



Oxycombustion of Heavy Liquid Fuels

Tidjani Niass

Chief Technologist, Carbon Management Research Division

01/11/2015



Outline



Oxycombustion in Saudi Aramco Context



Synergies with Refineries

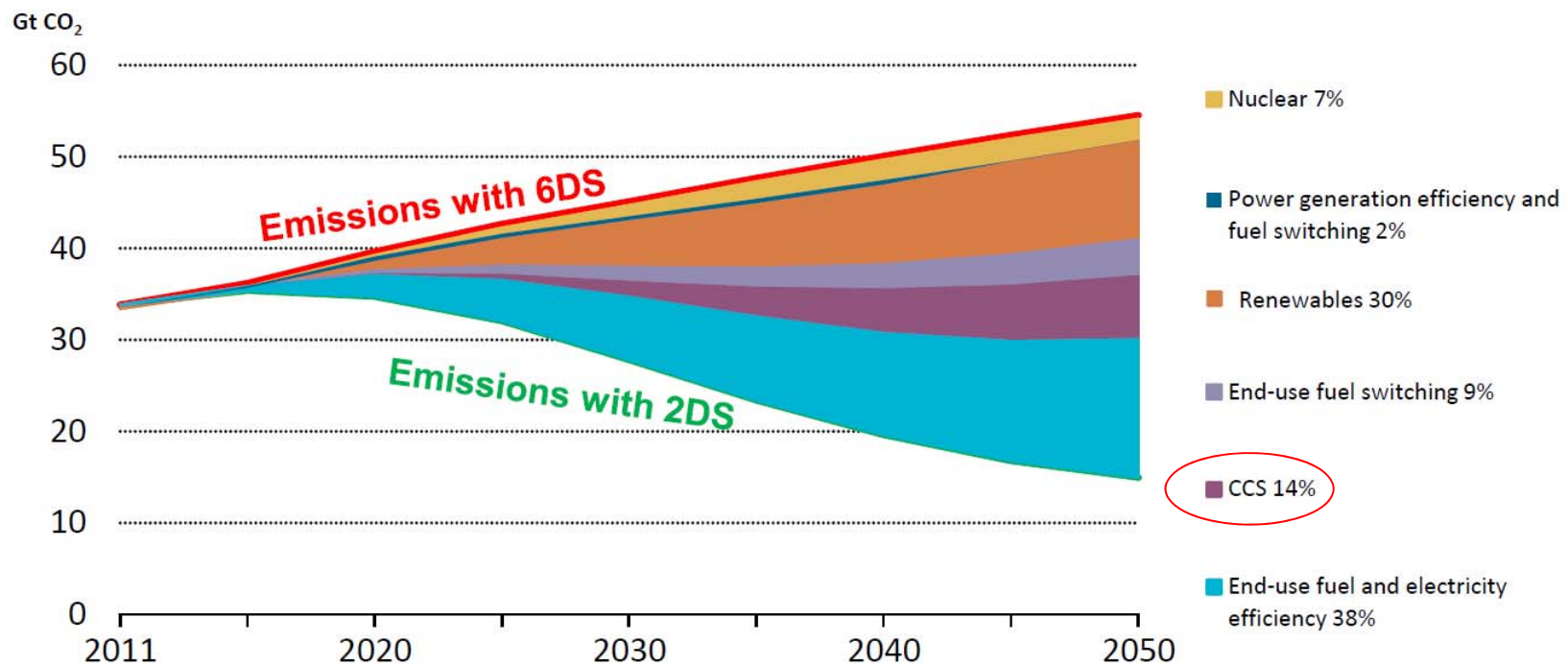


CO₂ Capture Performance



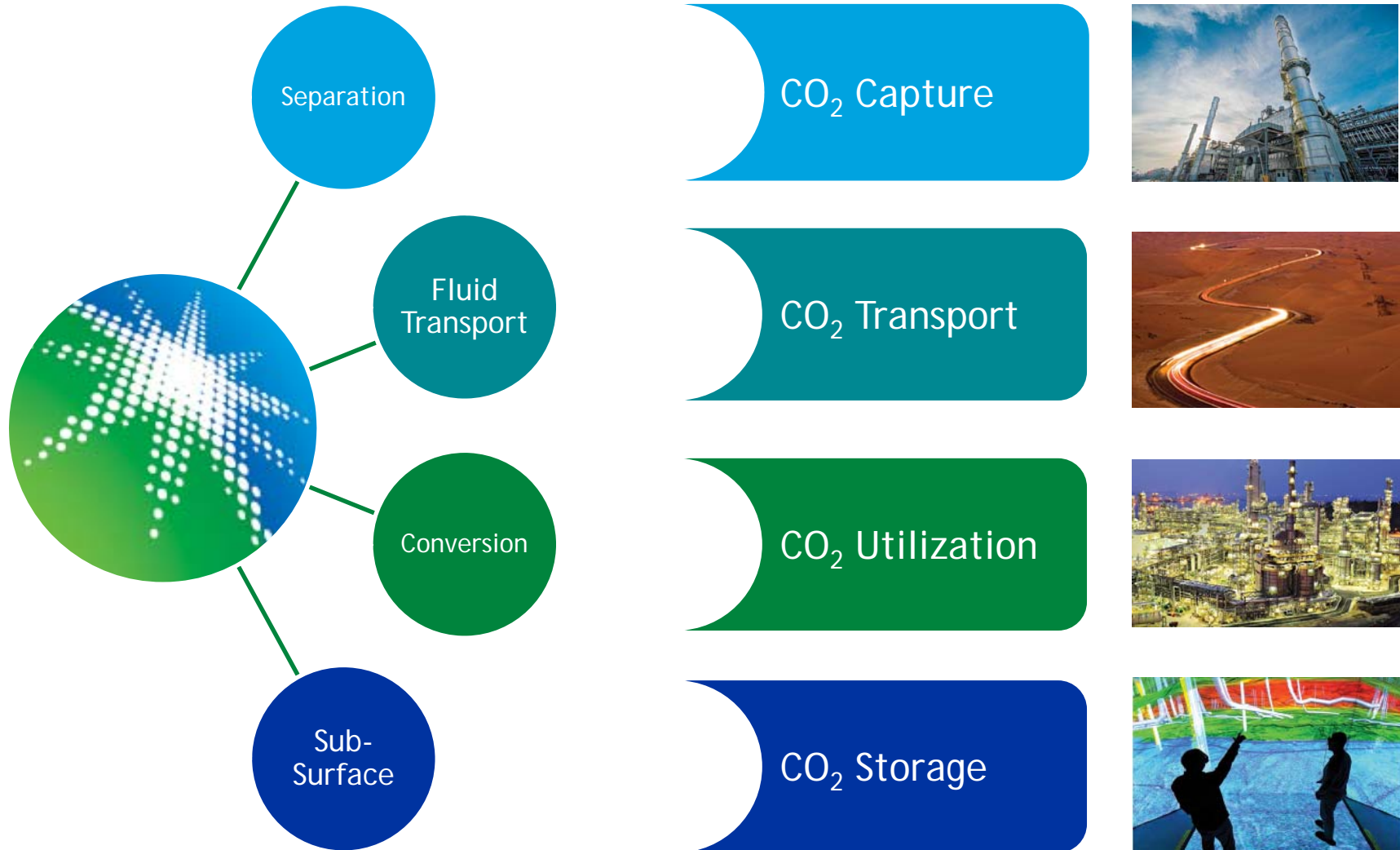
Roadmap

CCS is a critical element in the global quest to reduce CO₂ emissions



Source: IEA, 2015

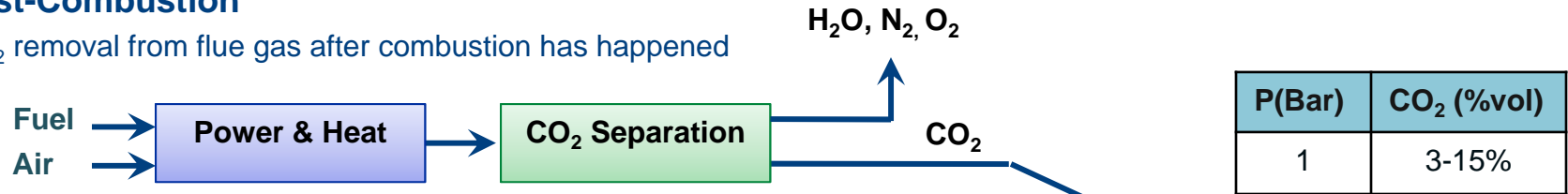
Saudi Aramco has capabilities on whole CCUS value chain



CO₂ Capture Routes

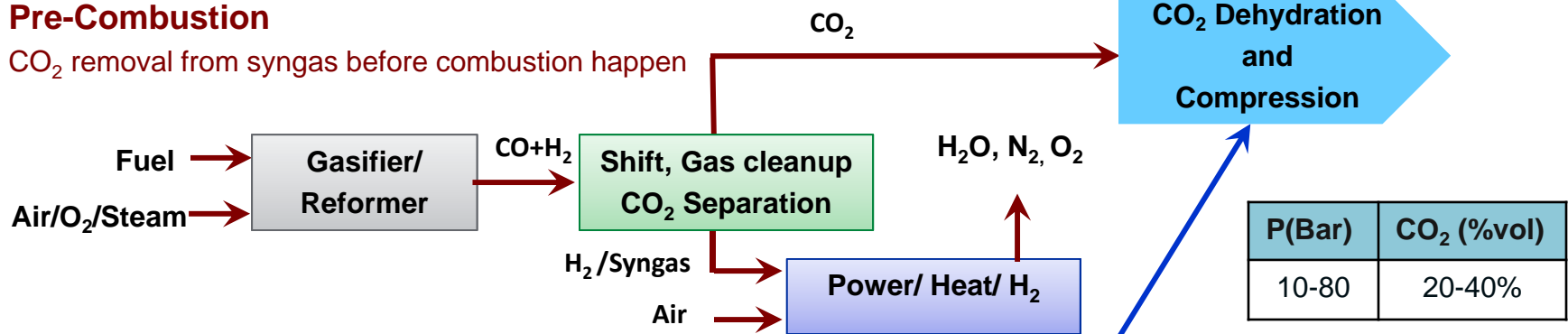
Post-Combustion

CO₂ removal from flue gas after combustion has happened



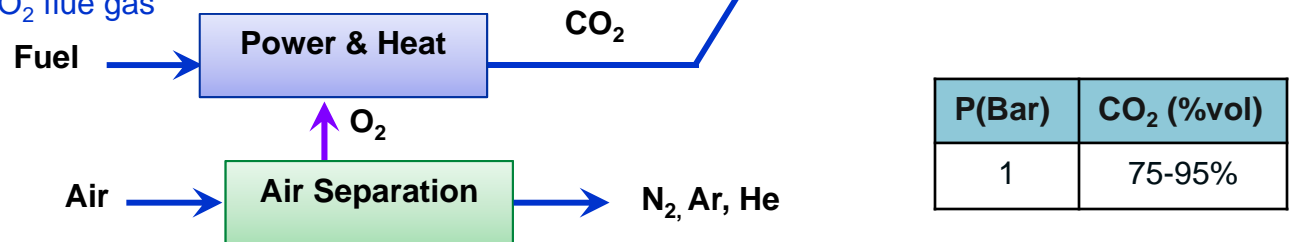
Pre-Combustion

CO₂ removal from syngas before combustion happen



Oxy-Combustion

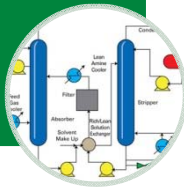
Produce highly concentrated CO₂ flue gas



Why Oxycombustion for heavy residues?

- Quasi independent of fuel type
- Widely investigated
- New solvent and sorbent in existing processes

Post-combustion



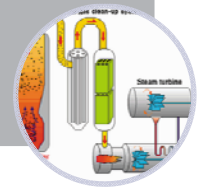
- Promising technique
- Little work performed on liquid fuel
- Possible innovation:
 - Burner
 - Steam cycle

Oxy-combustion



- Gasification is widely investigated
- Available technology
- CO₂ capture quasi independent of fuel type

Pre-combustion

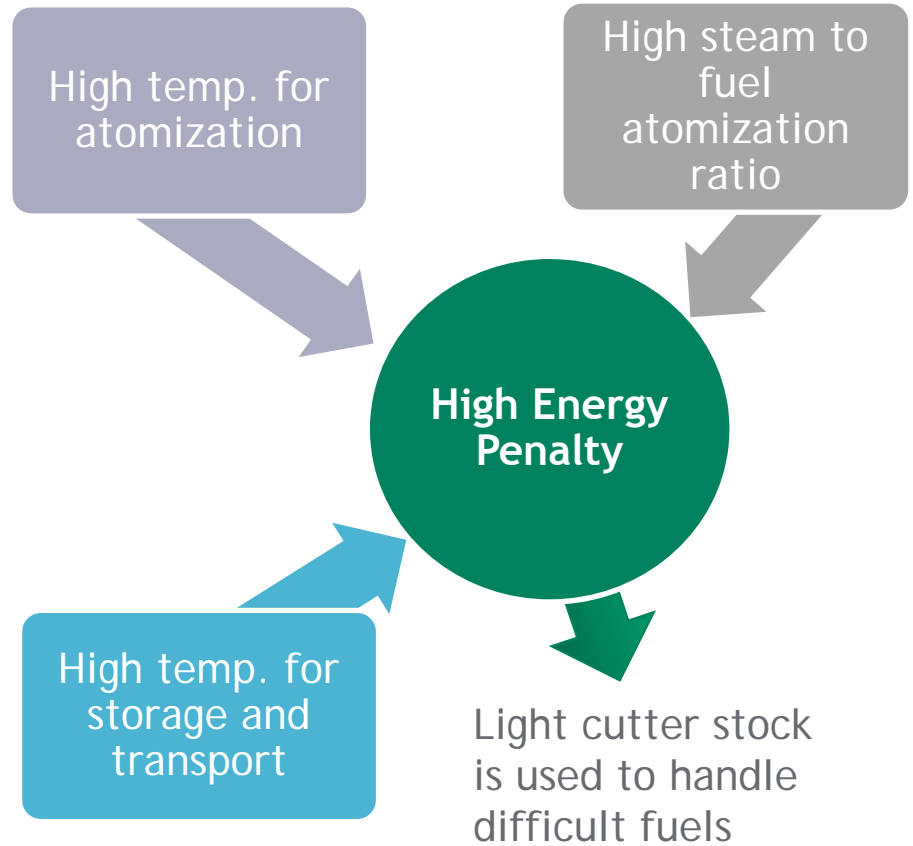
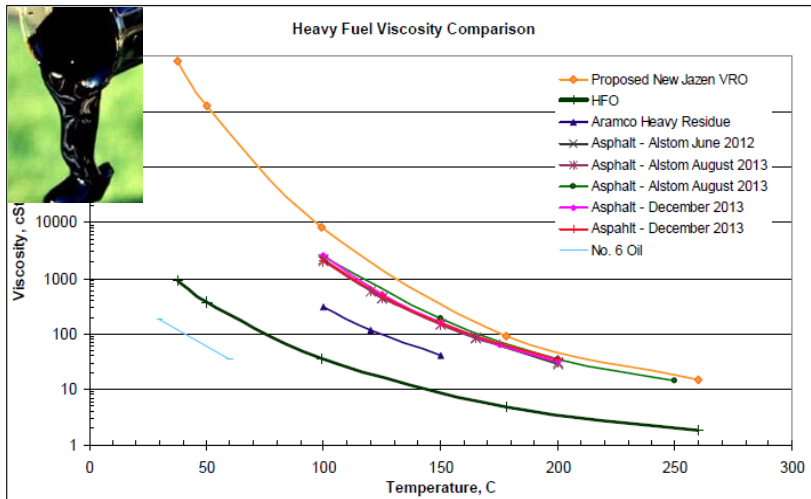


Oxy-combustion has the highest potential in efficiency and innovation

Challenges of Oil Heavy Residues (OHR) firing

Difficult to combust in classical Air systems

- High viscosity
- High Carbon Content (CCR 15%+)
- High Sulfur (5%+) & V (100 ppm+) Content



Challenges of Oil Heavy Residues (OHR) firing

Difficult to combust in classical Air systems

- High viscosity
- High Carbon Content (CCR 15%+)
- High Sulfur (5%+) & V (100 ppm+) Content

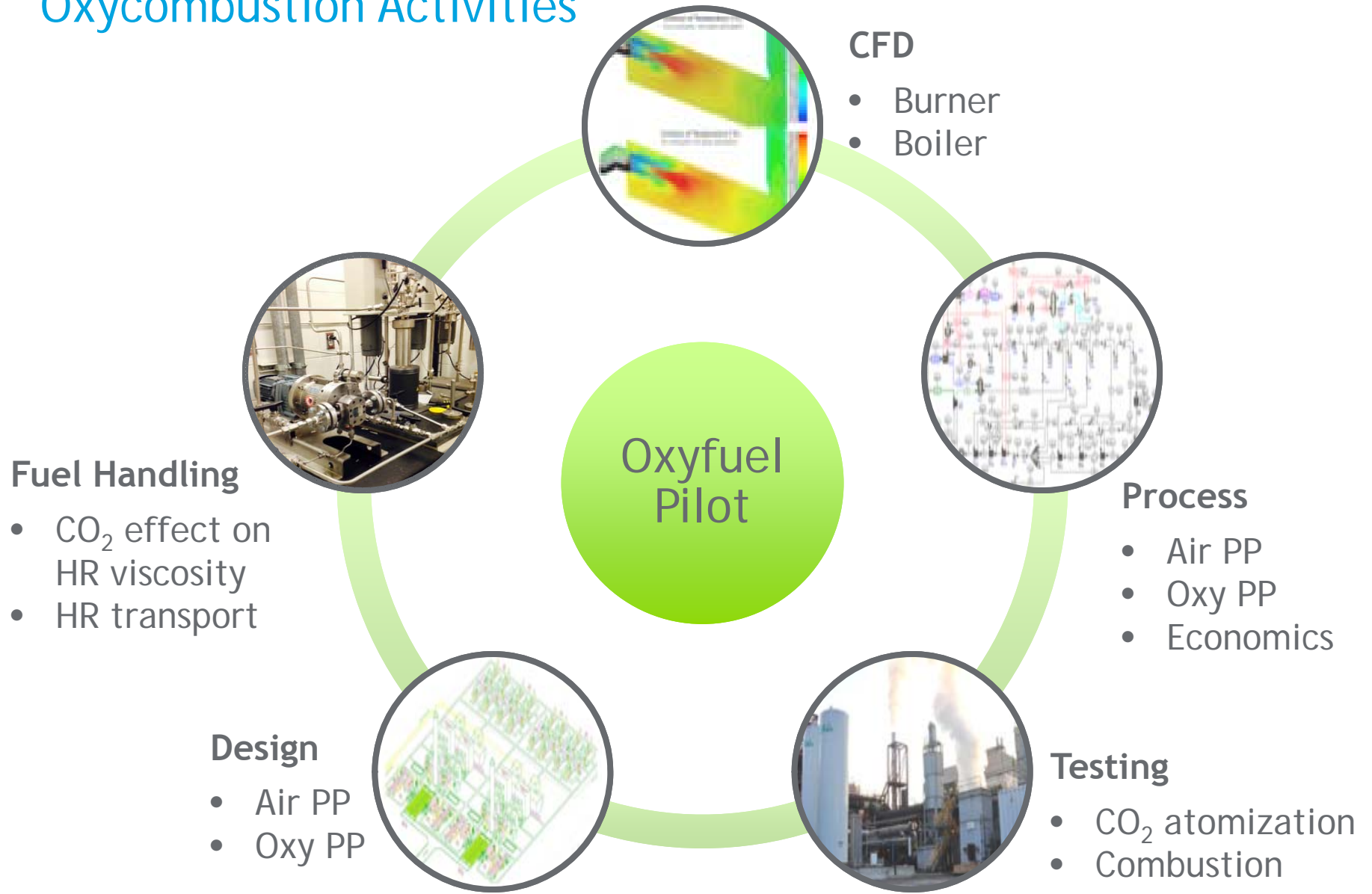
Power and industry Sectors

- Primarily based on fossil fuels
- Double power capacity in next 2-3 decades

Oxycombustion allows direct firing of OHR

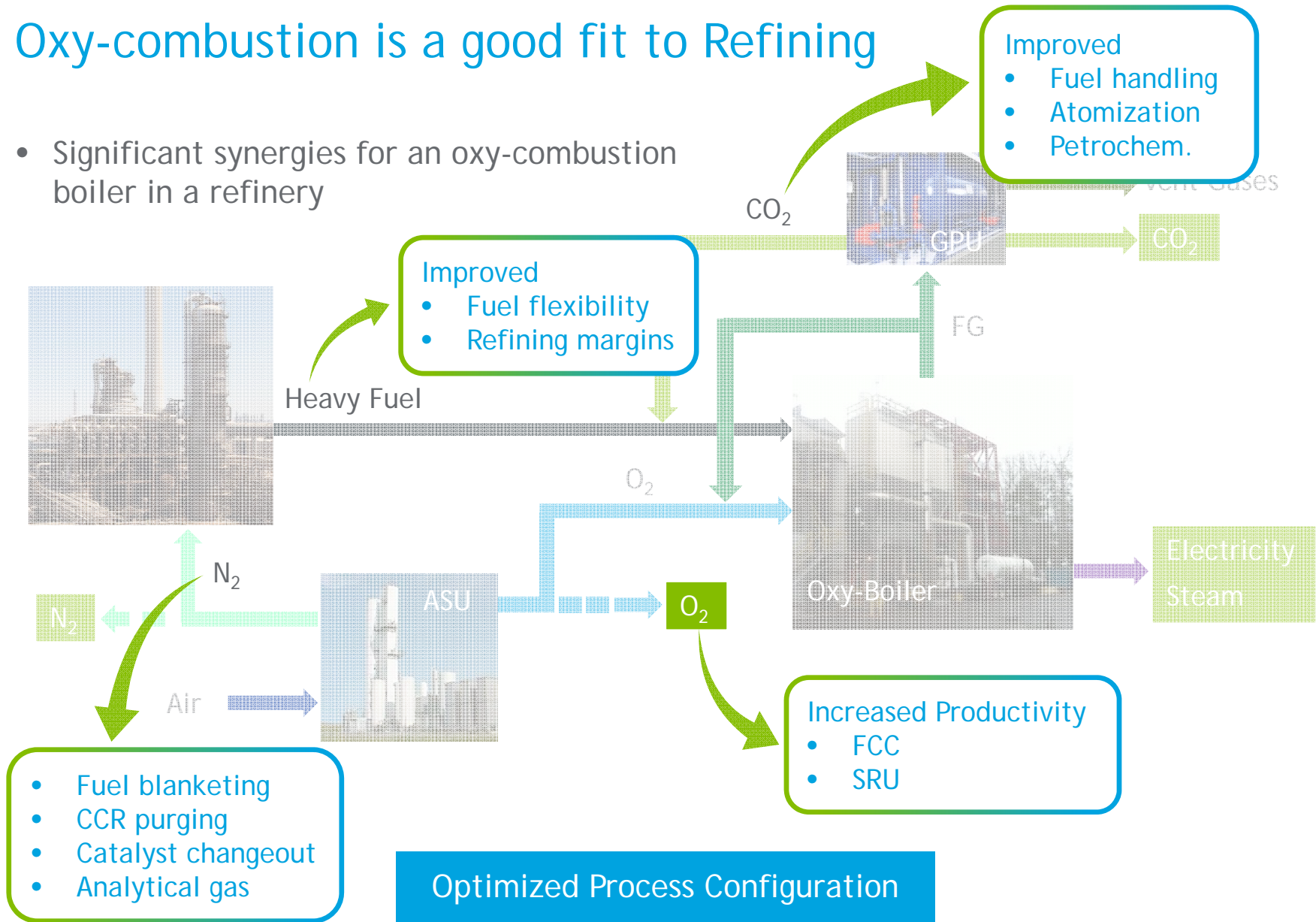
- Cutter Stock saving
- Improved fuel combustibility
- Lower NOx Emissions
- CO₂ concentrated Flue Gases
- Retrofit technology (for existing park)

Oxycombustion Activities



Oxy-combustion is a good fit to Refining

- Significant synergies for an oxy-combustion boiler in a refinery

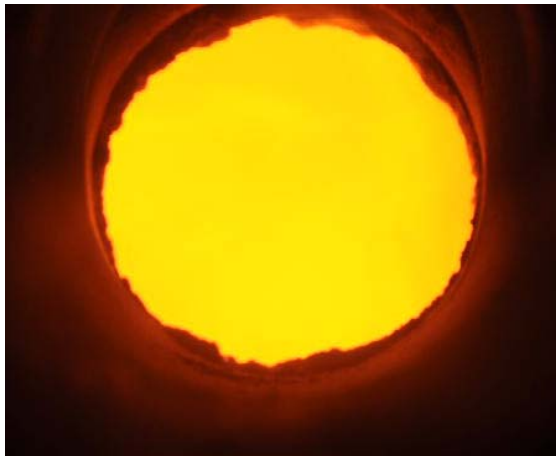


15 MWth Testing Campaign

Saudi Aramco Program tested in Alstom facility, Windsor, CT

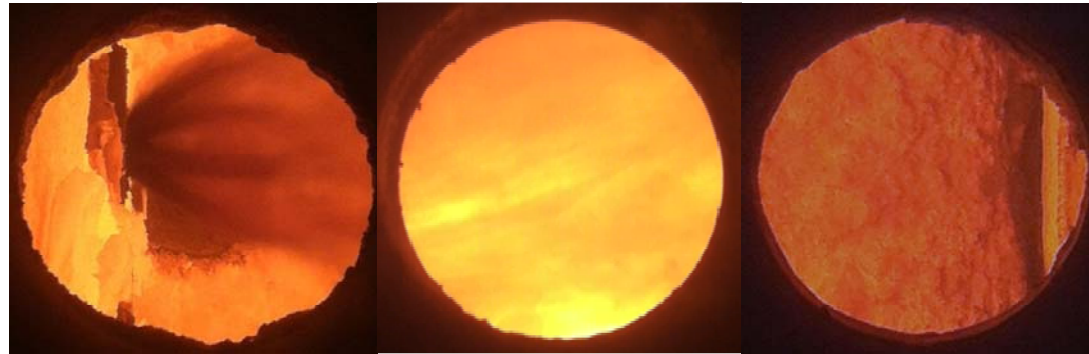
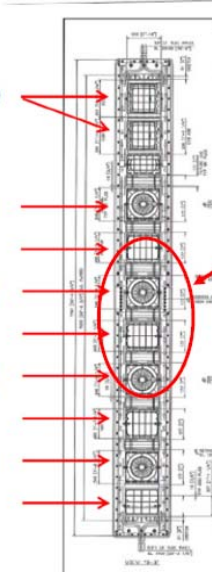
First of a kind VR oxy-firing campaign

- 1100 bbl



CLOSE-COUPLED
OVERFIRE AIR

OIL ELEVATION
AUXILIARY AIR
OIL ELEVATION
AUXILIARY AIR
OIL ELEVATION
AUXILIARY AIR
OIL ELEVATION
AUXILIARY AIR



15 MWth Testing Campaign

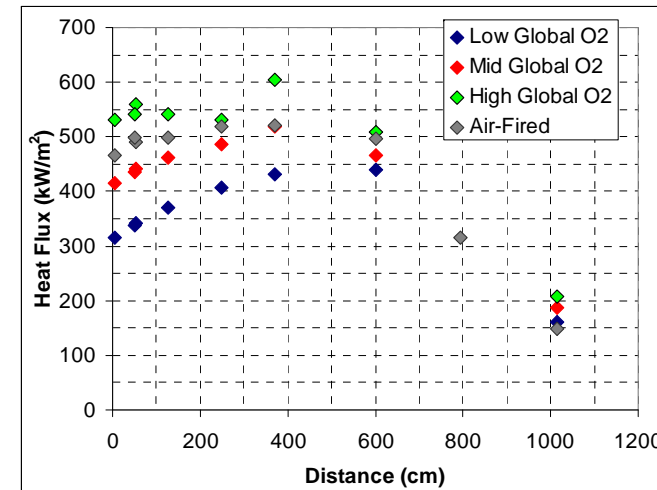
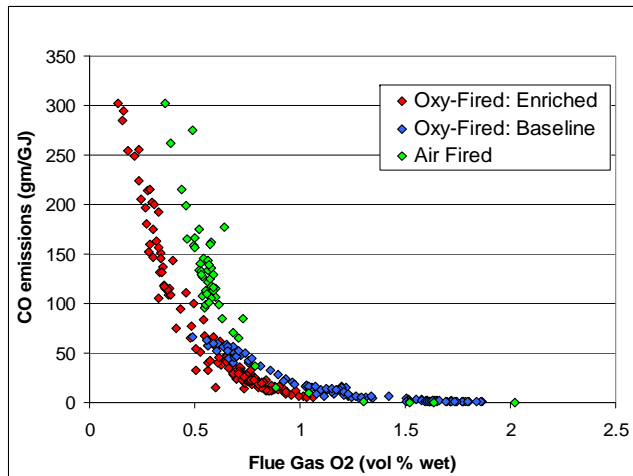
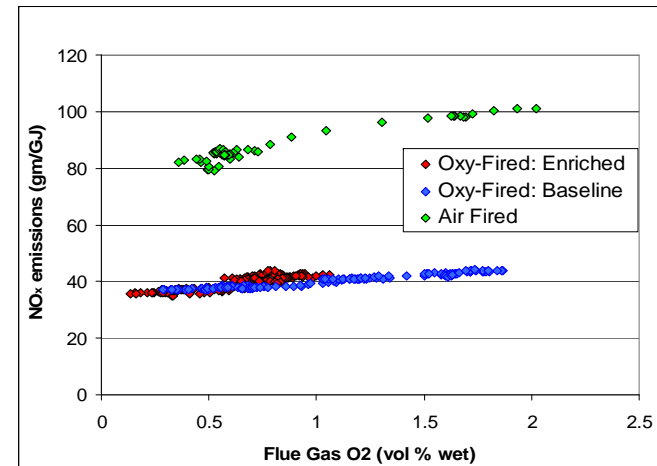
Saudi Aramco Program tested in Alstom facility, Windsor, CT

First of a kind VR oxy-firing campaign

- 1100 bbl

Competitive Advantages

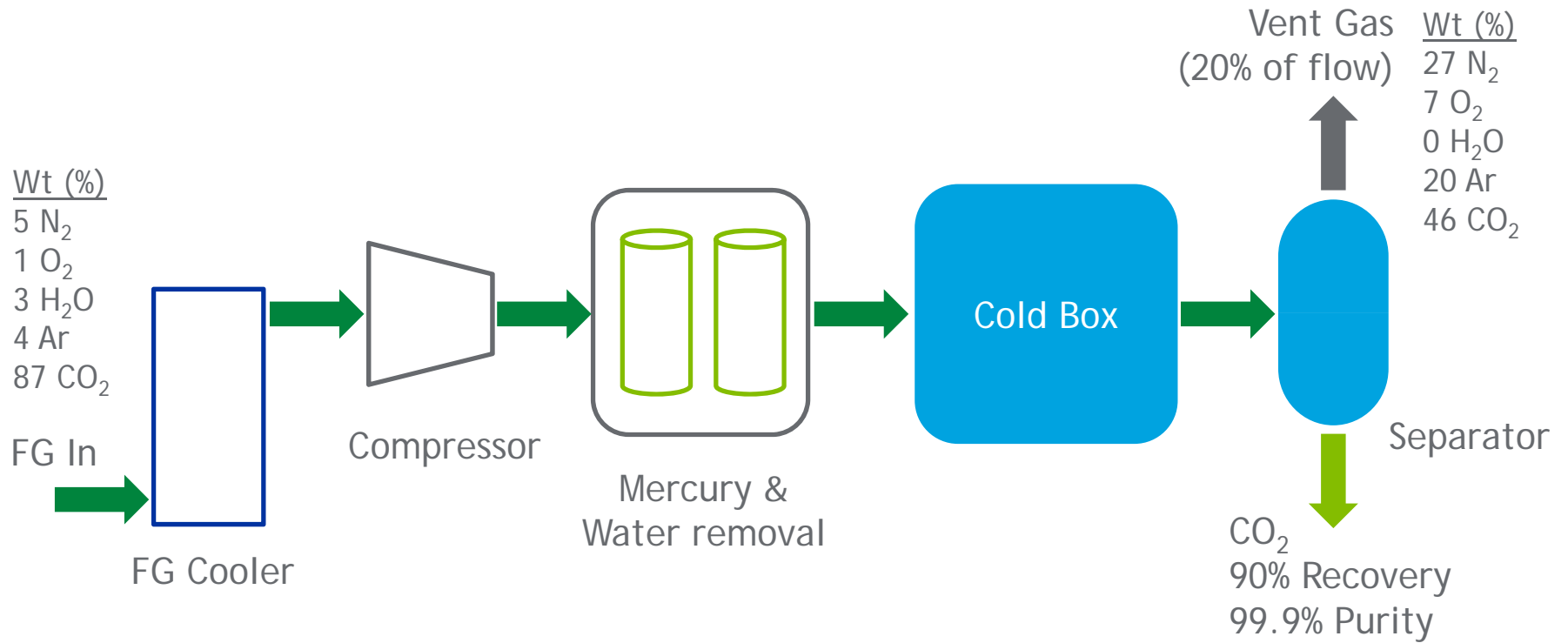
- Improved Combustion (90% less CHL)
- 50% lower NO_x Emissions
- Successful CO₂ atomization
- Matching Heat flux profiles



Gas Processing Unit

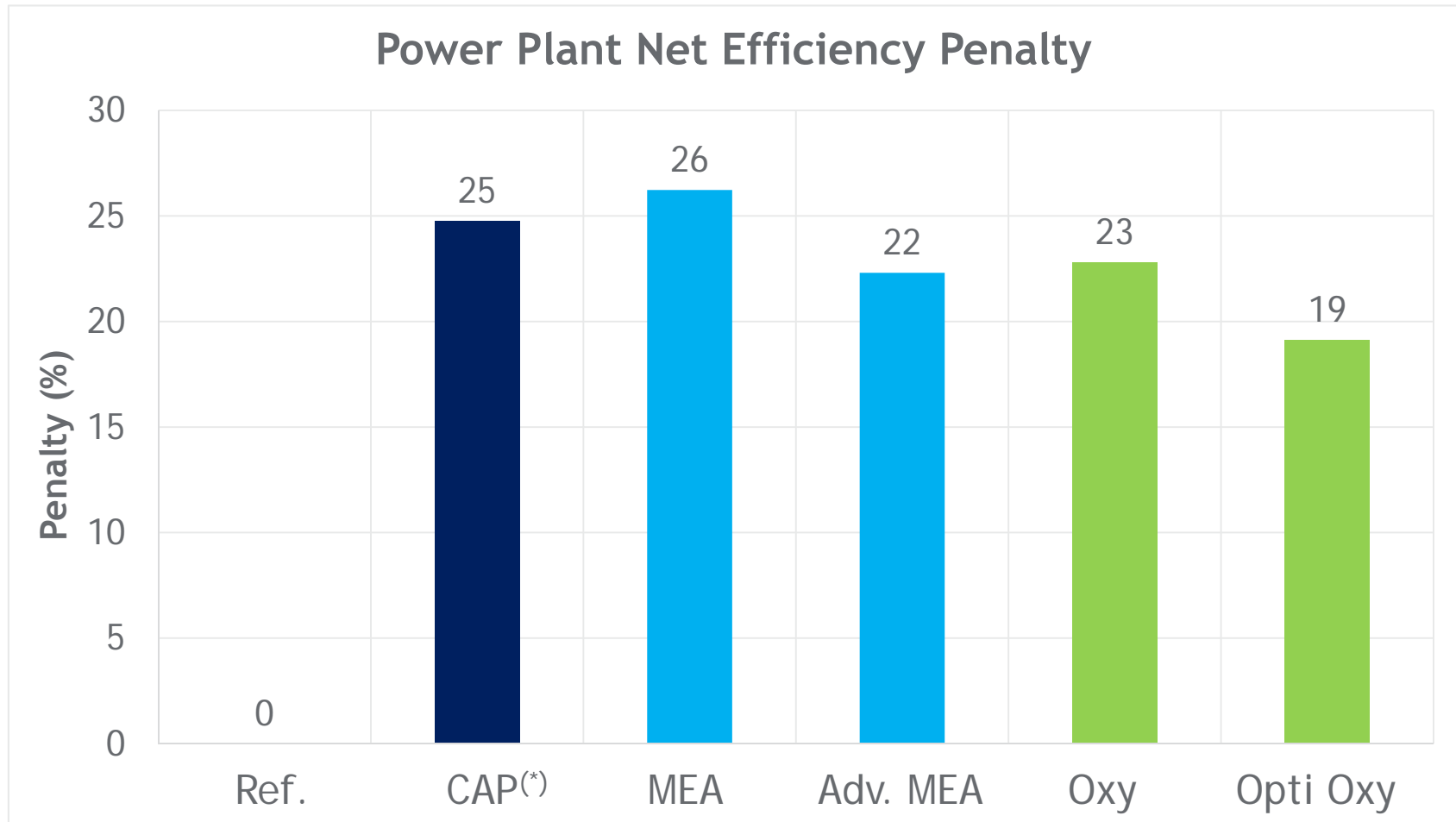
Produce required purity CO₂ stream

- Refrigeration based process
- Optional distillation column for high CO₂ purity (Food or EOR grades)



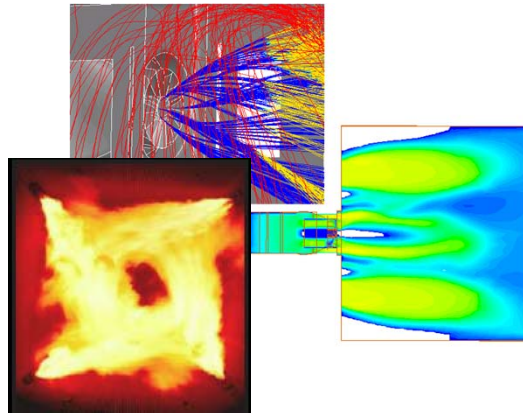
Energy performance

Heavy residue oxycombustion vs. postcombustion



(*) Chilled Ammonia Process

Oxycombustion Roadmap



2012 - 2015

- Economic viability
- Successful combustion testing campaign
- Refining synergies
- High CO₂ capture rate
- High CO₂ purity
- No major roadblock



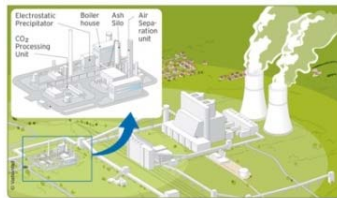
Passed Stage Gate

≥ 2015

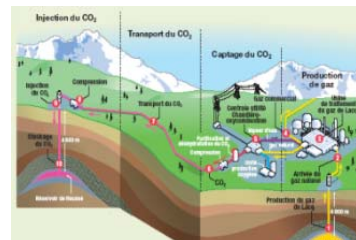
- Building the case for large scale pilot
- Design, Build and Operate a large scale Oxycombustion pilot for difficult to burn liquid fuels

Summary

Oxycombustion has been developed mainly for coal and gas



Shwarze Pumpe - DE
(Coal)



Lacq - FR
(Gas)



CS Energy - AU
(Coal)



CIUDEN - ES
(Coal)

Saudi Aramco Oxycombustion project close the fuel gap

- Oxycombustion offers good synergies with refineries
- 90% CO₂ capture meeting CO₂-EOR specifications was achieved
- Oxycombustion improve the combustibility of difficult to burn liquid fuels
- Saudi Aramco oxycombustion technology provides technical solution for oil fired power plants

Thank You

