

# Hot Oxygen Burner (HOB) Technology For Syngas Generation

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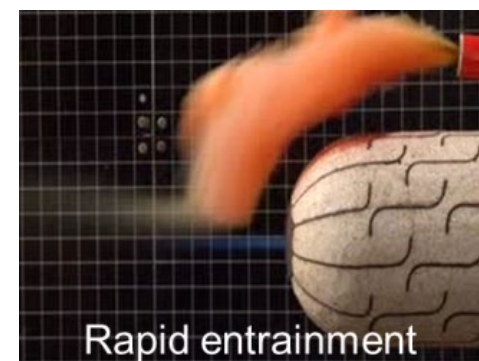
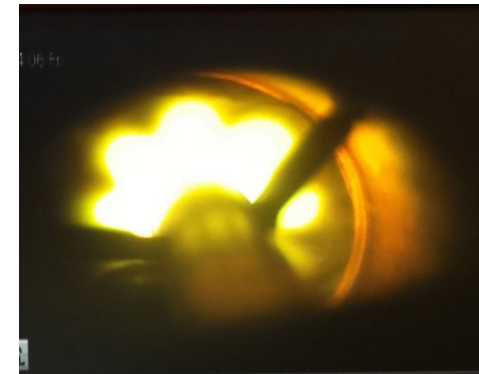
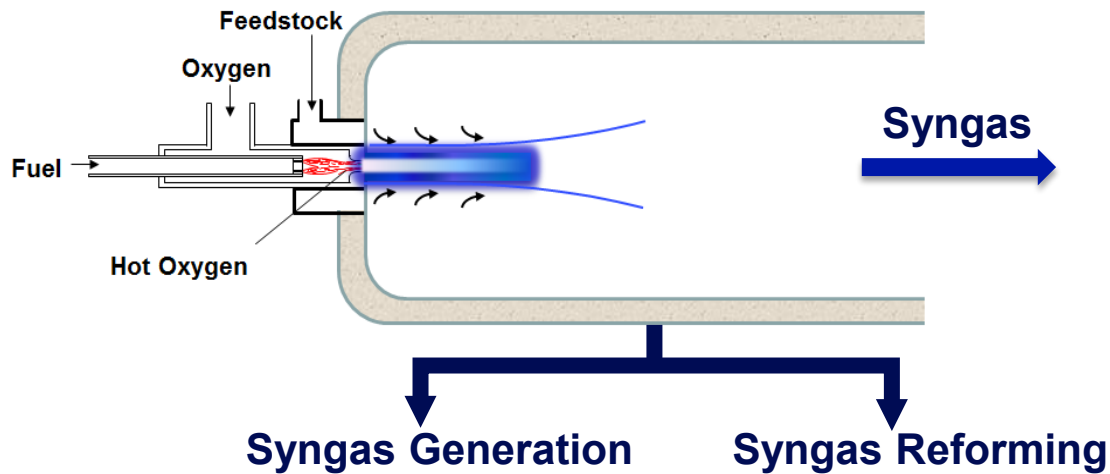
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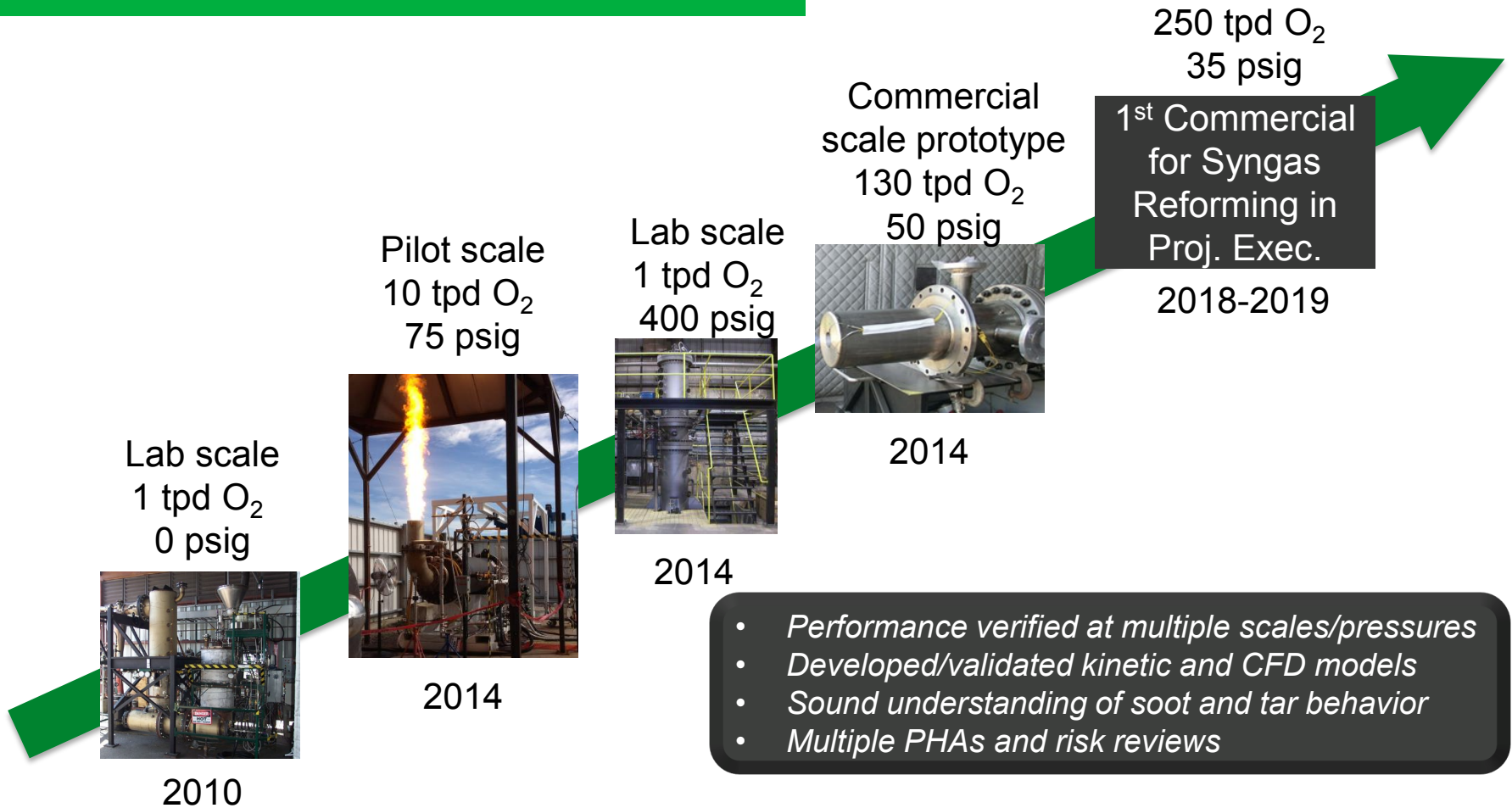
# Hot Oxygen Burner (HOB)



## Key Features:

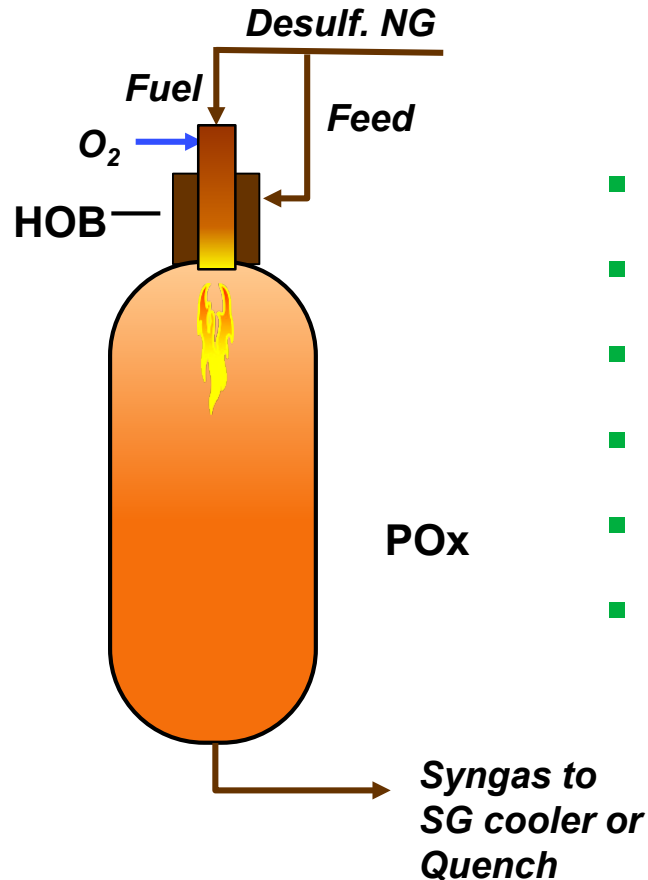
- High velocity, high temperature O<sub>2</sub> jet
- Rapid entrainment of feedstock
- Highly reactive hot O<sub>2</sub> jet
- Soot minimization (US 9,540,240)

# HOB Development and Scale-Up



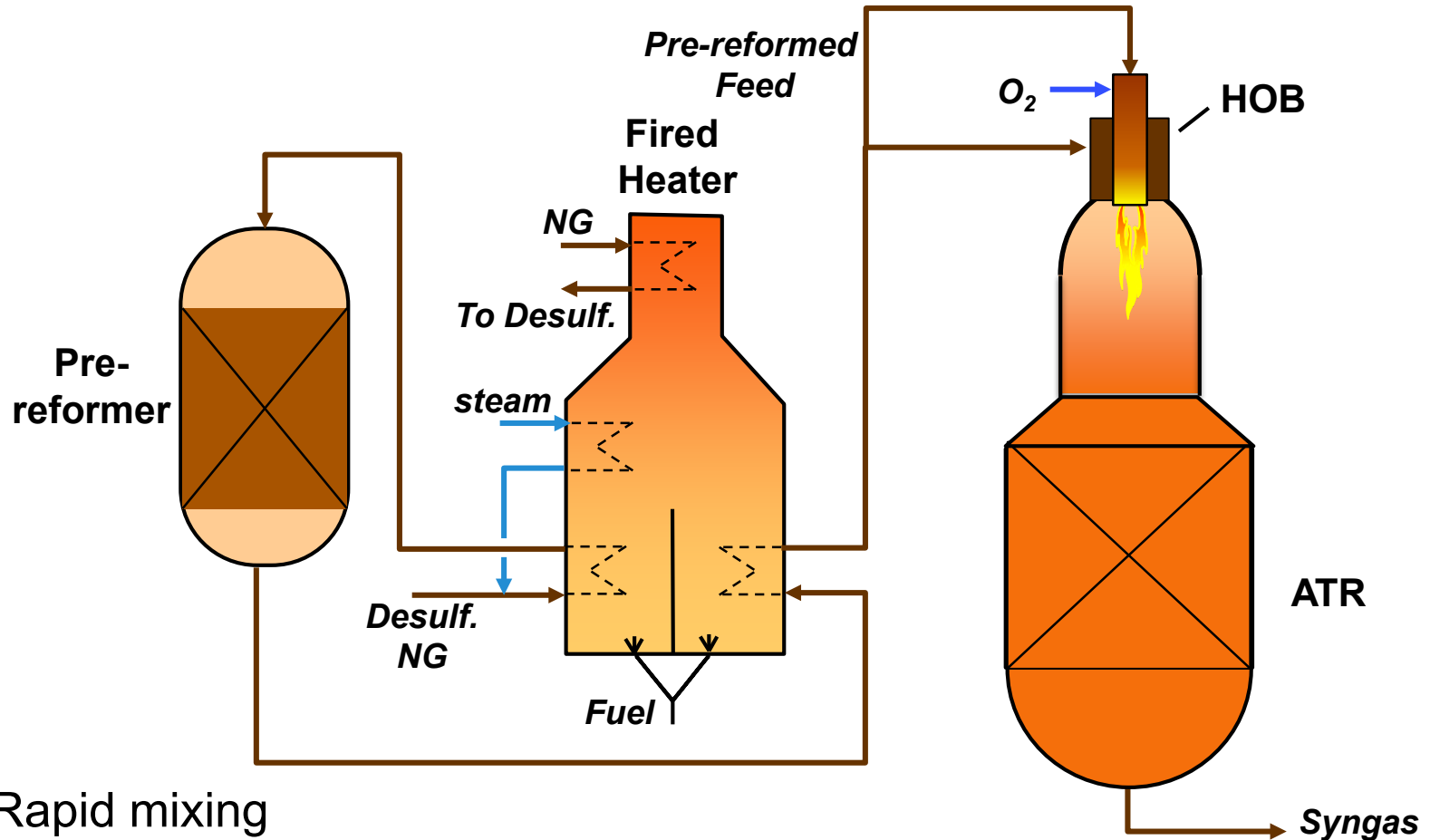
**Solid Foundation for Commercializing Syngas Applications**

# HOB in Partial Oxidation (POx) Process



- Simplified reactor design
- Feedstock flexibility
- Faster start-up
- Excellent turndown to <50%
- Minimal soot
- Syngas yields similar to other POx designs

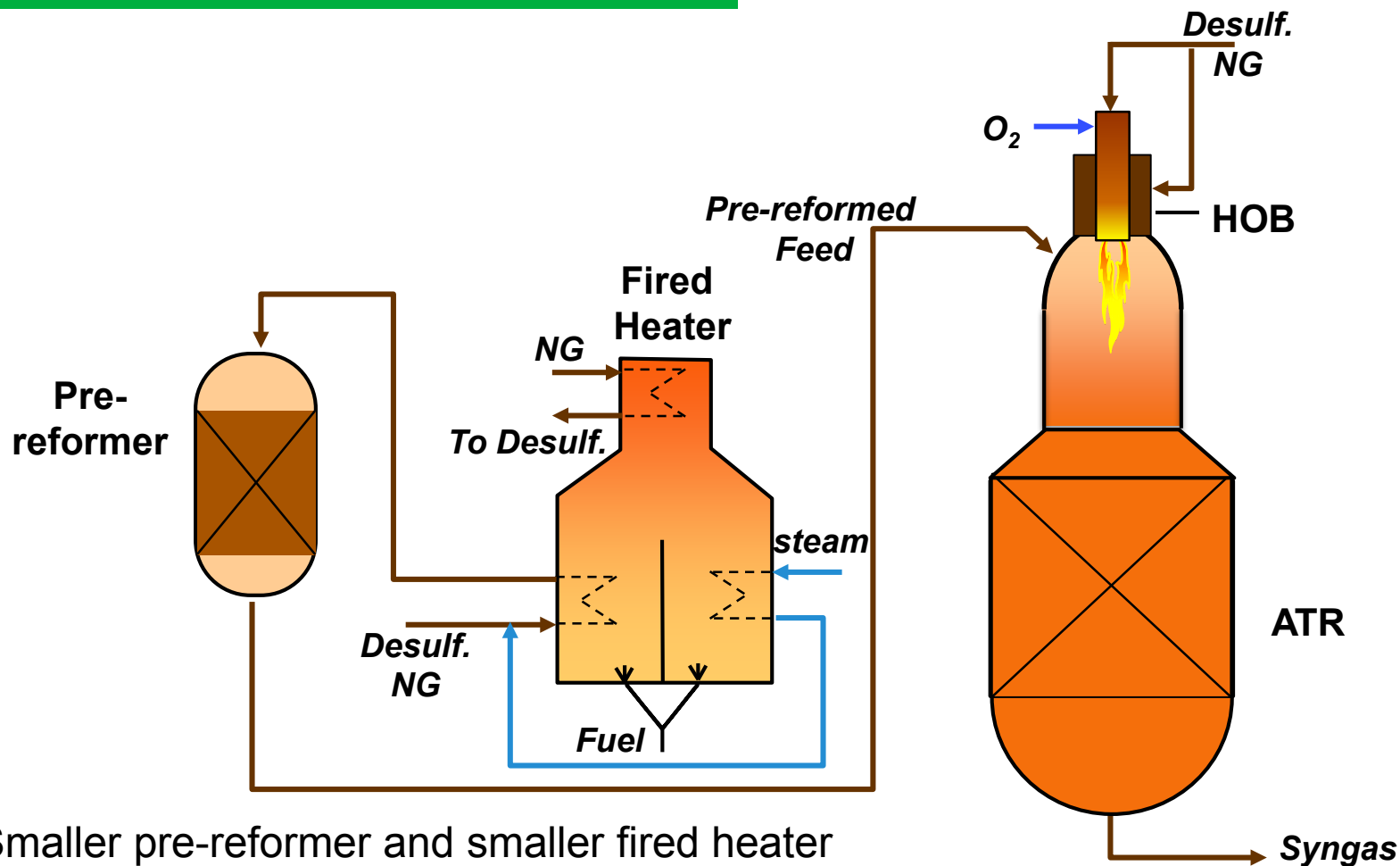
# HOB in ATR Process



- Rapid mixing
- Soot avoidance
- Feedstock flexibility

Praxair Patent Pending

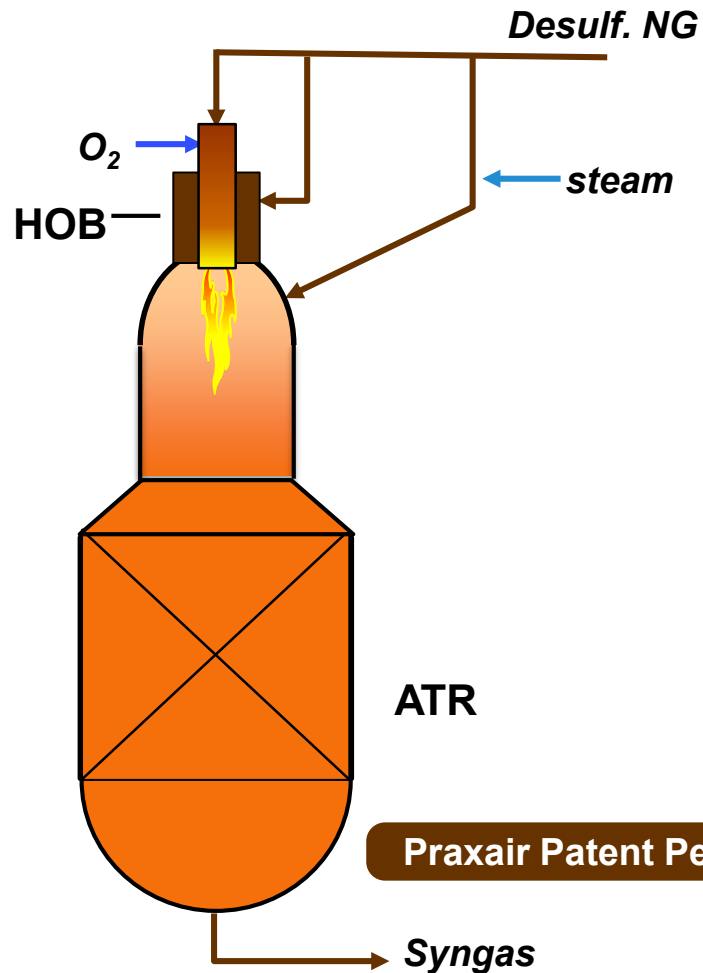
# HOB in Partially Intensified ATR Process



- Smaller pre-reformer and smaller fired heater
  - ~30% of NG by-passes pre-reformer
  - Pre-reformed feed is supplied without further heating

Praxair Patent Pending

# HOB in Intensified ATR Process



- Pre-reformer and fired heater eliminated
  - Desulfurized NG is directly used in ATR as fuel and feed streams
- Reduced process complexity leads to lower Capex
- O<sub>2</sub> consumption will increase compared to base ATR process
- Soot avoidance will be key to success of this concept

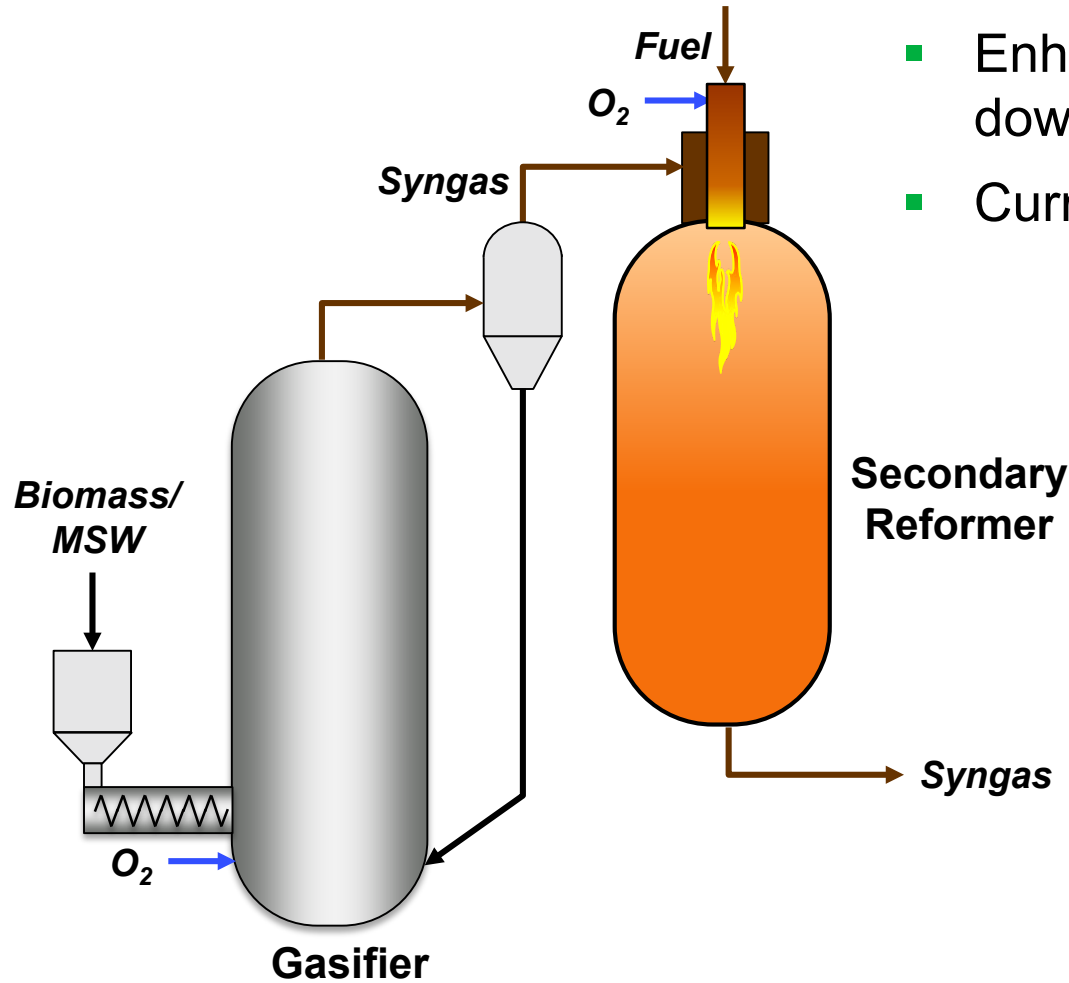
# Simulated Performance Comparison of HOB in Different Process Configurations

	ATR	Partially Intensified ATR	Intensified ATR	POx
<b>H<sub>2</sub> + CO in SG, MMscfd</b>	20	20	20	20
<b>NG/(H<sub>2</sub> + CO)</b>	0.39	0.39	0.38	0.38
<b>O<sub>2</sub>/(H<sub>2</sub> + CO)</b>	0.20	0.23	0.24	0.27
<b>H<sub>2</sub>/CO ratio</b>	2.4	2.4	2.2	1.6
<b>Steam export, klb/hr</b>	28	30	31	44
<b>Prereformer size</b>	1	0.7	n/a	n/a
<b>Fired heater duty</b>	1	0.6	n/a	n/a
<b>Steam generation equip.</b>	PGB	PGB	PGB	SG cooler

**HOB Enables Process Flexibility for Optimizing Capex vs. Opex**



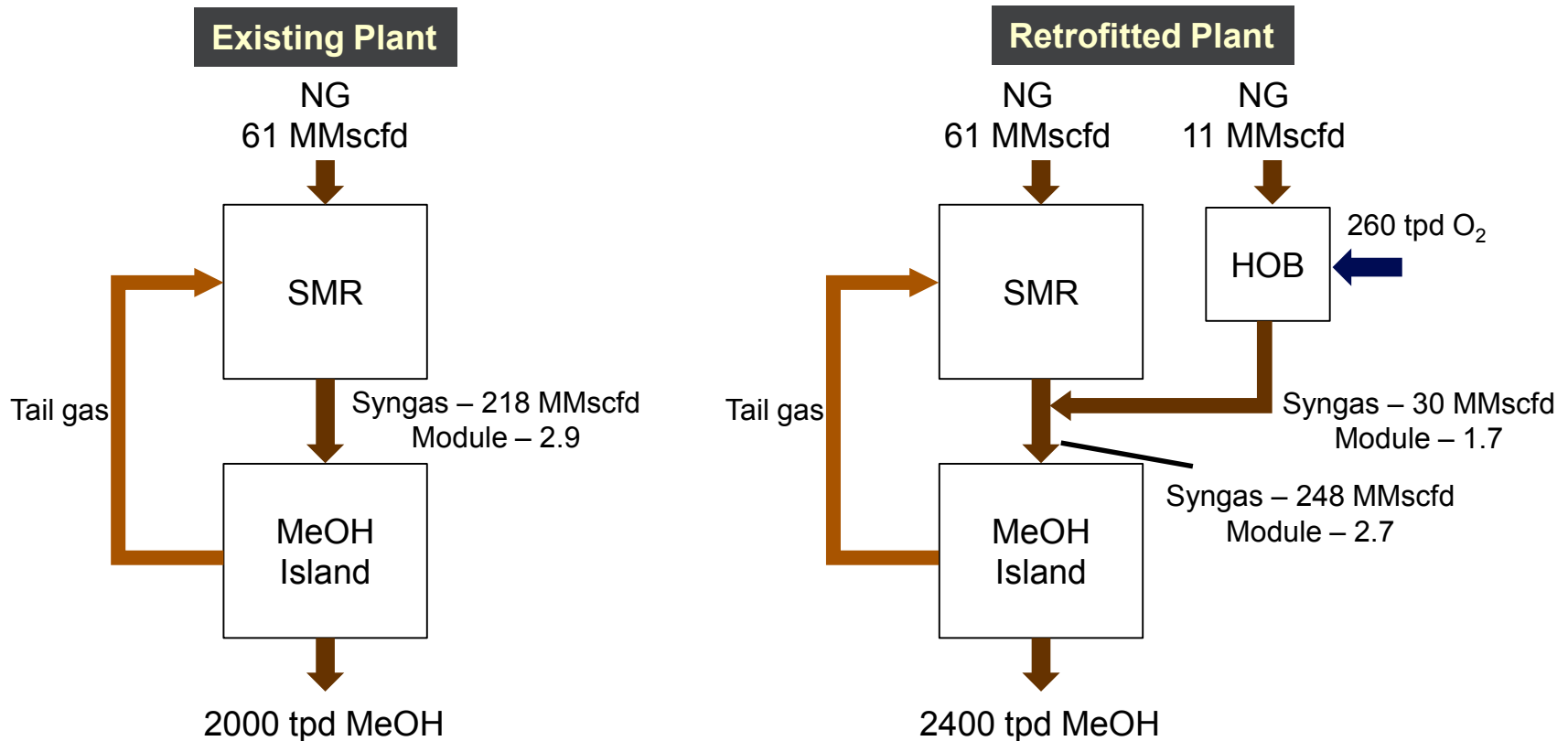
# HOB in a Secondary Reformer



- Reforms tar and other HCs
- Enhances product yield of downstream process
- Currently in project execution

# HOB for Methanol Plant Throughput Increase

- 80% of existing methanol plants are SMR-based
- Newer MeOH catalysts could enable 10 – 30% throughput increase
- Supplemental HOB syngas can improve Module for MeOH synthesis and increase throughput (US 9,637,432)



## Syngas Generation

- HOB incorporated in syngas/CO supply system owned and operated by Praxair
- O<sub>2</sub> Supplied by Praxair

## Secondary Reforming of Syngas from Biomass/MSW

- HOB and flow control system sold via EPC firms or key equipment suppliers
  - Functional reactor design by Praxair
- O<sub>2</sub> Supplied by Praxair

- High velocity hot oxygen jet from HOB drives rapid mixing and reaction
- HOB can be used in POx and ATR reactors for syngas generation
- HOB enables flexibility in ATR process for optimizing Capex vs. Opex
- HOB effective in reforming syngas from biomass/MSW gasifiers
- Commercialization underway for a syngas reforming application