

# FPO

## Flameless Pressurized Oxy-combustion

ENVIRONMENTAL FRIENDLY

High efficiency

Competitive

Compact - Reduced Footprint

Flexible Fuel

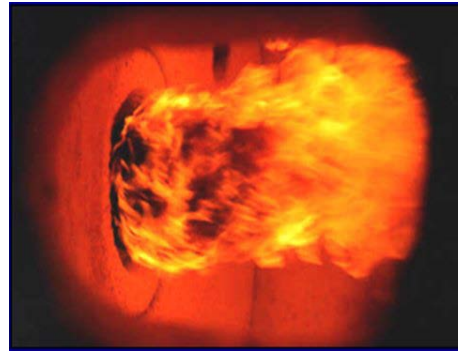
Cycling Response

Problem Solving Innovative Technology

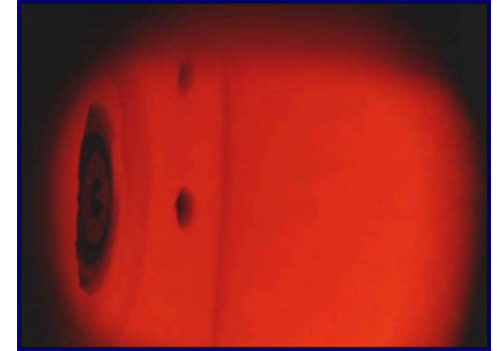
# FPO Combustion Premise

- Pressurized atmosphere of water and CO<sub>2</sub> under “volume expanded combustion” avoids traditional flame fronts
  - FPO combustion is more locally controllable with more uniform temperatures
  - Pressurized firing also improves cycle efficiency
- Conversion of carbon to CO<sub>2</sub> is over 99%
- Almost zero carbon content in incombustible products
  - Traditional: flying and falling ash particles
  - FPO: slag with near-zero carbon content and tiny particulate

**Traditional Combustion  
with Flame Front**



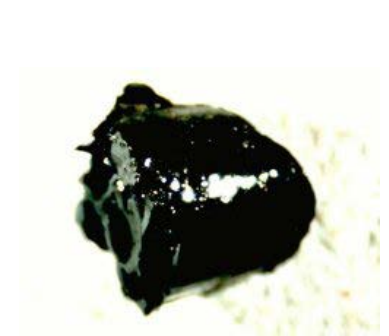
**Flameless Pressurized  
Combustion**



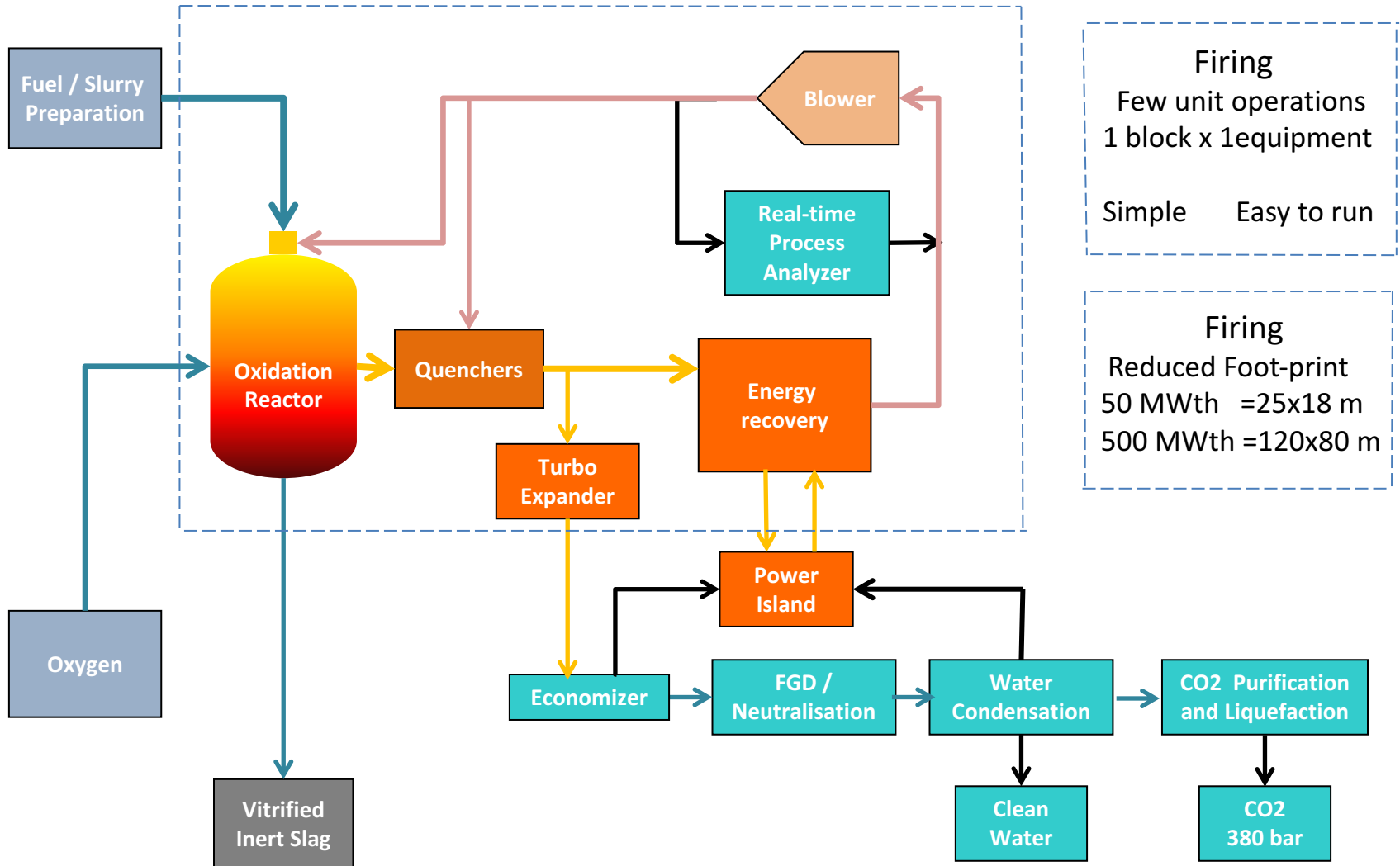
**Traditional Combustor  
Products: Particulate**



**FPO Combustor Products:  
Near-zero carbon, neutral slag**



## FPO block process scheme



**Firing**  
 Few unit operations  
 1 block x 1 equipment  
 Simple Easy to run

**Firing**  
 Reduced Foot-print  
 50 MWth = 25x18 m  
 500 MWth = 120x80 m

# FPO

## Novel Set of Performances

### Clean fumes since combustor outlet

- No Dioxin, PCB, HPA, soot
- Ashes 100% transformed into vitrified beads  
zero carbon, non leaching HM  
fully inert  
salable to construction industry
- Water (clean) total recovery
- Ease in recovery commercial CO<sub>2</sub>

# FPO

## Novel Set of Performances

### Clean fumes since combustor outlet

- Simplified process scheme  
reduced capital
- Pressurized firing  
high efficiency

Cost competitive  
environmental performance

# FPO

## Novel Set of Performances

### Flexible Fuel

- Firing of any type of fuel (gas, liquid, solid), waste, carbonaceous, oil heavies, biomasses
- Co-firing of separately fed streams at any relative proportion quantities
- Constant combustor performance from 5 to 100% load

Multi-task

Business Ease

# FPO

## Novel Set of Performances

### «Velox» Power Cycle

- Load uptake, and down to standby in less than 1 hour
- (Emergency) Firing block without concerns
- Producing from 100% Steam to 100% Power  
Steam up to SC Steam
- Fast response to grid demand, cycling

# FPO

## Novel Set of Performances

### Waste to Product Only

From Municipal, Industrial Waste

- vitrified beads
  - power, steam
  - commercial CO<sub>2</sub>
- construction industry
  - district heating/power
  - industrial grade
  - food grade



# FPO

## Novel Set of Performances

### Waste to Product Only

Capability to close complex, multi-process,  
industrial works  
to treat hazardous wastes  
to treat byproducts  
to match demand unbalances

# FPO

## Novel Set of Performances

### Firing Hardware

- Few operations, compact, fully automated  
reduced footprint: 50MW<sub>th</sub> 28 x 18 m
- Ancillary units: modules placed at any  
distance from firing core

Easy to locate

Ease for retrofit

## Development Tools

### 5 MW<sub>th</sub> Feasibility Pilot Unit (Italy)

in operation since 2005

more than 30.000 firing hours



Available for:

- joint dev. Projects
- feasibility trials

## Development Tools

### FPO Projects in Progress

#### Municipal waste to product only

Capacity 15 MW<sub>th</sub> – 80.000 t/yr municipal waste

Engineering completed

Location: Bari suburban area(Italy)

Funding + grants secured

Power, commercial vitrified ash and CO<sub>2</sub> sold

No stack, no plum

Close to definitive permit concession

## Development Tools

### FPO Projects in Progress

#### Coal CCS large pilot (USA)

Capacity: 50 MW<sub>th</sub>

Coal, low ranking coals and alkali lignite

Feasibility Study

Supported by DOE Project DE - FE0027771

to advanced coal CCS technologies

Feasibility completed Oct. 2018

# FPO

## Development Tools

### FPO Projects in Progress

Oil heavies, coal, NG, CCS large pilot

Capacity: 50 MWth

Oil heavies, Coal, NG

Feasibility completed

Basic engineering in progress

Supported by Italian Government Grants

Project definitive launch expected by 2017 end

In cooperation with: Sotacarbo, ENEA (Italy)

# FPO

## Development Tools

ITEA is available to perform:  
Preliminary feasibility/economics analysis  
of FPO development initiatives  
proposed by potential customer/partners

**THANK YOU FOR YOUR ATTENTION**