



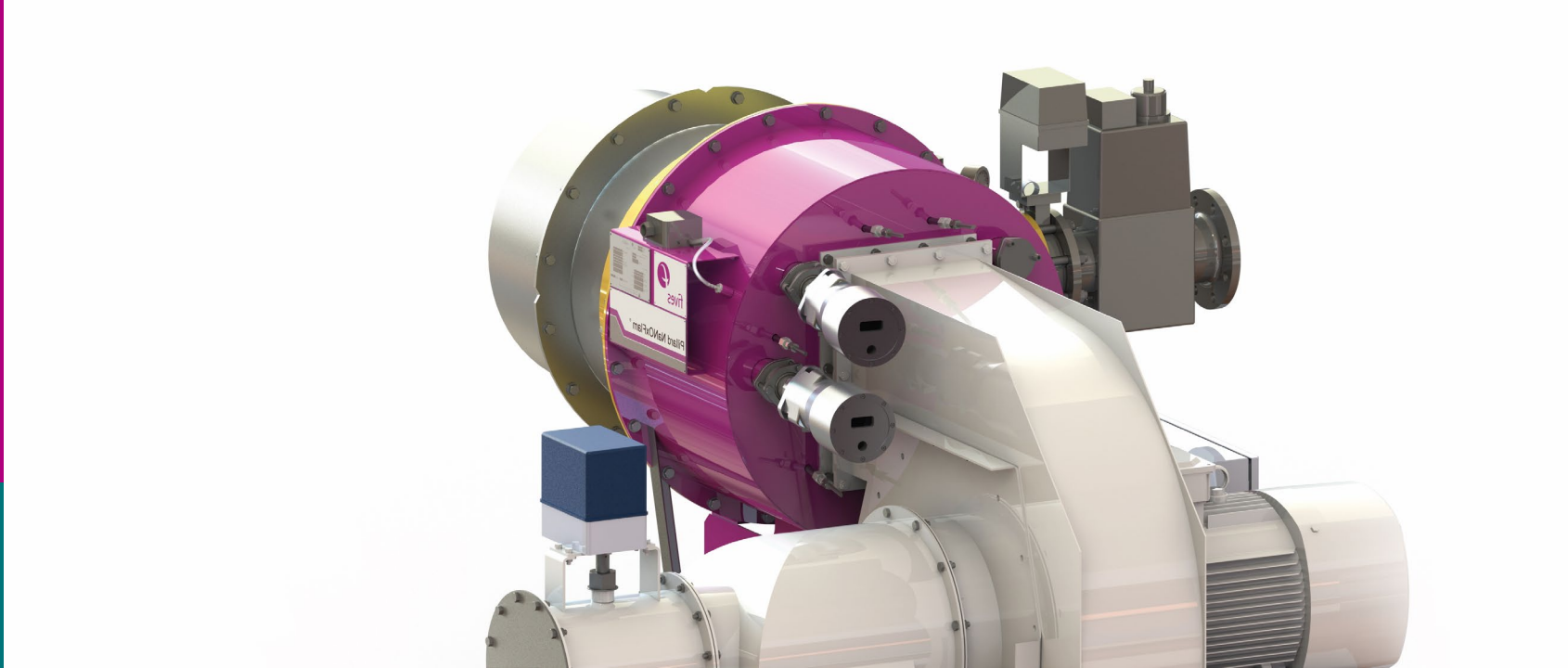
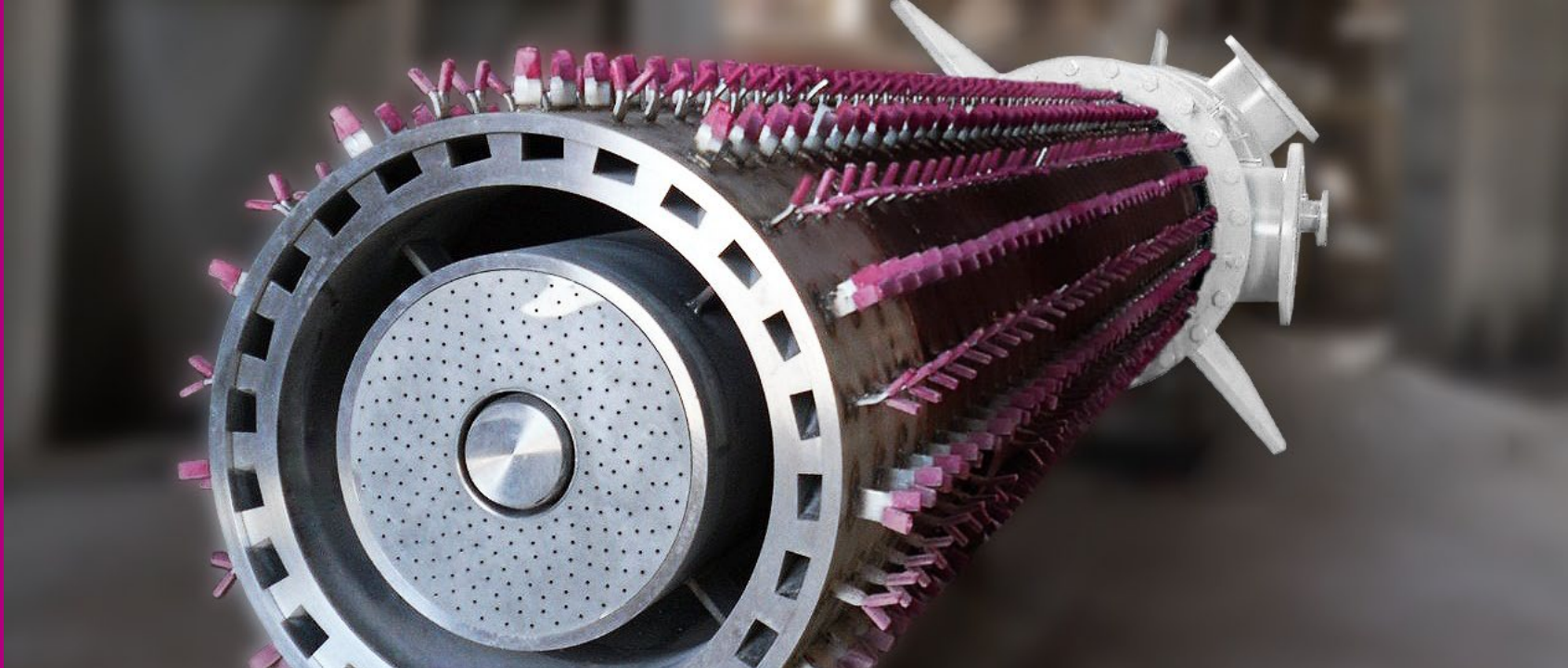
fives

FIVES PILLARD PRESENTATION



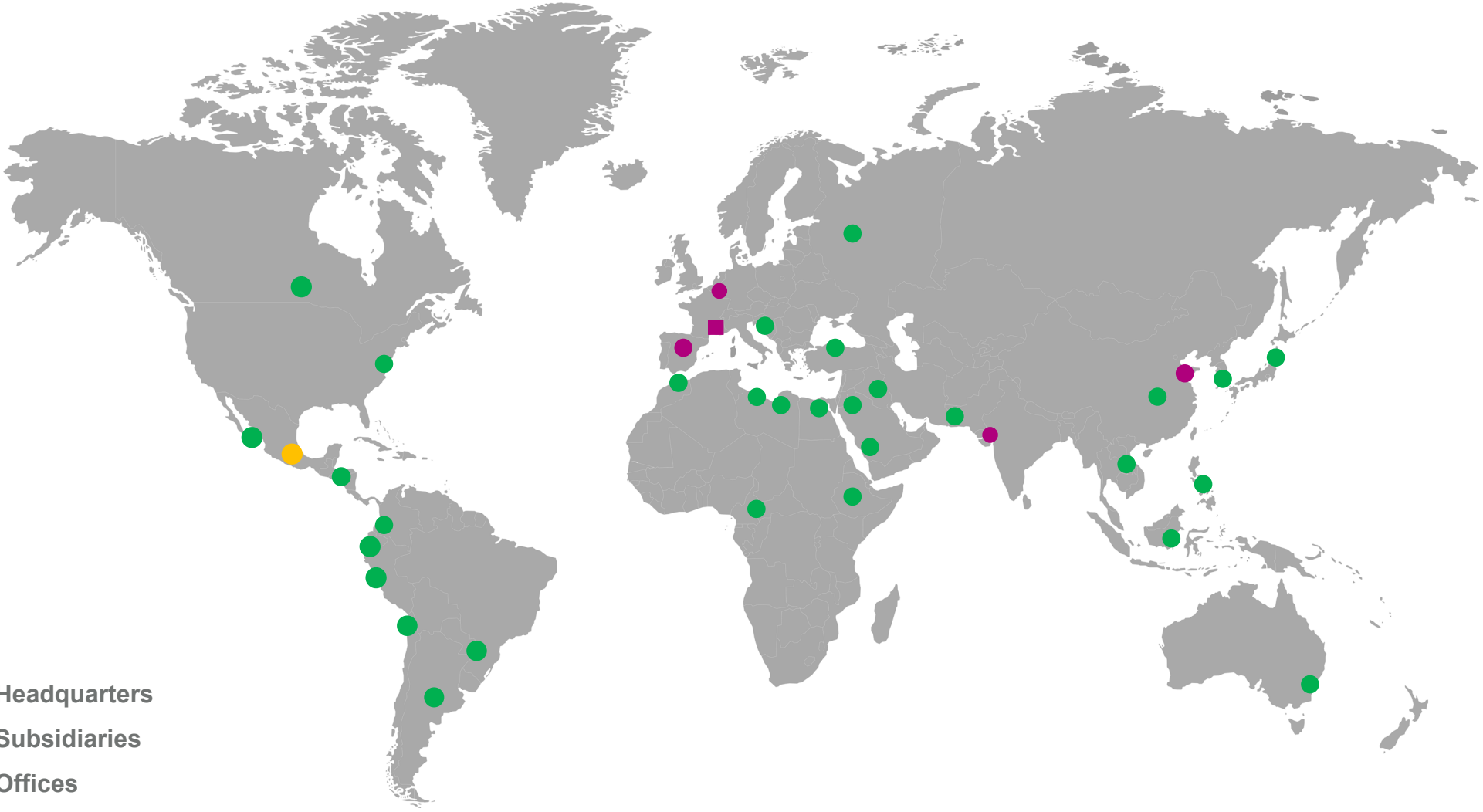
PROCESS
TECHNOLOGIES

ENERGY | COMBUSTION





A worldwide operational support through an international network



- Fives Pillard Headquarters
- Fives Pillard Subsidiaries
- Fives Pillard Offices
- Pillard Product Line – Sales Agent

Fives Pillard offices



FIVES PILLARD – World Head Office
Headcount: 158

Marseille, France



FIVES PILLARD DEUTSCHLAND GmbH
Headcount: 48

Taunusstein, Germany



FIVES PILLARD ESPAÑA SA
Headcount: 14

Madrid, Spain



FIVES AUTOMATION & PROCESSING
Headcount: 18

Shanghai, P.R.China



FIVES COMBUSTION SYSTEMS Pvt Ltd
Headcount: 87

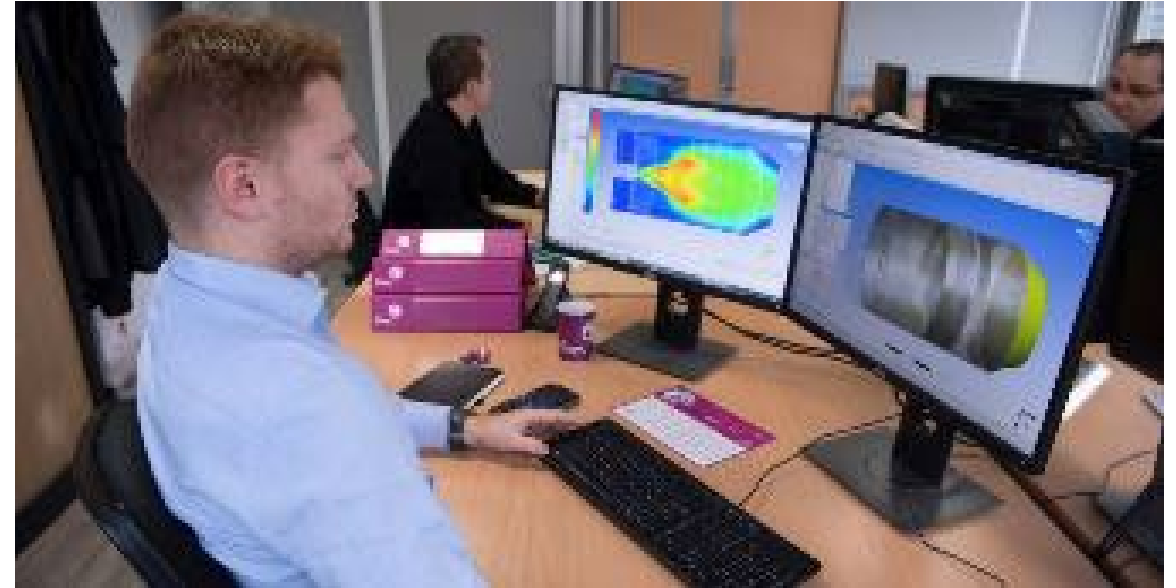
Vadodara, India



Pillard products at your side since 1920

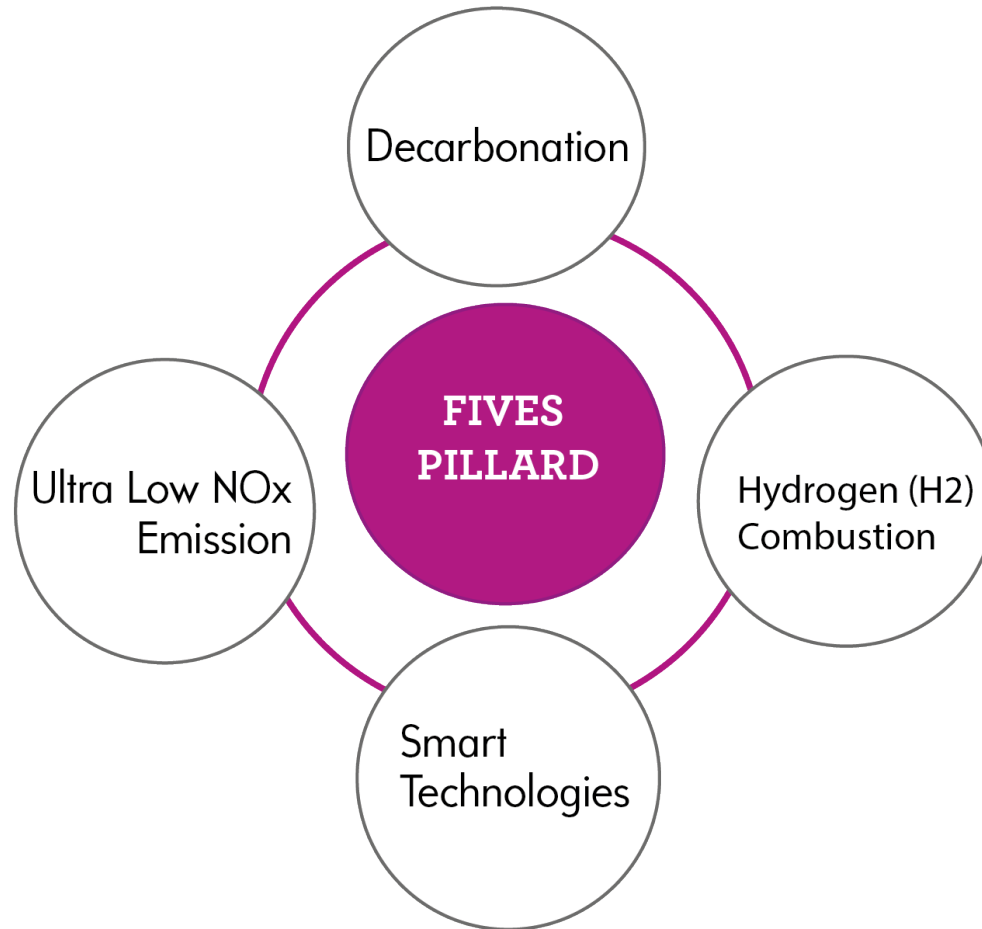


- Powerful R&D organization: over 100 Patents often quoted as BAT (Best Available Techniques), Test Center (Piacenza, Italy),
- CFD Fluent modeling capabilities
- Innovative technologies, tailor-made to customer needs
- Ultimate firing equipment for Energy, Cement & Minerals, Oil & Gas markets
- Eco-friendly designs (low CO and NOx emissions)
- High performance, long lifetime, best cost of ownership
- Long-term relationship with customers, reliability in execution



Our commitments for the environment

Fives Pillard has been innovating since 1980's to reduce atmospheric pollution.
Now, our four pillars are :



Fives European Combustion Research Centre – Piacenza, Italy

- 30 MW installed test furnaces/boilers
 - Hot Combustion Air (> 300°C), FGR, TEG
 - Various types of fuels (see below)
- Liquid fuel spray room for flame characterization
- Flame video-monitoring by a highly sensitive UV camera
- Commercial presentation Area
- Remote monitoring system to enable the test campaigns to be followed live from the Marseilles Head Office
- Mixing skid for fuel gas preparation, adapted for CH₄, H₂, CO, C₃H₈, DO, Biofuels...





Pillard product range

— Energy application – Oil & Gas



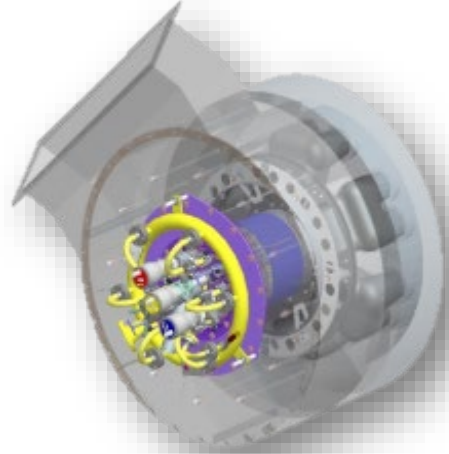
Pillard SULFLAM®
Acid gas burners for Claus units



Natural or forced draft burners
for petrochemical heaters



Pillard OPTIMAFLAM™
For atmospheric
distillation furnace



Pillard product range

— Energy applications : Boilers



fives

Solutions for decarbonation

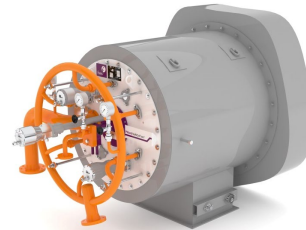
Pillard BIOFLAM™
Burners for biogas

Pillard GR FLAM
CP Biomass



Hydrogen Combustion

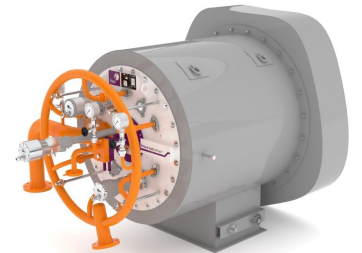
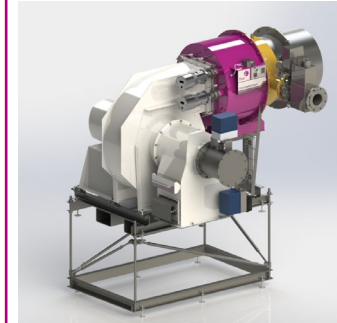
Pillard NANOxFLAM®



Ultra Low NOx Burners

Pillard NANOxFLAM®
Compact

Pillard
NANOxFLAM®



Miscellaneous

Pillard GRFLAM™

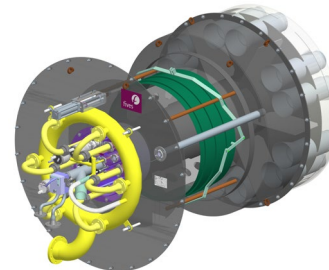
Pillard LEANGASFLAM™
Low LCV gas burners (COG,
BFG...)



Low NOx Burners

Pillard LONOxFLAM
AS

Pillard LONOxFLAM®
G2



Pillard product range

— Mineral application - Cement

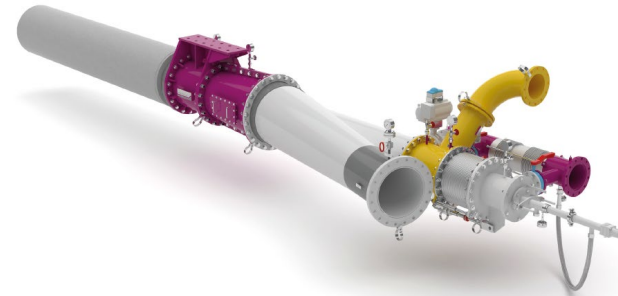
Pillard PRECAFLAM™



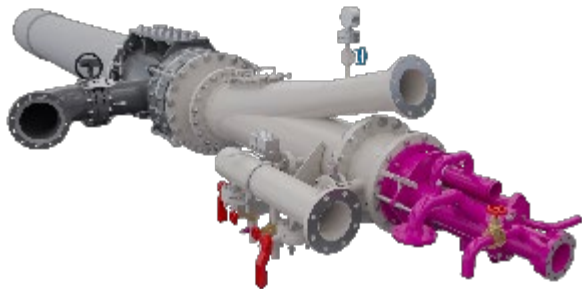
Pillard ROTAFLAM®



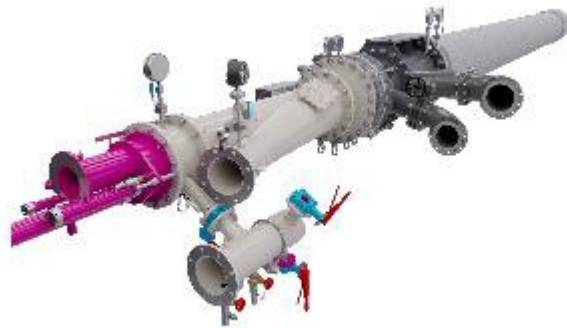
Pillard DNOxFLAM®



Pillard NOVAFLAM® Evolution



Pillard NOVAFLAM® Evolution+



Solutions for decarbonation

Pillard PFZ™



ASF Preparation



Pillard product range

— Mineral application – Cement, lime and ferronickel

Pillard HEATGEN™ Systems
(Hot Gas Generators)
firing pulverized, liquid or
gaseous fuels



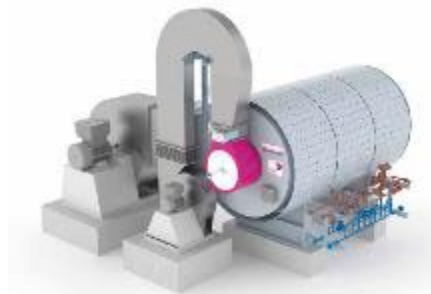
Pillard Fuel Systems (Fuel handling)
for liquid, gaseous, pulverized and
alternative fuels



Pillard STAPILDOS™ dosing
system for pulverized solid fuels



Pillard HEATGEN™
Light Duty



Pillard NEUTRINOx™
SNCR system for NOx reduction
at stack



Pillard product range

— Control systems

Design and manufacturing of advanced combustion system including:

- Burner management system based upon:
 - *Relay –based systems,*
 - *Standard and Fail safe PLC*
- Fuel/air ratio control
- Screen view (HMI) and process supervision
- For precise and close burner performances control
- And Services: commissioning and training



Analysers and Instruments applications

Combustion
safety
instruments



Pillard POWERPACK™
Ignition burner



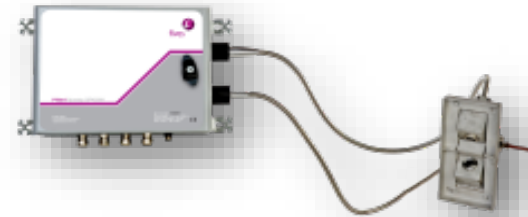
Pillard Flame detector range



Continuous
Emission
monitoring



Pillard OPASTOP® GP4000H
Dust monitor



Pillard OXYCHECK™
Oxygen analyser





SERVICES



ENERGY | COMBUSTION

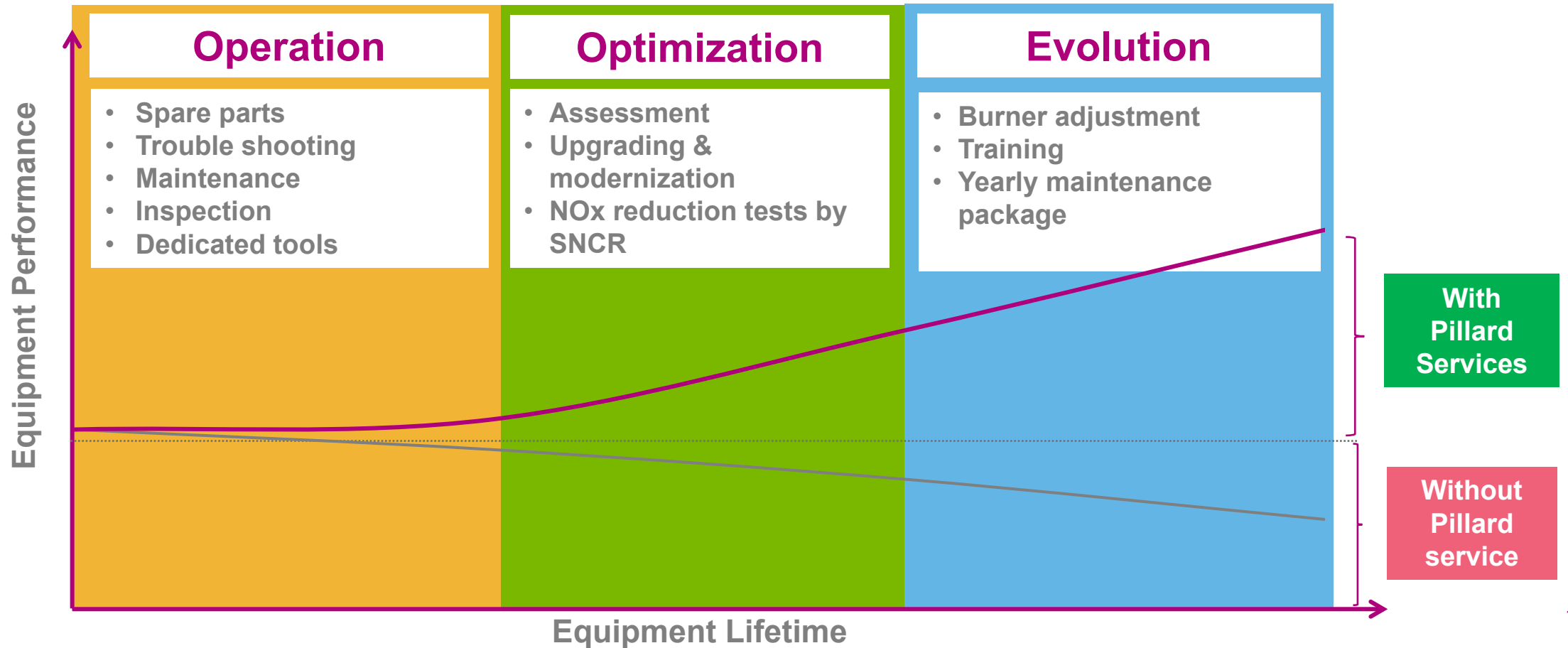


Pillard Service Offer



Complete Life-cycle support

Extend the life of your equipment with Pillard Service and Pillard genuine spare parts





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Pillard NOVAFLAM[®]

Evolution

Ultimate burner for cement kilns



Date xx/xx/xxxx

Prepared by xxxxx



PROCESS
TECHNOLOGIES

ENERGY | COMBUSTION



World leader
in cement kiln firing
with references in over
50 countries

over **15000**
burners
implemented



PROCESS
TECHNOLOGIES



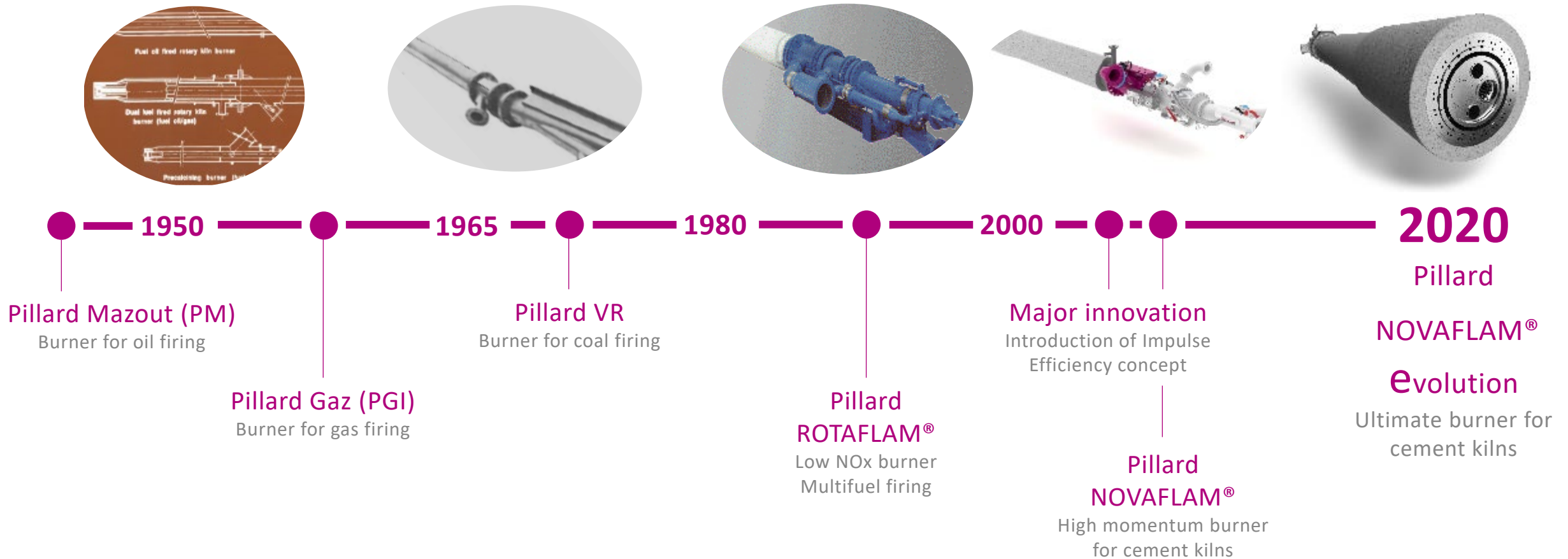
World Record
Alternative Solid Fuel
in a cement kiln
24 t/h
through the main burner

Since 2009
over **6000**
references worldwide



PROCESS
TECHNOLOGIES

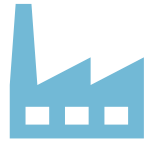
Pillard's cement kiln burner history



Why the new Pillard NOVAFLAM® Evolution burner ?



Still a step ahead



Maximized **clinker quality** and **production rate**



Enhanced **fuel flexibility** with the **same efficiency**



Reduced **CO₂ impact** and cost savings thanks to an **increased substitution rate of alternative fuels**

High momentum using **lower primary air flow** for **lower NOx emissions** and **increased efficiency**

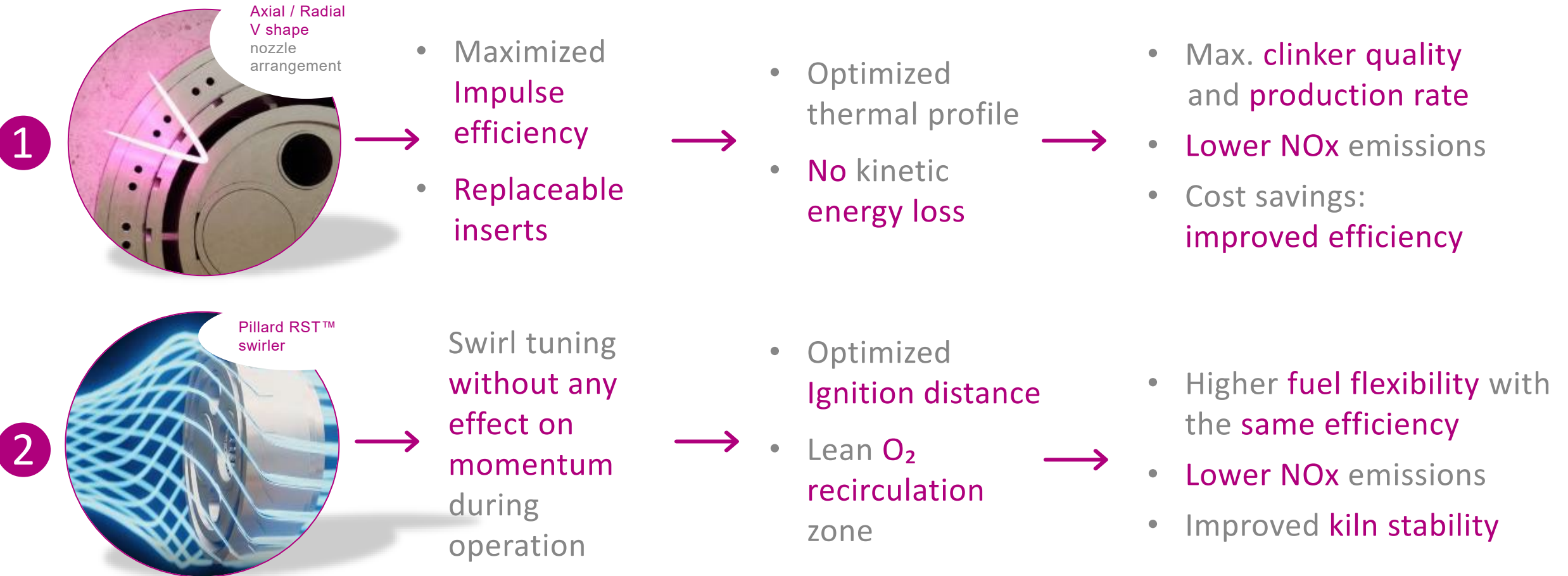


Improved **burner lifetime** and reduced **kiln downtime**



How does the Pillard NOVAFLAM® Evolution achieve such improvements ?

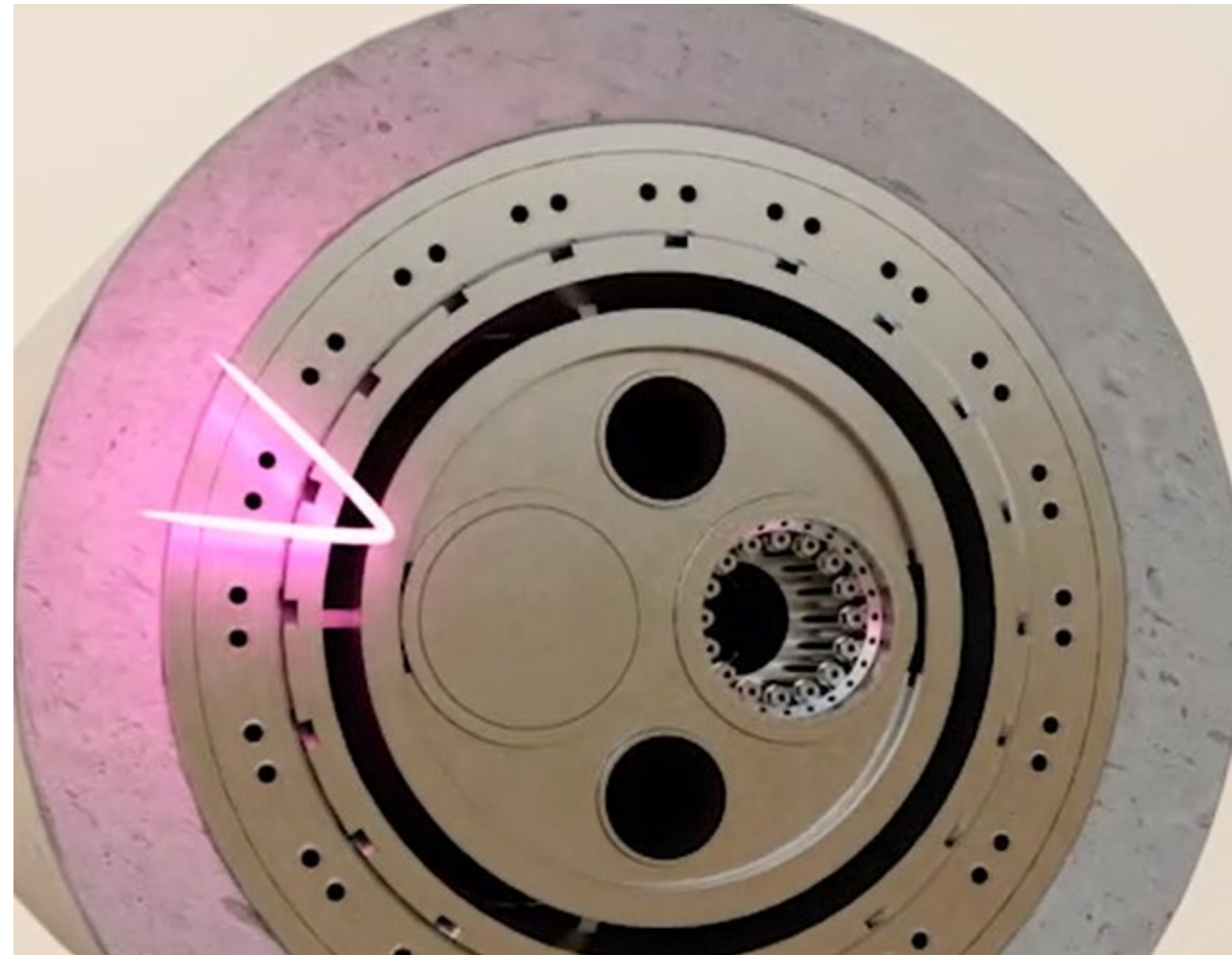
A package of innovations



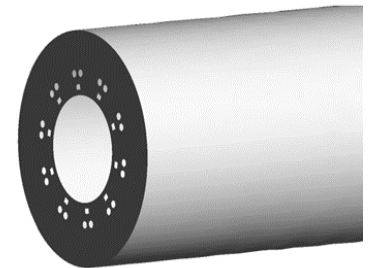
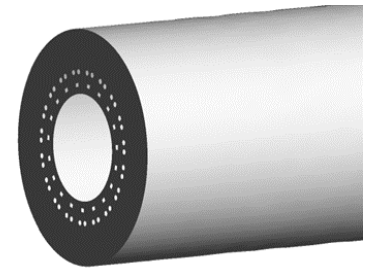
How does the Pillard NOVAFLAM[®] Evolution achieve such improvements ?

1°) Axial/Radial “V shape” nozzle arrangement

1



Extensive CFD engineering work has been made to determine the best axial/radial tip arrangement

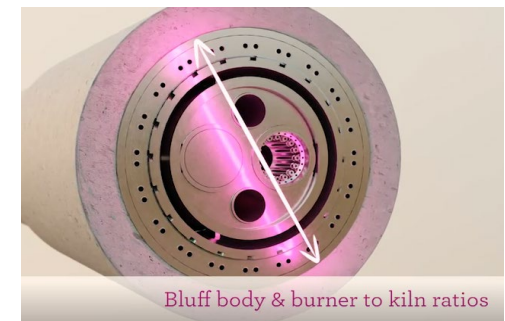
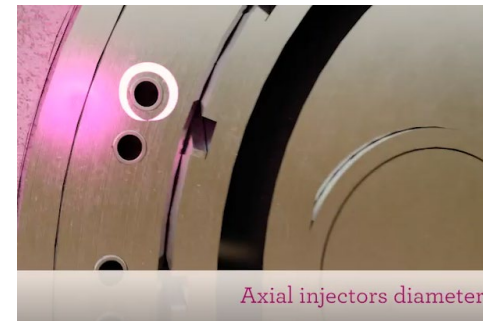
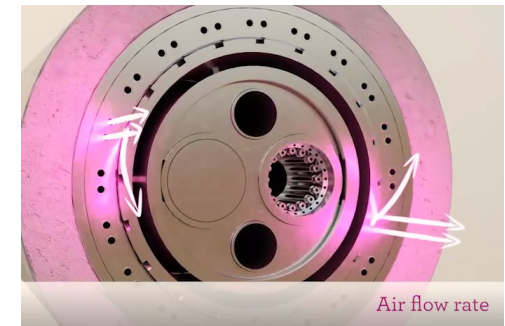
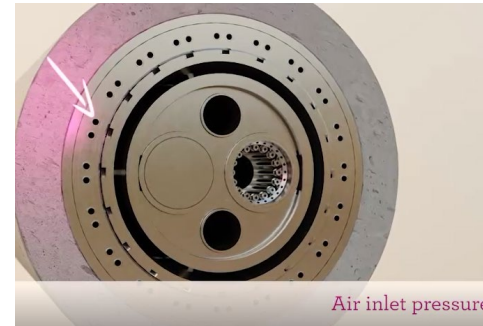


How does the Pillard NOVAFLAM® evolution achieve such improvements ?

Numerous parameters impacting the thermal profile have been studied

The new Axial/Radial “V shape” nozzle arrangement ensures:

- best thermal profile
- best clinker quality and production rate

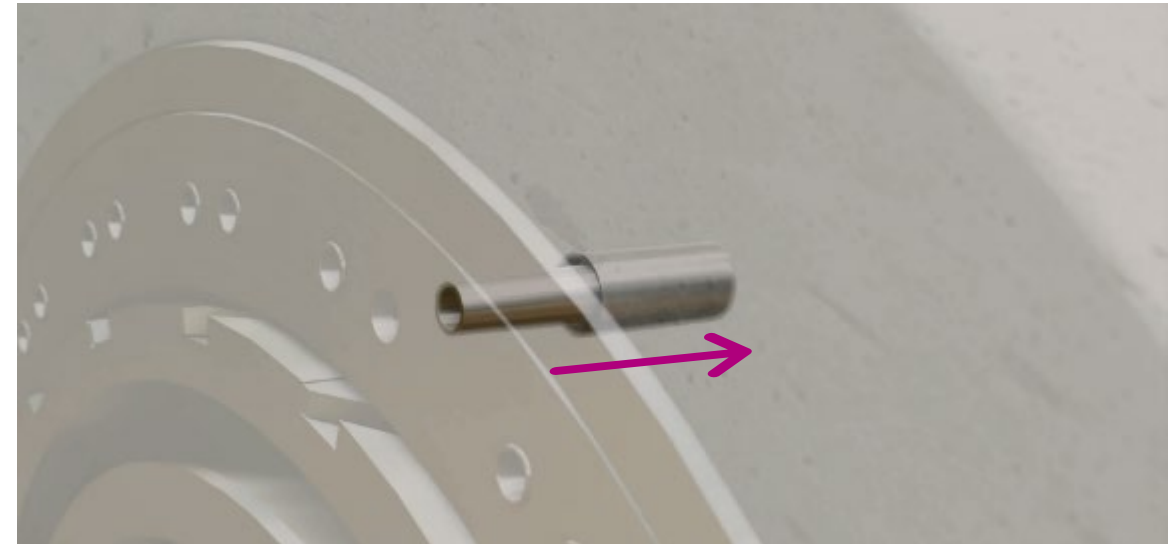
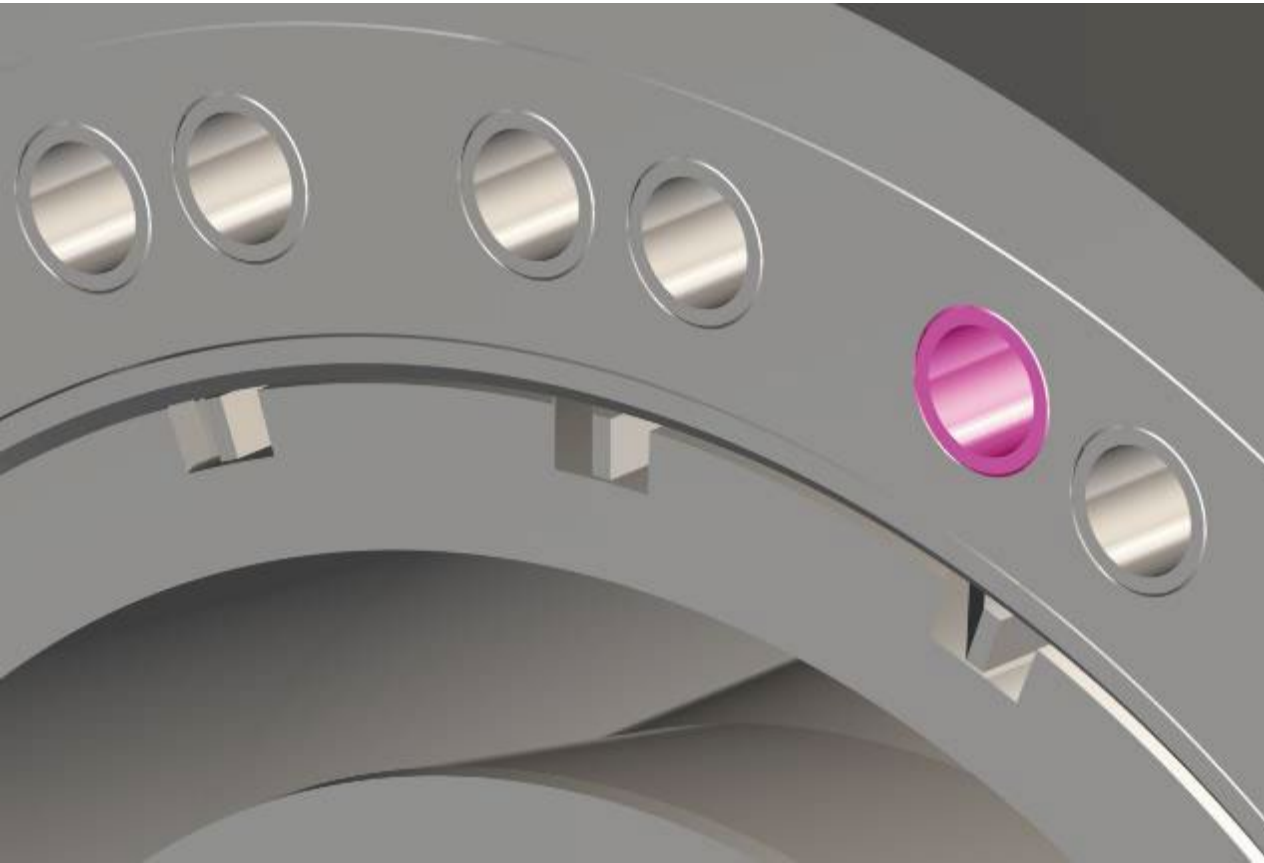




How does the Pillard NOVAFLAM® Evolution achieve such improvements ?

2°) Replaceable inserts for Axial air injectors

1



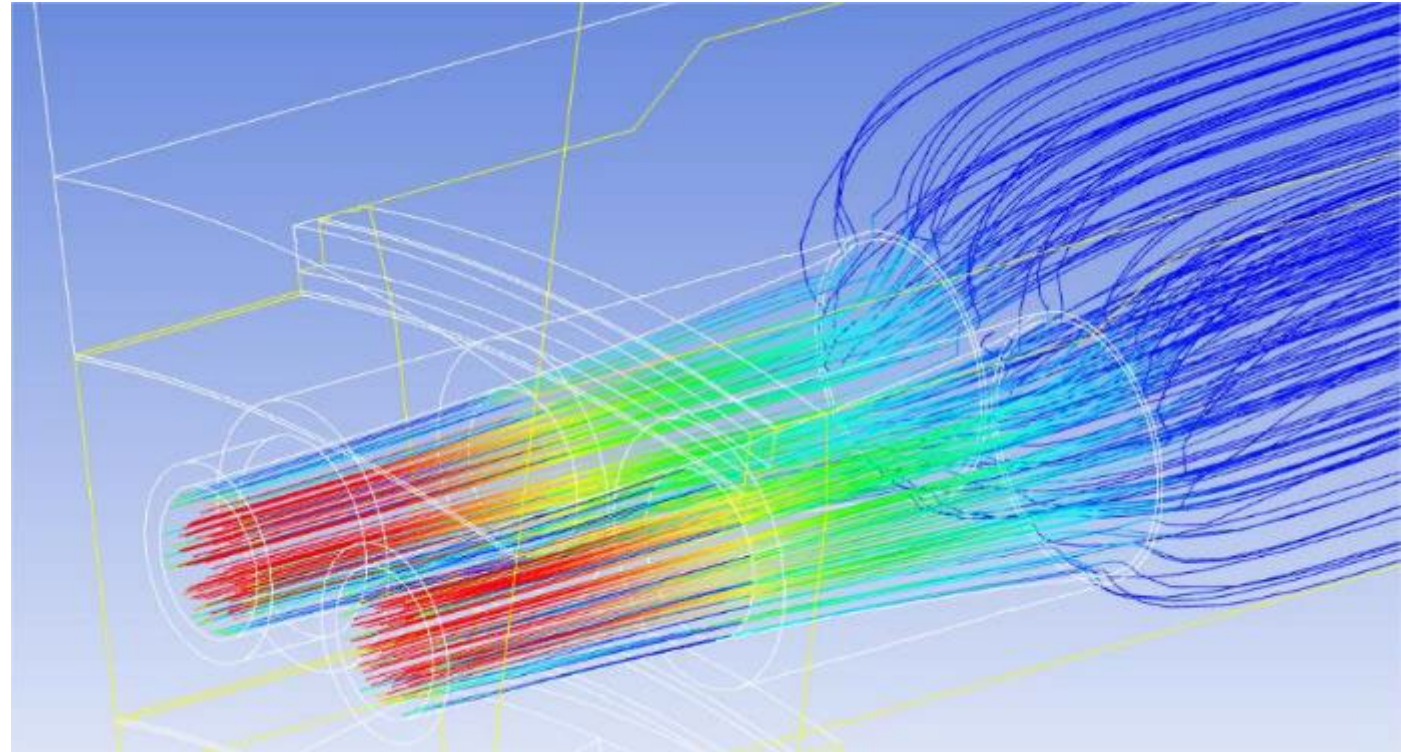
Possibility of **replacing axial air injectors** in the case of major change in operating mode
→ **Reduced OPEX** by avoiding the replacement of the entire burner tip

How does the Pillard NOVAFLAM® evolution achieve such improvements ?

3°) Aerodynamically shaped Axial air injectors for lowest pressure drop

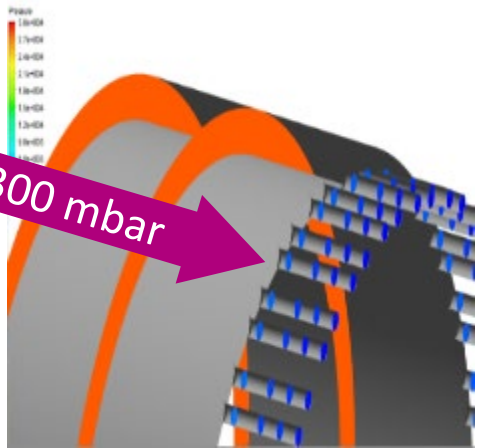
1

- All **static pressure** is **converted** in dynamic pressure and momentum with a **very limited energy loss**
- Allows **reducing** both the **primary air flow** rate and the **electrical consumption** of the blower

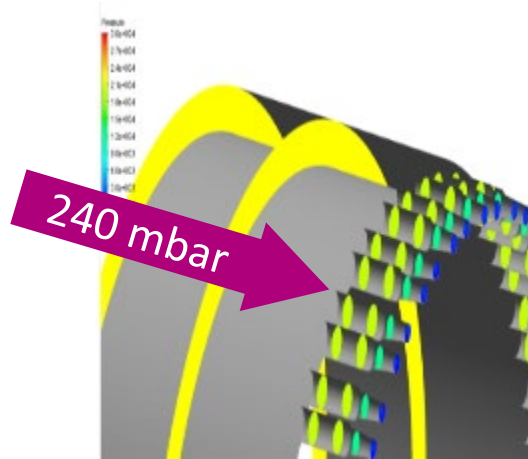


How does the Pillard NOVAFLAM® Evolution achieve such improvements ?

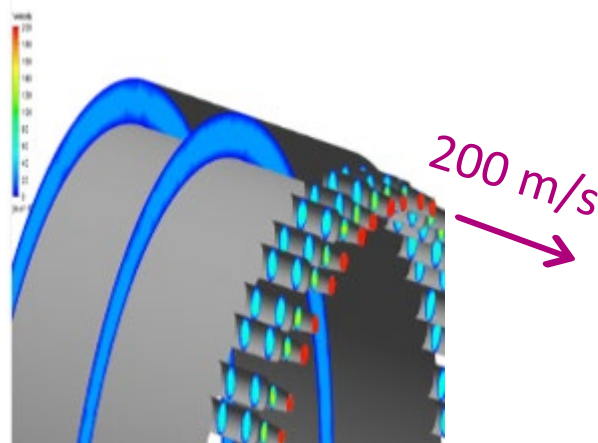
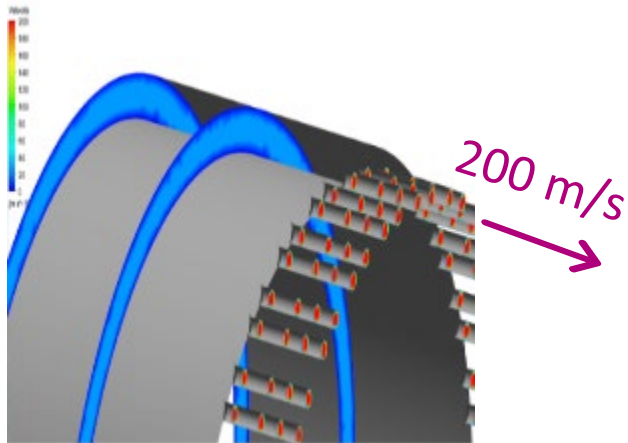
Straight hole



Conical hole



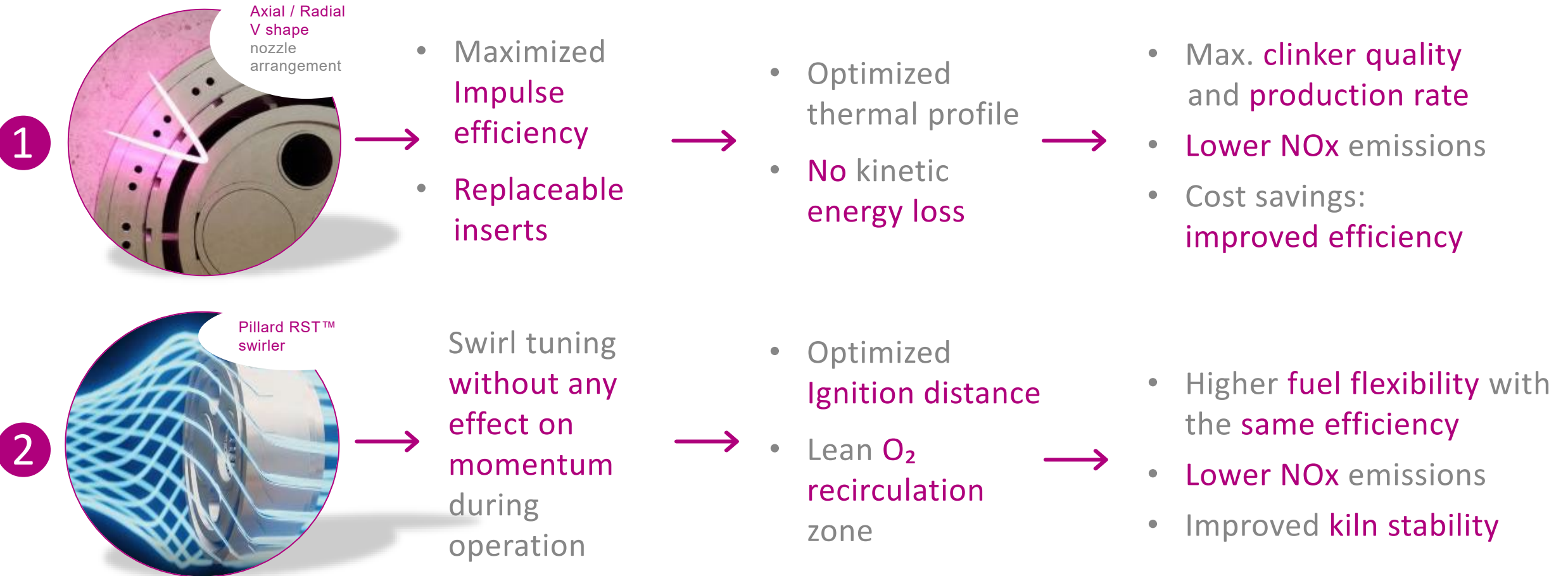
The **same injection** velocity at the tip is achieved with **60 mbar less pressure** than a straight hole shape.



The conical shaped hole is a design parameter which **improves burner efficiency**

How does the Pillard NOVAFLAM® Evolution achieve such improvements ?

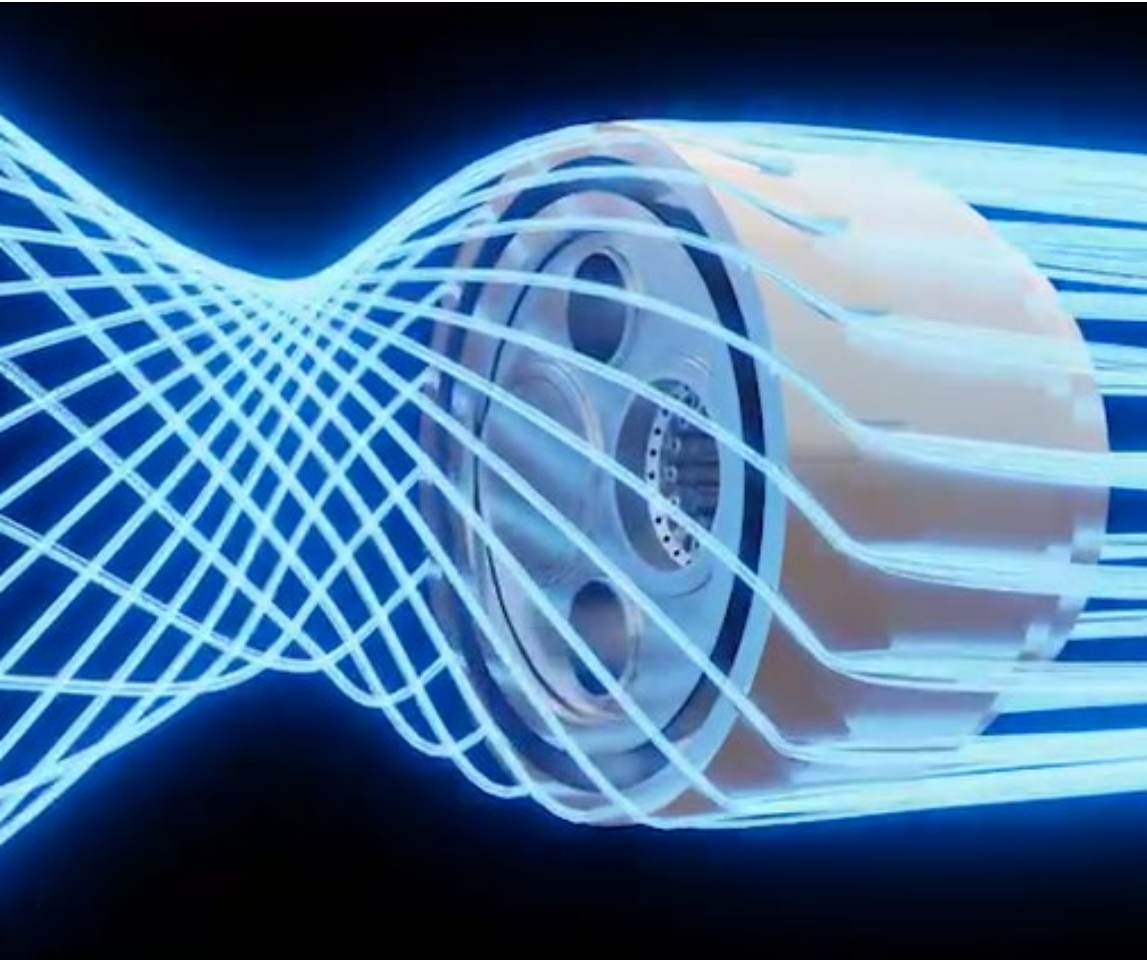
A package of innovations



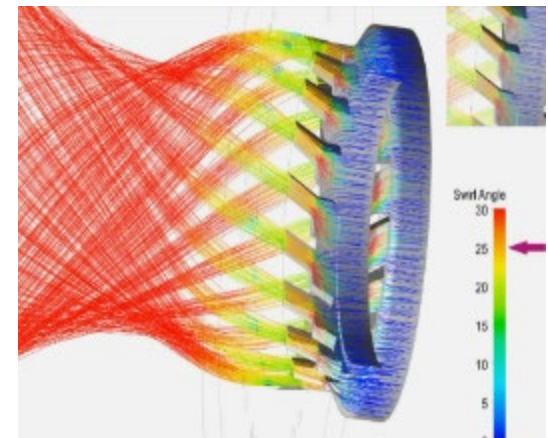
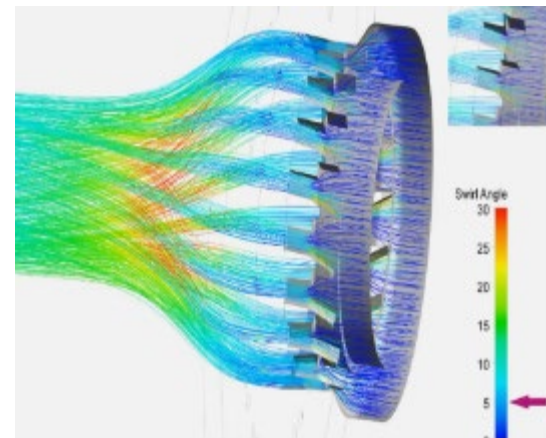
How does the Pillard NOVAFLAM® Evolution achieve such improvements ?

The Pillard Rotating Swirler Technology (RST™)

2



- No moving parts on fire
- Better swirler efficiency & adjustment possibility (from 0° to 45°)
- Possibility to go from 100% axial flame to high swirl flame





How does the Pillard NOVAFLAM[®] evolution achieve such improvements ?

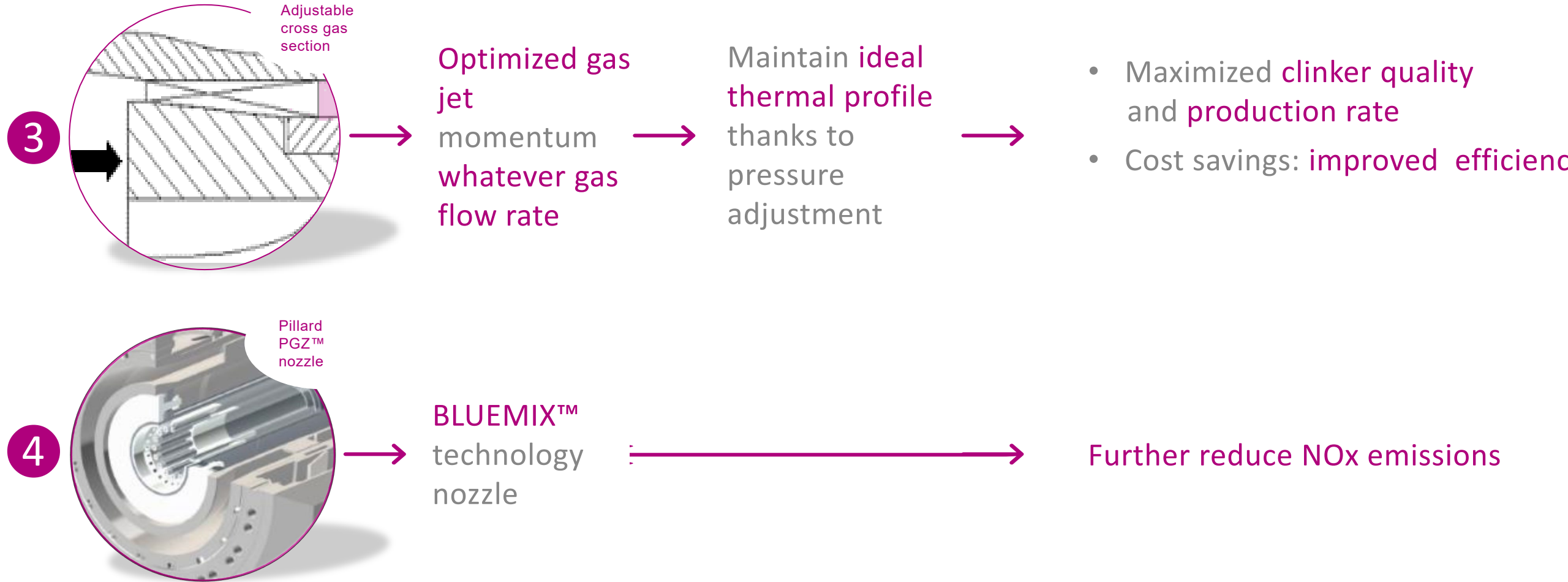


Pillard RST[™] Mechanical Design

2



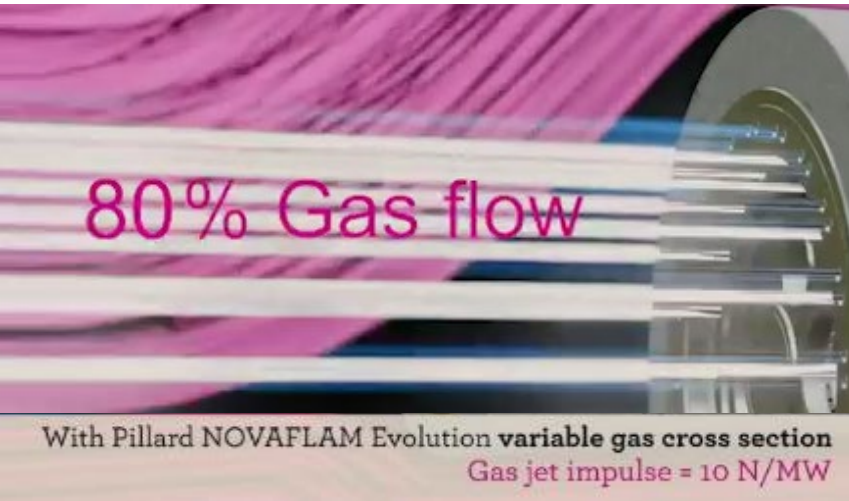
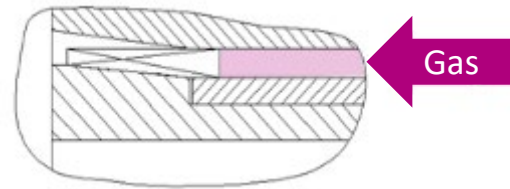
A package of innovations at your service



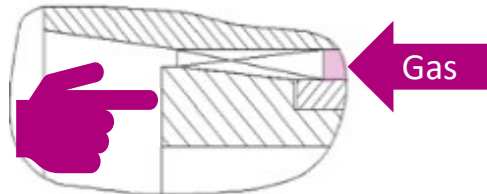
How does the Pillard NOVAFLAM[®] Evolution achieve such improvements ?



Bigger outlet section



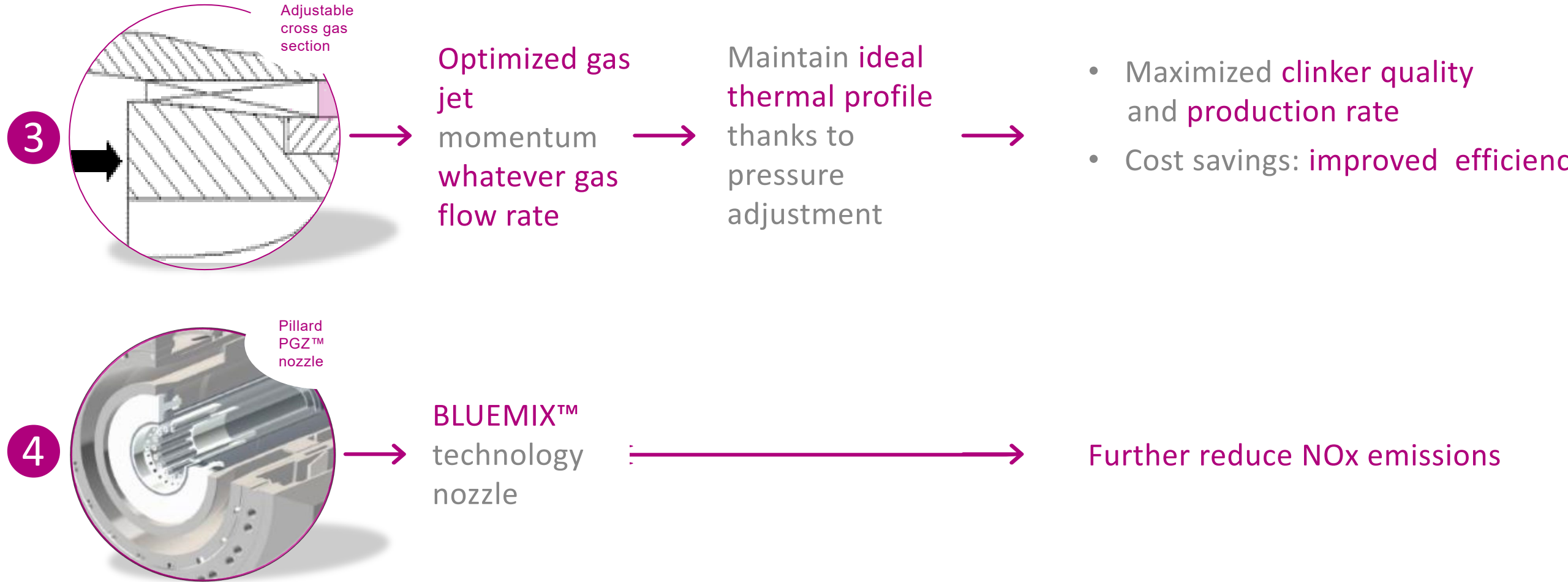
Smaller outlet section



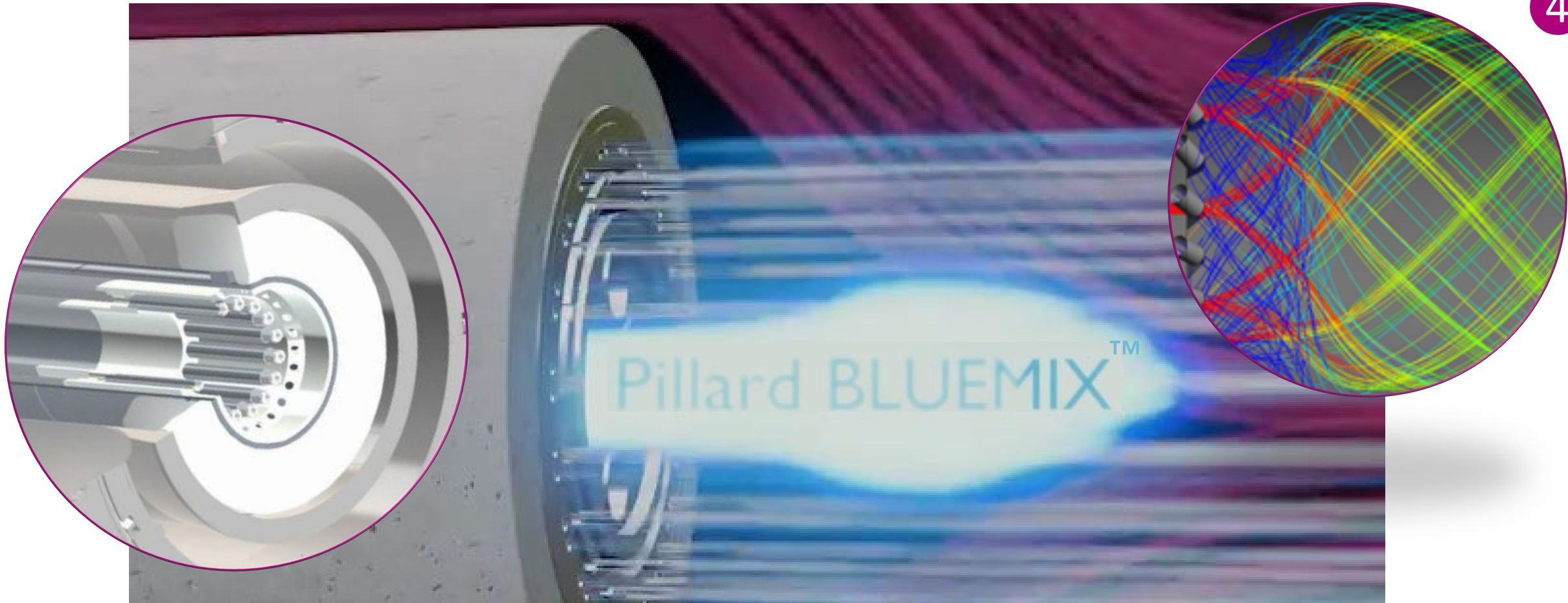
Possibility to **adjust natural gas momentum** keeping **same gas flow rate** and injection angle:

- Same momentum

A package of innovations at your service



How does the Pillard NOVAFLAM[®] Evolution achieve such improvements ?



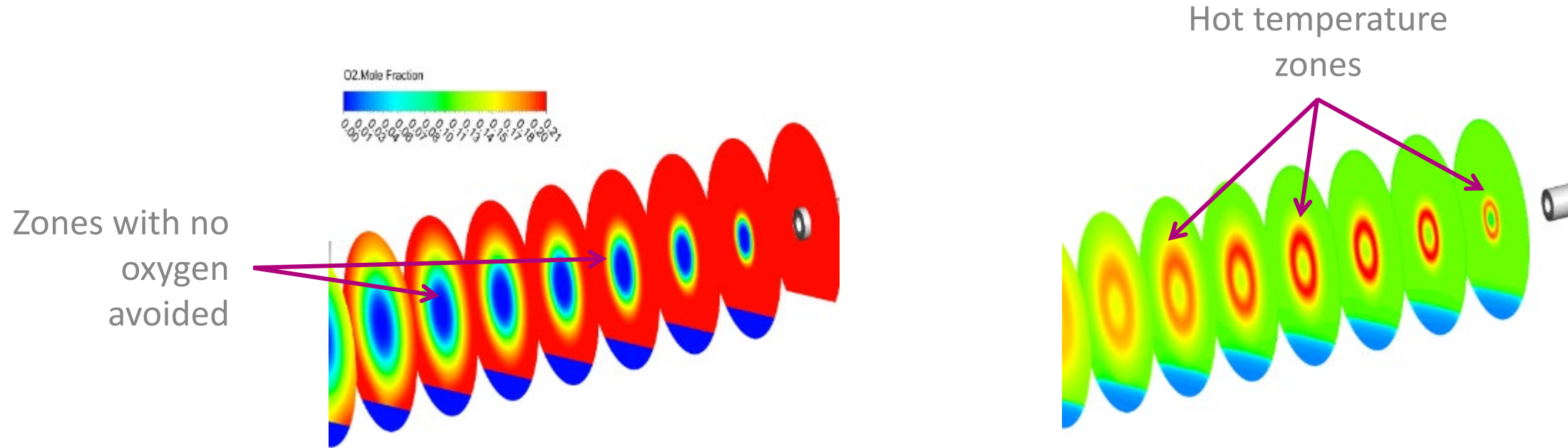
Reduced ignition distance to reduce NOx



How does the Pillard NOVAFLAM® evolution achieve such improvements ?

ASF are injected in the ideal combustion zone

6



- The ASF are injected into the high oxygen and high temperature zones.
- The residence time in these areas is optimized.

How does the Pillard NOVAFLAM® Evolution achieve such improvements ?

ASF injector choices

Central injection of ASF

- Engineered to cope with **various ASF densities** and **size parameters**
- **Longer residence** time for large or dense particles
- **Avoids the 'double flame'** effect for flying particles



Low granulometry



High granulometry

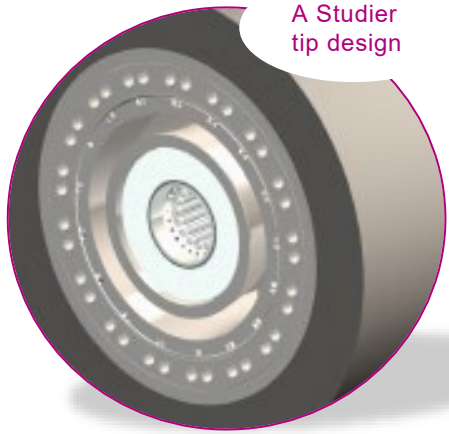
Satellite injection of ASF (Pillard PFZ™)

- **Adjustable** trolley
- **Adapted to large particles** with high moisture content
- Variable injection velocity



A package of innovations at your service

7



- Cooled heavy duty tips in specific alloys
- No moving part on fire
- Replaceable inserts
- Easily dismantable

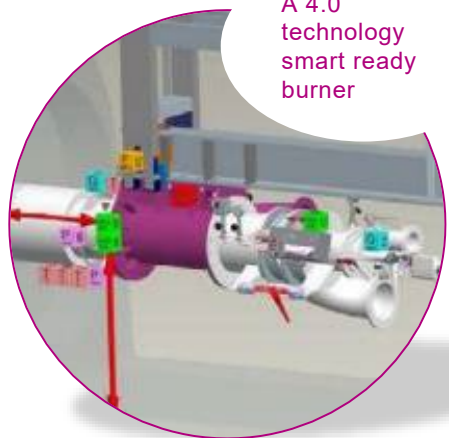


- Resilience to heat expansion
- Wear reduction
- Reduced downtime



- Increased burner lifetime and reduced kiln downtime
- Cost savings

8



- Specific sensors onboard the burner
- Junction box with analog and logic modules
- Digital gateway « Pillard NOVASMART® » for data acquisition and exportation



- Survey
- Detection
- Diagnostic
- Action

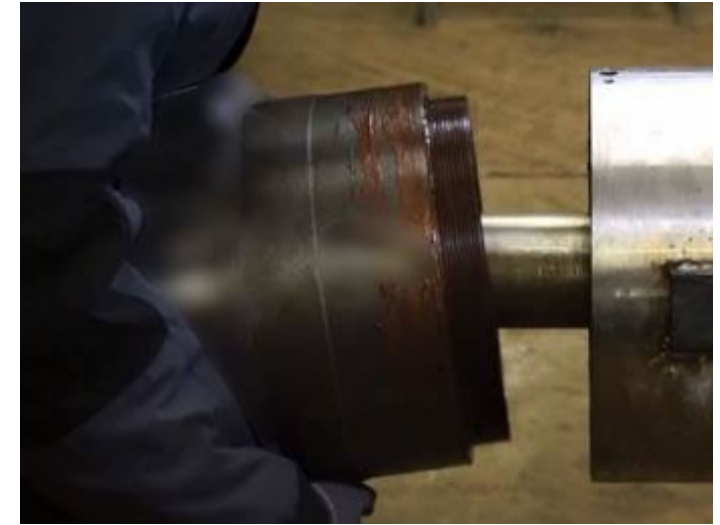
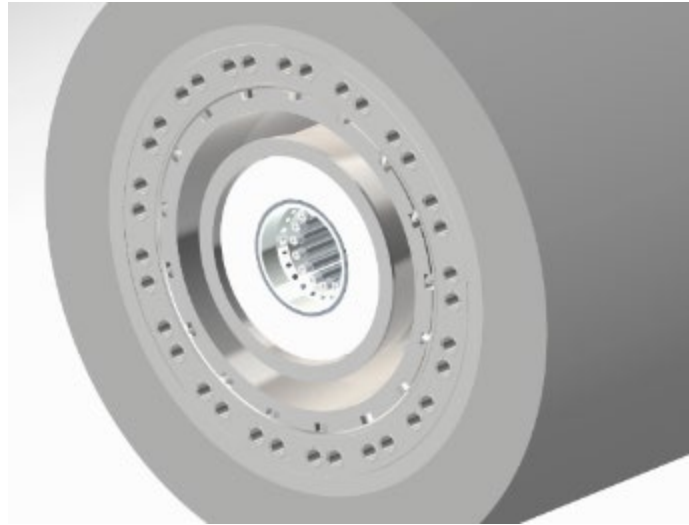
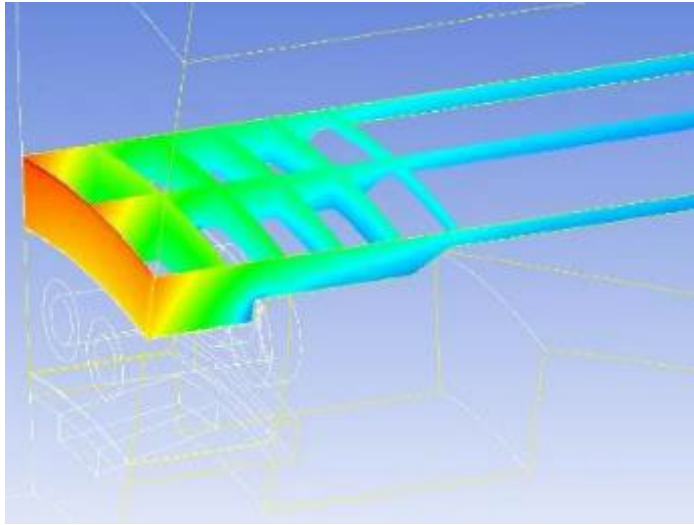


- Increased burner lifetime
- Kiln failure prevention

How does the Pillard NOVAFLAM® Evolution achieve such improvements ?

A sturdier tip design

7



Cooled Heavy Duty tips

- Strong sustainability to heat expansion
- Improved durability

Wear reduction

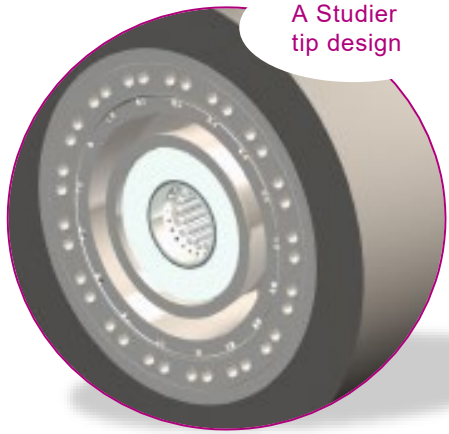
- No moving part on fire
- Wear resistant materials

Reduced downtime

- Easy dismantling
- Reduce maintenance
- Adapt burner to a different operating mode

A package of innovations at your service

7



- Cooled heavy duty tips in specific alloys
- No moving part on fire
- Replaceable inserts
- Easily dismantable

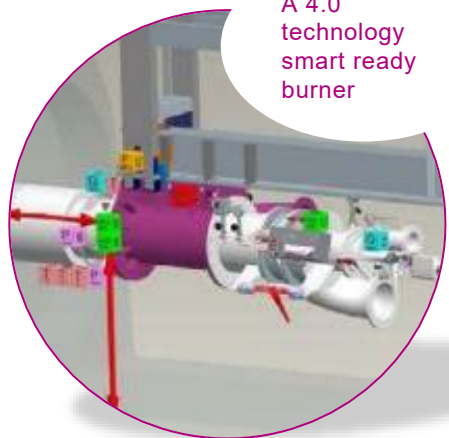


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- Survey
- Detection
- Diagnostic
- Action



- Increased burner lifetime
- Kiln failure prevention

How does the Pillard NOVAFLAM® Evolution achieve such improvements ?

4 Smart functions



Survey



Detection



Diagnostic



Action



8

Burner monitoring :

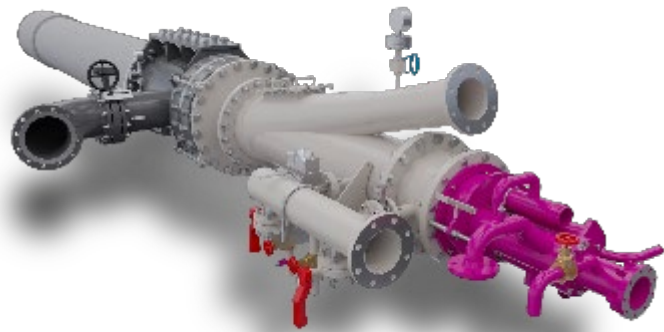
- Primary air flow & pressure (momentum calculation)
- Gas & radial tip position
- Gas pressure at burner inlet
- Tip & refractory temperature
- Conveying air flow
- Burner position
- etc

Burner remote settings :

- VFD on primary air fan or valve
- hydraulic jack for radial air and gas tip adjustment

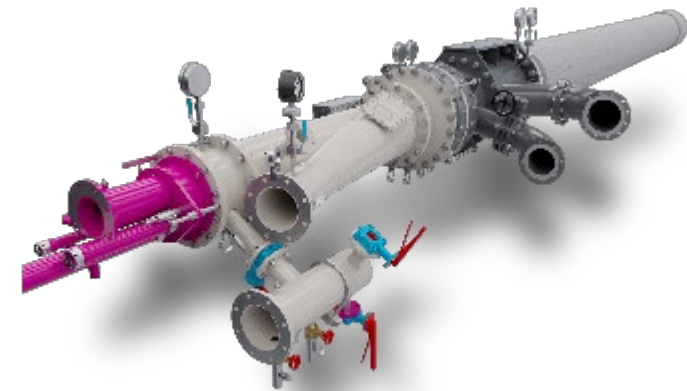
Mono-channel Pillard NOVAFLAM® Evolution

- **Common primary air channel** with primary air pressure up to 400mb
- Only **one primary air device** (fan or blower)
- **Easy flame settings** / user friendly
- **No compromise on performance**



Bi-channel Pillard NOVAFLAM® Evolution+

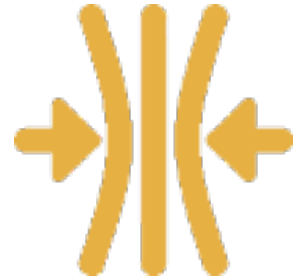
- **Separate axial and swirl air channels**
- **Two primary air inlet** (high axial pressure: up to 700mb, low radial pressure: up to 400mb)
- Extremely fine **adjustment possibilities**
- **No compromise on performance**



Pillard NOVAFLAM[®] Evolution burner

Improve your resilience

- Best fuel flexibility
- Higher thermal efficiency
- Increased burner lifetime
- Maximized clinker quality & production rate



Reduce your environmental footprint

- Lower CO₂ impact
- Lower NO_x emissions
- Eco friendly design





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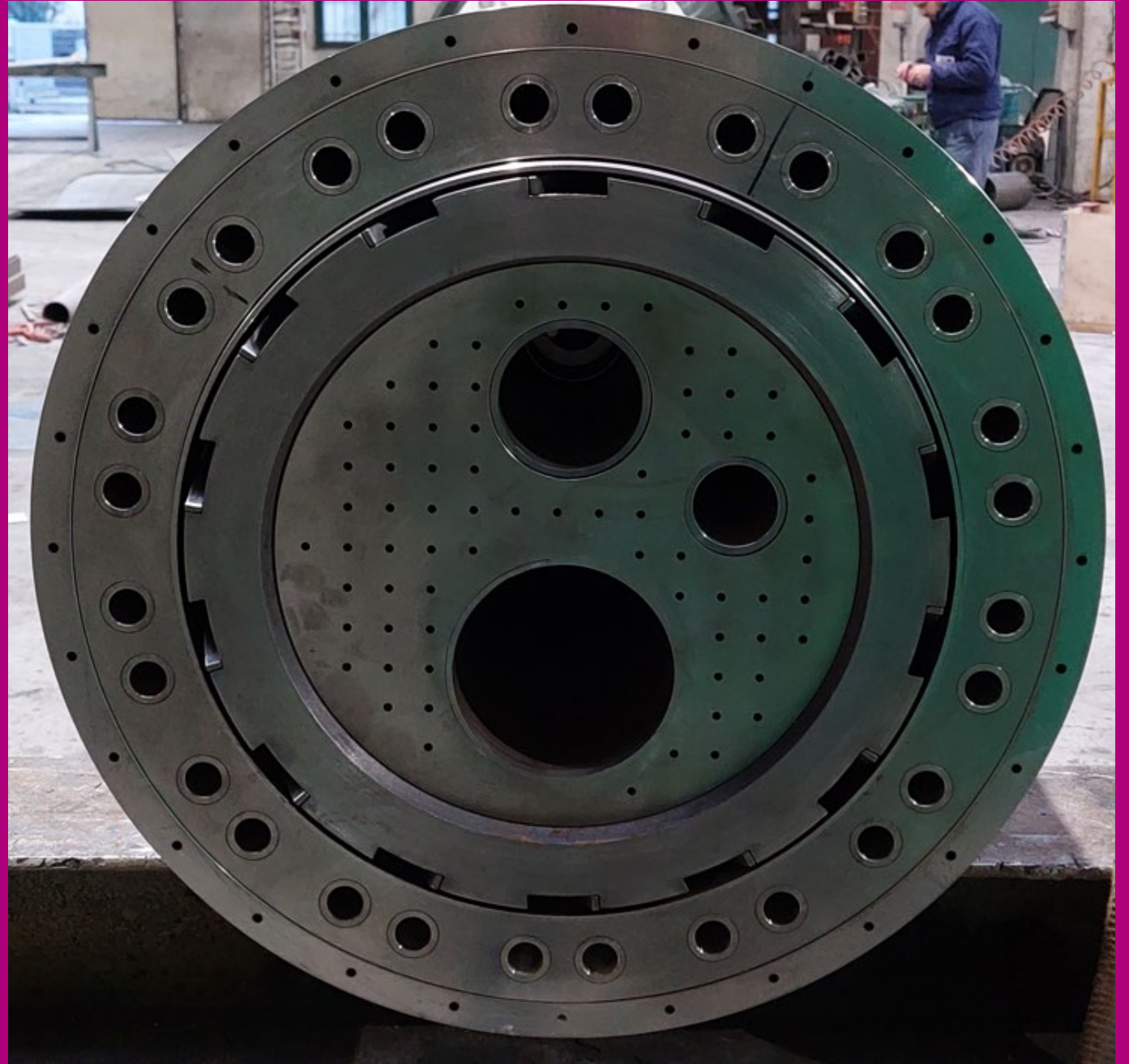
Pillard NOVAFLAM[®] Evolution Reference list

Ultimate burner for cement kilns



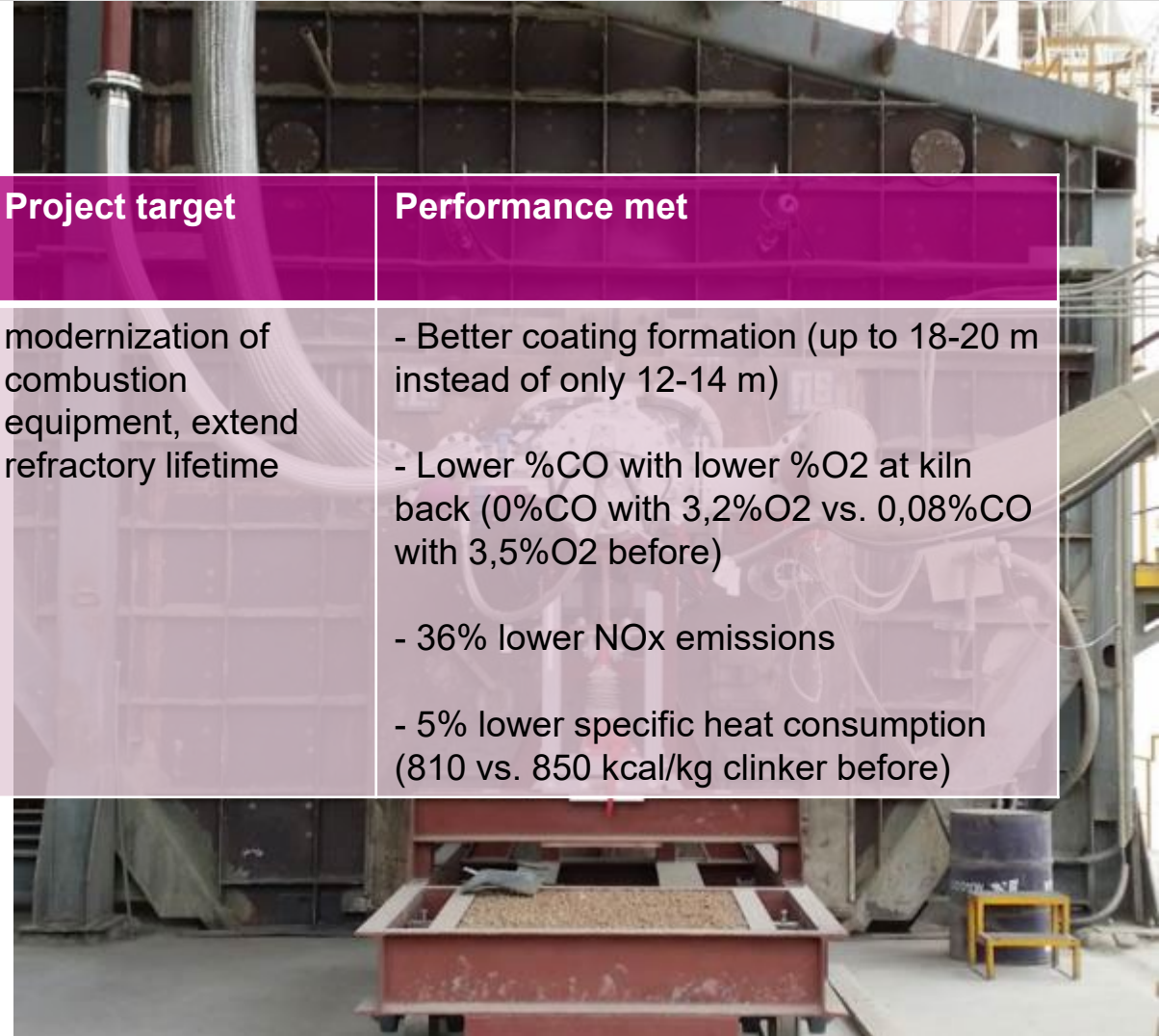
PROCESS
TECHNOLOGIES

ENERGY | COMBUSTION

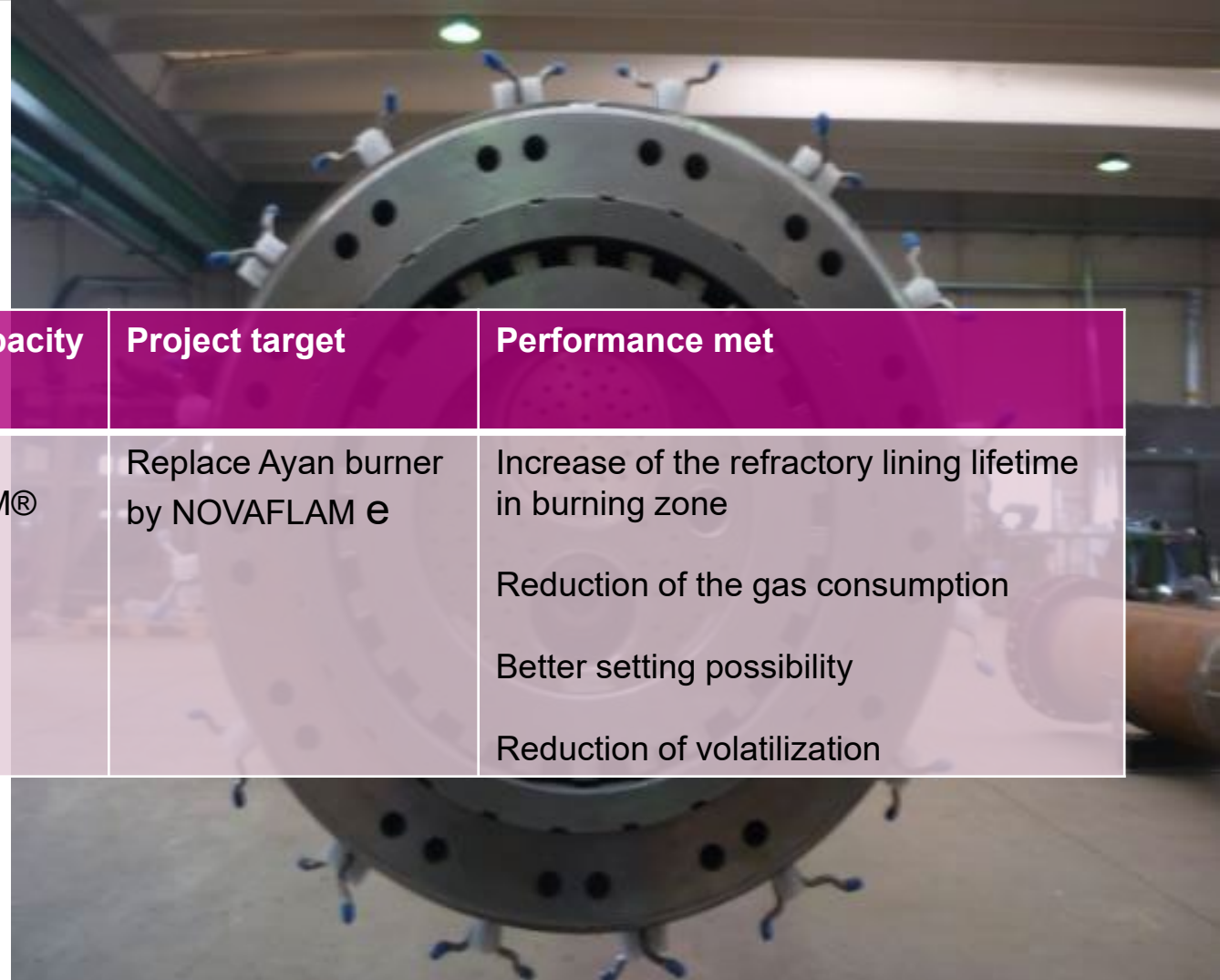


FANCESA

Plant Location	Kiln type	FUELS	Burner capacity	Project target	Performance met
Bolivia	<ul style="list-style-type: none"> - 2000 TPD - Dry line / calcinator SLC 5 stages - Grate cooler 	100% Natural Gas	Pillard NOVAFLAM® Evolution 65.1 MW	modernization of combustion equipment, extend refractory lifetime	<ul style="list-style-type: none"> - Better coating formation (up to 18-20 m instead of only 12-14 m) - Lower %CO with lower %O2 at kiln back (0%CO with 3,2%O2 vs. 0,08%CO with 3,5%O2 before) - 36% lower NOx emissions - 5% lower specific heat consumption (810 vs. 850 kcal/kg clinker before)



SEBRYAKOV CEMENT



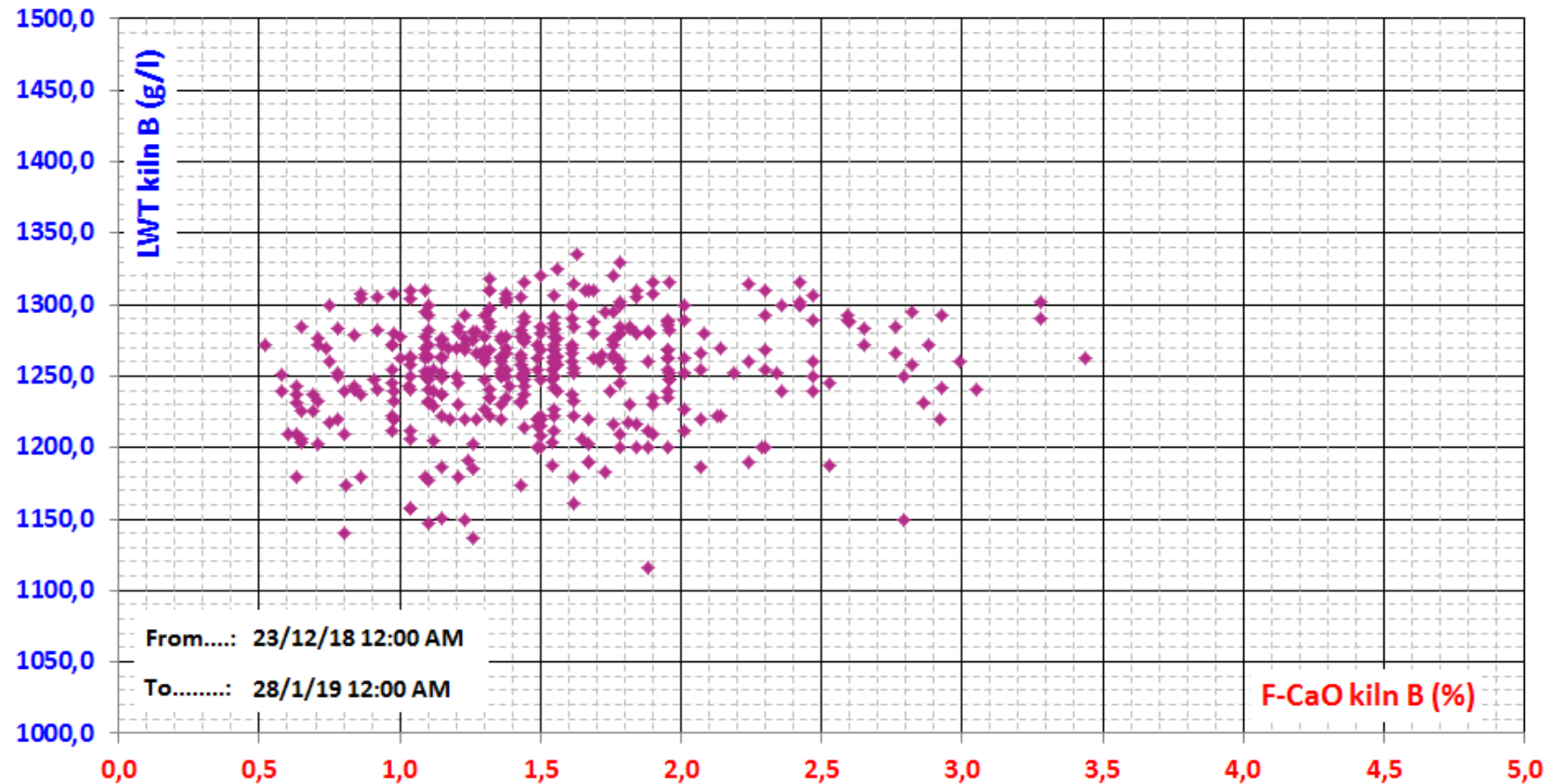
Plant Location	Kiln type	FUELS	Burner capacity	Project target	Performance met
Russia	<ul style="list-style-type: none"> - 2400 TPD - SEMI WET - Grate cooler 	<p>100% natural gas</p> <p>For future : solid AFR</p>	<p>Pillard NOVAFLAM®</p> <p>Evolution</p> <p>81 MW</p>	<p>Replace Ayan burner by NOVAFLAM e</p>	<ul style="list-style-type: none"> Increase of the refractory lining lifetime in burning zone Reduction of the gas consumption Better setting possibility Reduction of volatilization

Biskra



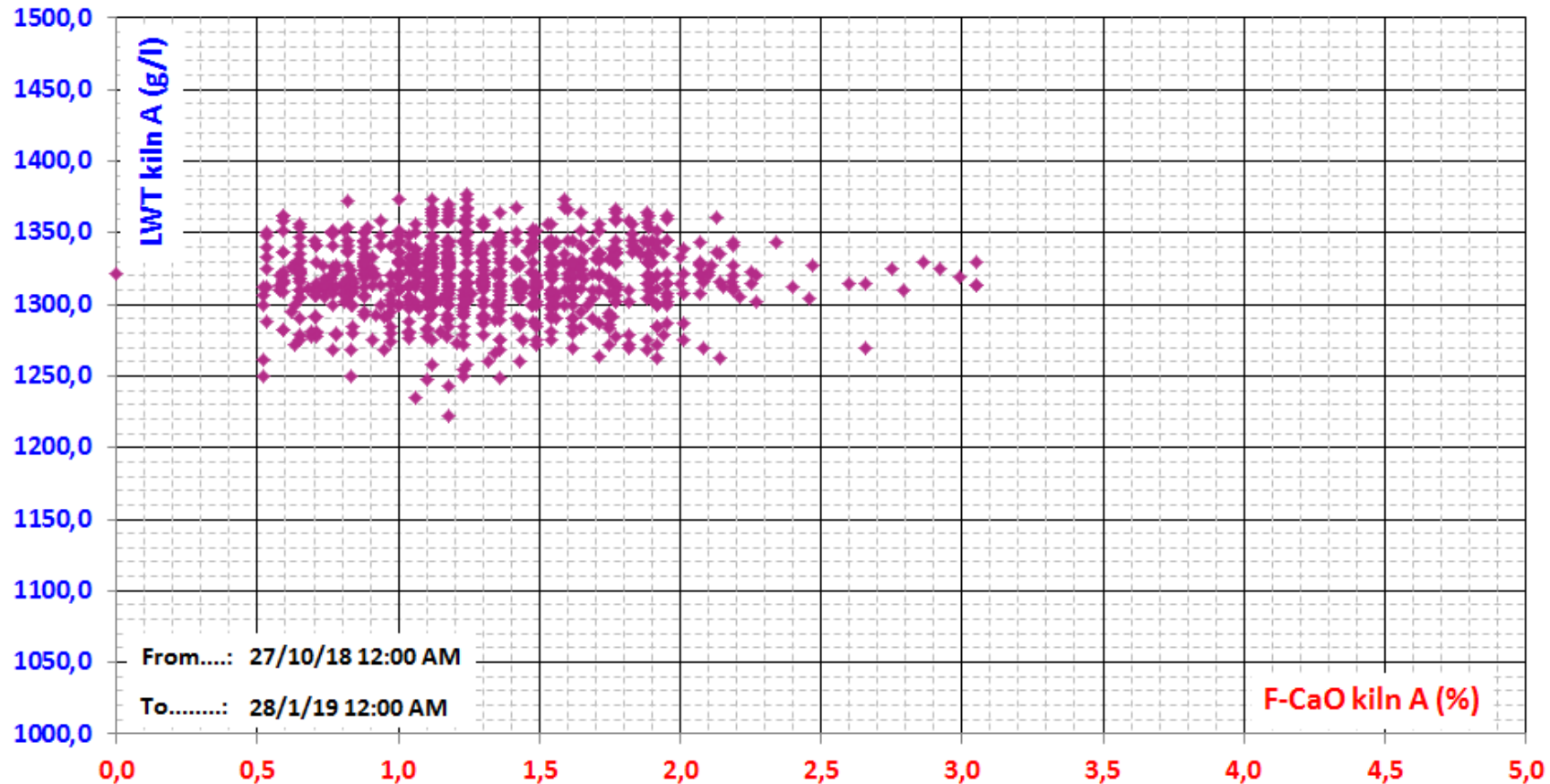
Plant Location	Kiln type	FUELS	Burner capacity	Project target	Performance met
Algeria	<ul style="list-style-type: none">- 6000 tpd- Precalciner- Grate cooler	100% natural gas	Pillard NOVAFLAM® Evolution 115 MW	- greenfield	<ul style="list-style-type: none">+ 5% clinker density- 0,2 freetime

Biskra Clinker – Line B – Kiln burner : Unitherm



Clinker density : Average 1253 g/l Deviation +/- 37 g/l
Freelime : Average 1,5 % Deviation 0,53

Biskra Clinker – Line A – Kiln burner : Pillard NOVAFLAM® Evolution



Clinker density : Average 1318 g/l Deviation +/- 37 g/l
Freelime : Average 1,3 % Deviation 0,45



fives

Industry can do it