%	WON
AVEDØRE 2	DENMARK	415 MWe	2003	DONG	COAL	WOOD DUST	70%	WON
HERNING 1	DENMARK	80 MWe	2000	DONG	COAL	WOOD CHIP	40%	WON

REFERENCES: GREENFIELD

UNIT	COUNTRY	SIZE	YEAR	CUSTOMER	FUEL NOW	FRACTION	STATUS
GHENT	BELGIUM	20 Mwe	2020	BEE	WASTE WOOD	100%	WON
KENT	ENGLAND	28 MWe	2018	KENT ENERGY	WOOD CHIP	100%	WON
CRAMLINGTON	ENGLAND	28 MWe	2017	CRAMLINGTON ENERGY	WOOD CHIP	100%	WON
SNETTERTON	ENGLAND	44 MWe	2017	ECO2	STRAW	100%	WON
LISBJERG	DENMARK	37 MWe	2016	AVA	STRAW	100%	WON
BRIGG	ENGLAND	40 MWe	2016	ECO2	STRAW	100%	WON
EMLICHHEIM	GERMANY	18 MWe	2009	BIO ENERGIE	STRAW	100%	WON
SHANXIAN	CHINA	31 MWe	2006	NATIONAL BIO ENERGY	COTTON STALK	100%	WON

P = PROPOSAL
E = ENGINERING
P = PROCUREMENT
S = SUPPLY
I = INSTALLATION
R = ERECTION

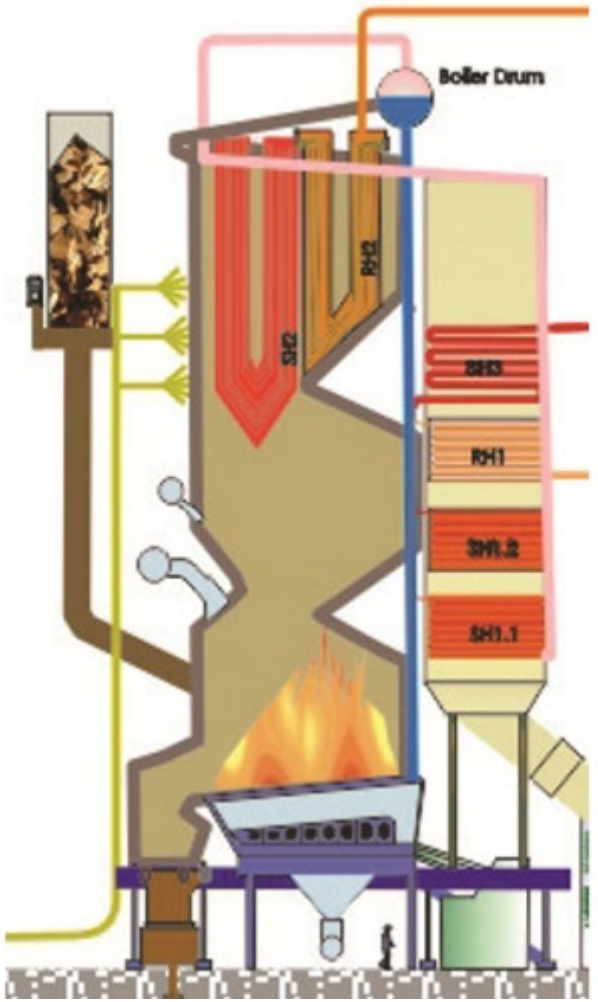
CASE STORIES - BWE BOILERS

KENT RENEWABLE ENERGY PLANT, UK

Boiler type:

Key figures, steam generator, nominal load point:

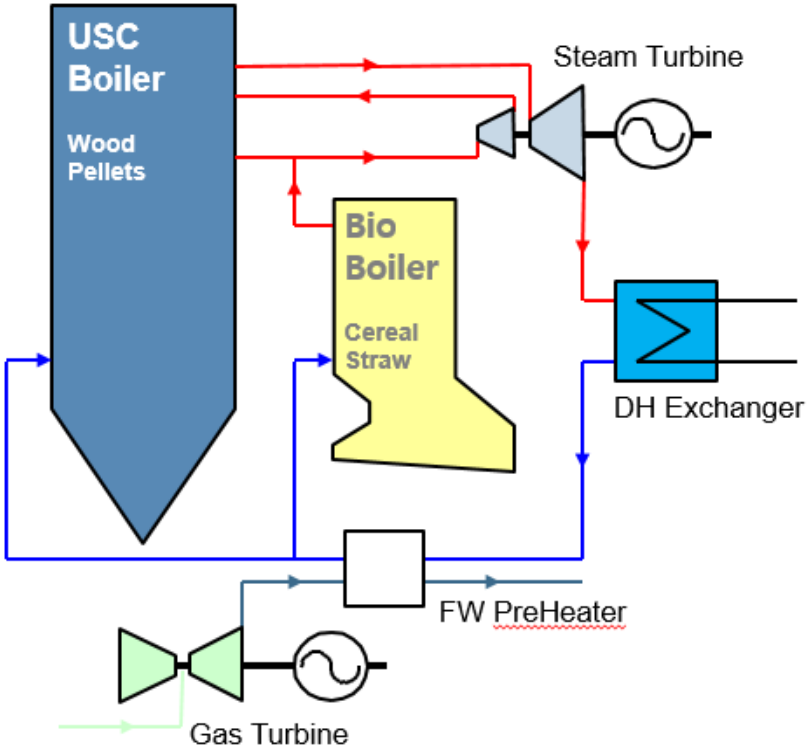
- Steam data: 90 t/h, 140 bar and 540/540°C
- Boiler efficiency: 91.7% (EN 12952-15)
- Heat input: 78 MJ/s
- Foot print: 26.5 m X 32.0 m
- Internal height of boiler house: 32 m



Avedøre Unit 2 (2000, 2003 & 2014)

Multi Fuel Technology

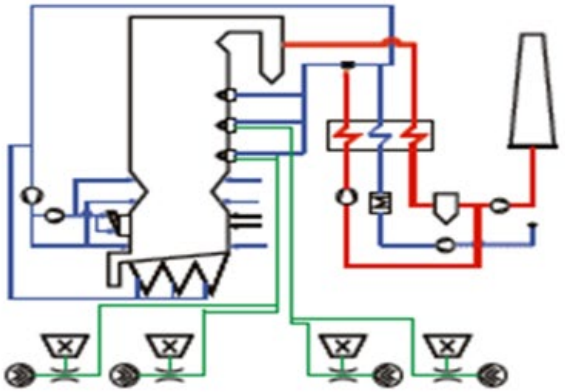
- USC 305 bar & 580/600 C
- ReHeat Single
- Fuel
  - 100% Wood Pellets
  - 100% Natural Gas
  - 100 % Coal & Heavy Fuel Oil
- Fuel Flow 180 t/h
- Milling Roller Mills
- Burner Tangential 4·4
- Output 360 MWe & 410 MWt
- Plant Efficiency 45 %



Herning Unit 1 (1982, 2000, 2002 & 2009)

Multi Fuel Technology

- Sub Critical 115 bar & 525 C
- ReHeat No
- Fuel
  - 70 % Wood Pellets
  - 30 % Wood Chip
  - 100 % Heavy Fuel Oil & Natural Gas
- Fuel Flow XX t/h
- Milling Roller Mills
- Burner Rear Wall 2·2
- Output 90 MWe & 175 MWt
- Plant Efficiency 35 %



STET – Triboelectrostatic Separator

IBE Corporation
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ST Equipment & Technology LLC

Triboelectric Beneficiation of Fly Ash

TITAN GROUP

Separation of carbon from fly ash

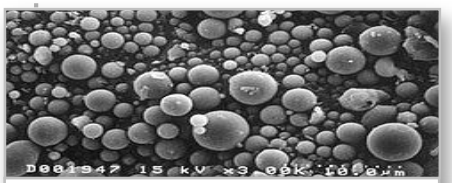
Who are we? What do we do?

History of Separation Technologies LLC

Startup founded in Boston by MIT engineer to develop Triboelectric Belt Separator.

1989

1995



ST begins commercial fly ash processing.

2002

Titan America acquires ST. First international project in Scotland.

2011

2014

Spin Off of the Technology activity due to diversification in Mineral Processing

Currently

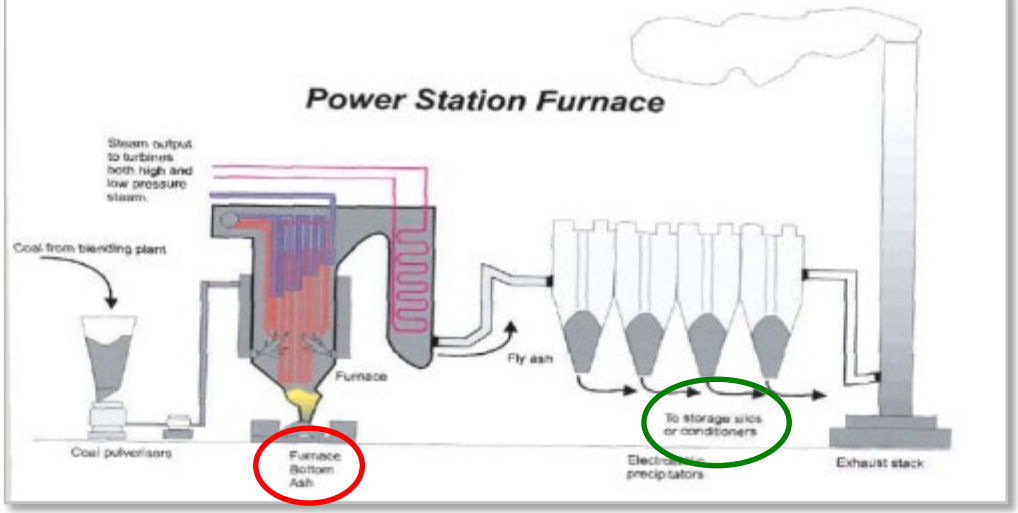
Fly ash installations in 6 countries: USA, UK, Canada, Poland , Philippines and Republic of Korea.

Different Types of Ash

What is Fly Ash?

- Fly Ash comes from coal, used for fuel in thermal electrical power plants
- Coal is found in the earth with incombustible minerals
- Those minerals are collected after the combustion:
  - In the bottom of the boiler (**bottom ash**)
  - In the filters (**fly ash**)

Schematic layout of a coal-fired power plant



Bottom Ash

Fly Ash

A costly waste to manage for Power Plants

- **Land filling : operations, transport, disposal need for future space, on-site storage capital charge**

  Cost per ton: Euros 20 to 40 +

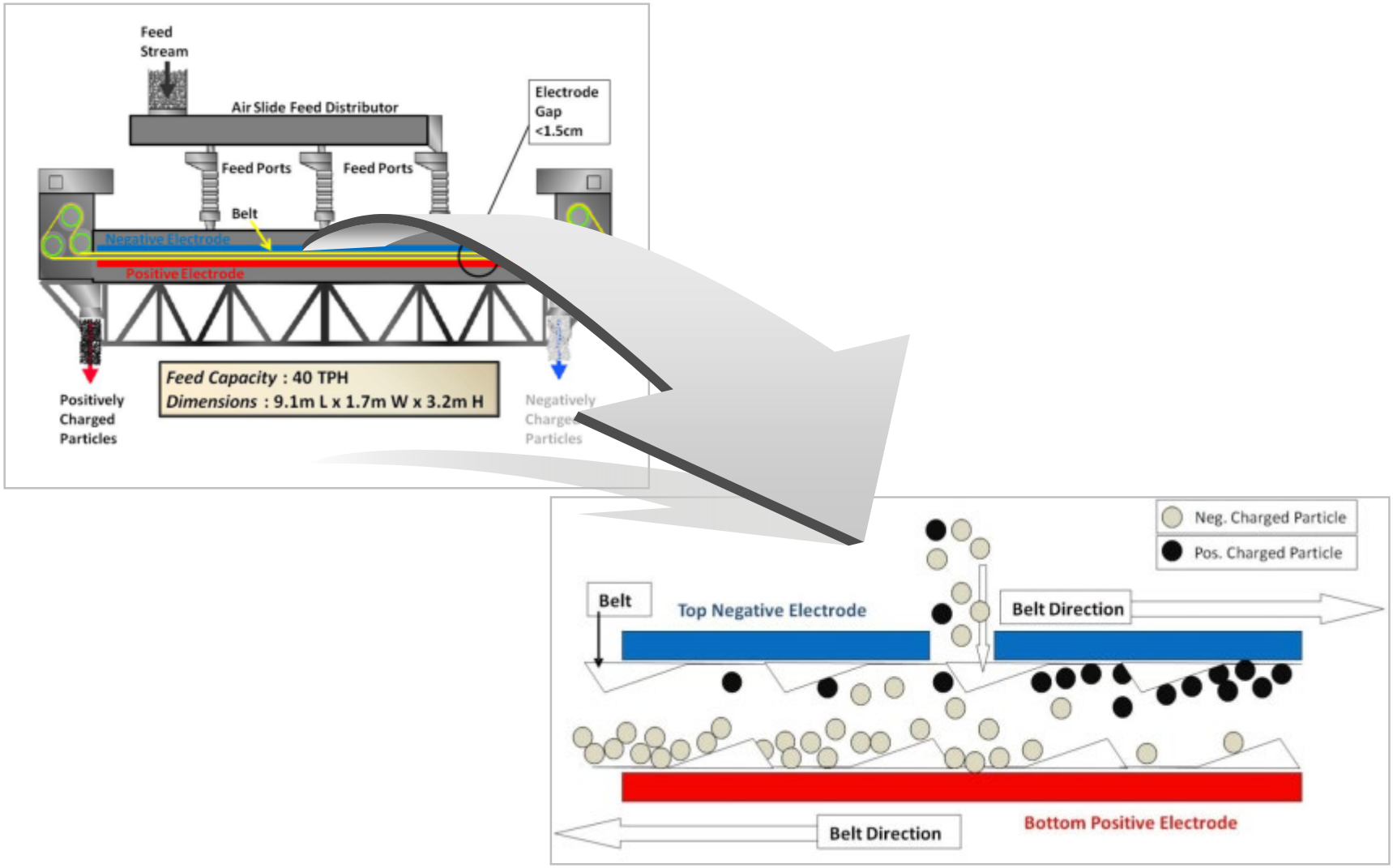
- **Penalties / Taxes : tipping fee**

- **Environmental constraints and concerns: groundwater pollution, air pollution**

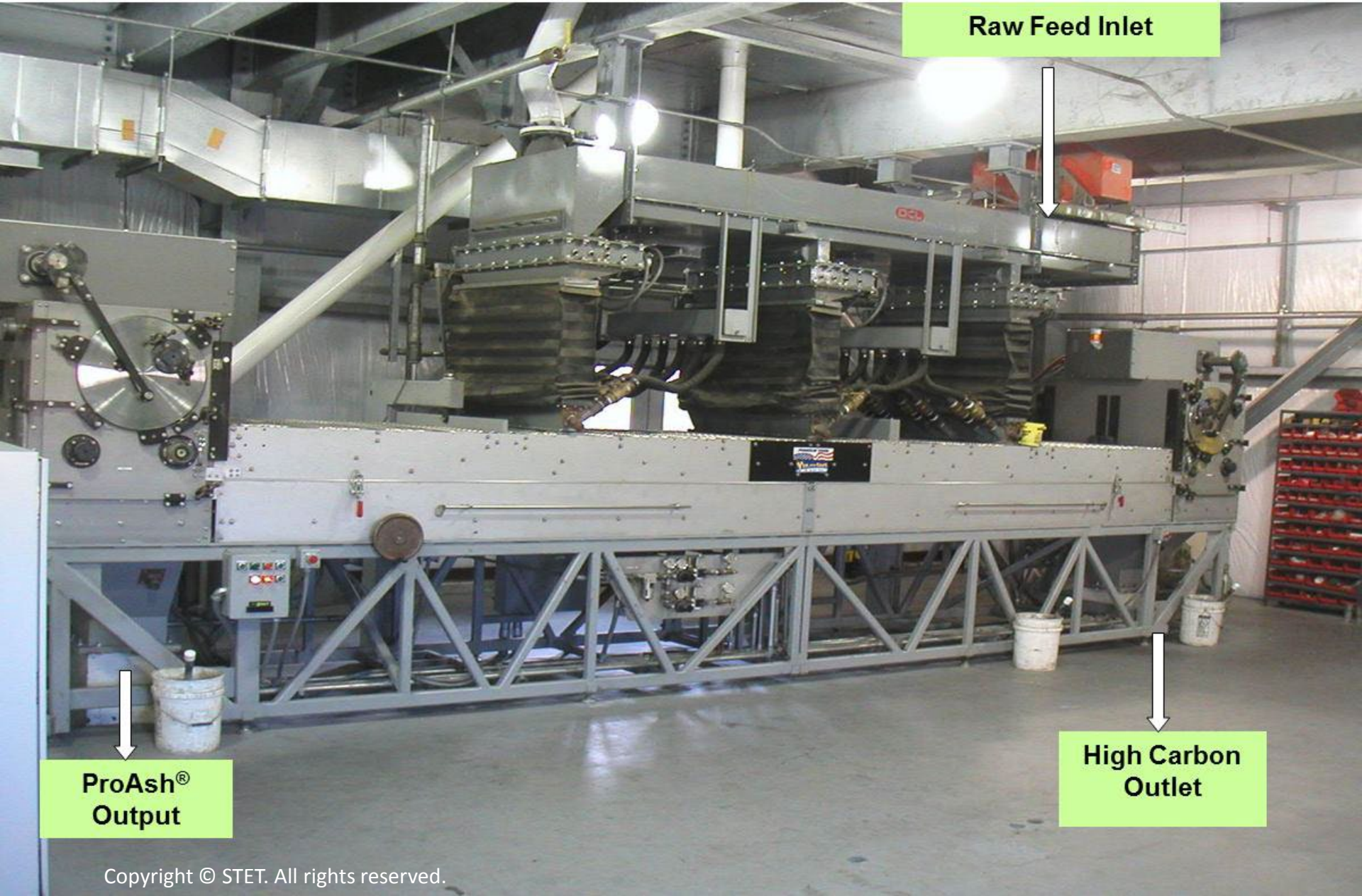
- **Liability for the future**

Fundamentals of ST Process

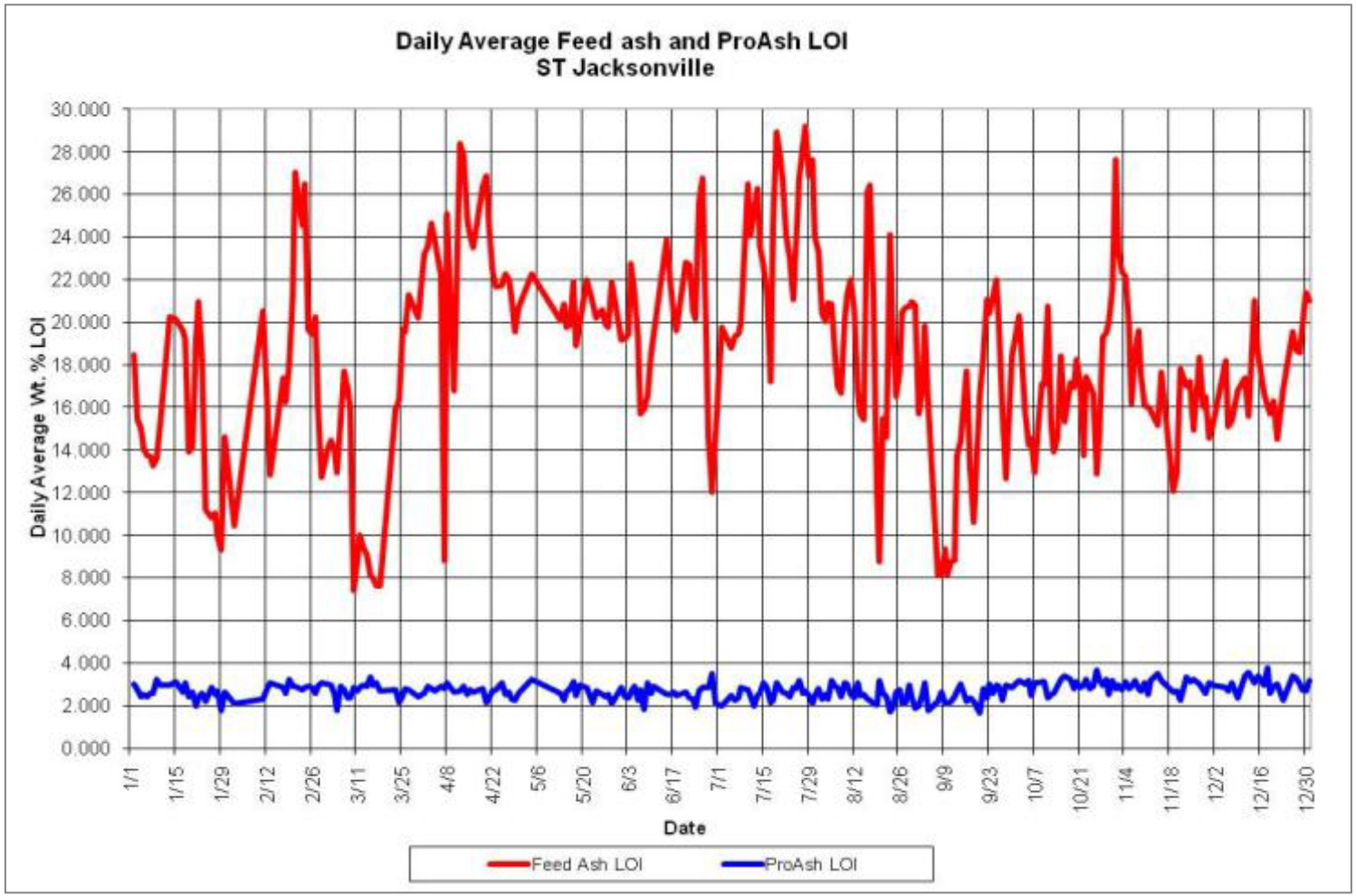
Schematic of the Separator and Electrode Gap



The ST Triboelectric Belt Separator



The consistent quality of product is independent from feed variability



More than 20 m tonnes of ProAsh produced in 15 different plants

Plant	Location	Country	Separators	Start Year
New England Power	Salem, MA		1	1995/2006
Duke Energy	Roxboro, NC		2	1997/1998
CPSG	Brandon Shores, MD		2	1999/2005
Scottish Power	Longannet, Scotland		1	2002
Jacksonville Electric SJRPP	Jacksonville, FL		2	2003/2004
SMEPA	Morrow, MS		1	2004
NB Power	Belledune, NB		1	2005
RWE	Didcot, England		1	2005/2013
PP&L	Brunner Island, PA		2	2007/2008
TECO	Big Bend, FL		3	2008
RWE	Aberthaw, Wales		1	2008
EDF Energy	W. Burton, England		1	2008
ZGP (Lafarge / Ciech)	Janikowo, Poland		1	2011
KOSEP	YONG HEUNG 5 & 6		1	2015
Siekerki (Lafarge/Vatenfall)	Warsaw, Poland		1	2016
Eagle Cement	Manilla, Philippines		1	2017

benefits

- **Fly Ash with LOI within the standard limits**
- **Reliable source all the year long**
- **Price mark-up**
- **Cost savings**

⇒ **Over 20,000,000 tons of Proash® used in the cement and concrete industry**

ST Equipment & Technology was chosen as a key supplier in the construction of the the **New World Trade Center** and produced thousands of tons of high quality ProAsh, thereby, creating high strength, durability, workability and reduced heat of hydration.

THANK YOU!

For more information:

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