

Developing Gasification Projects in a Difficult Environment

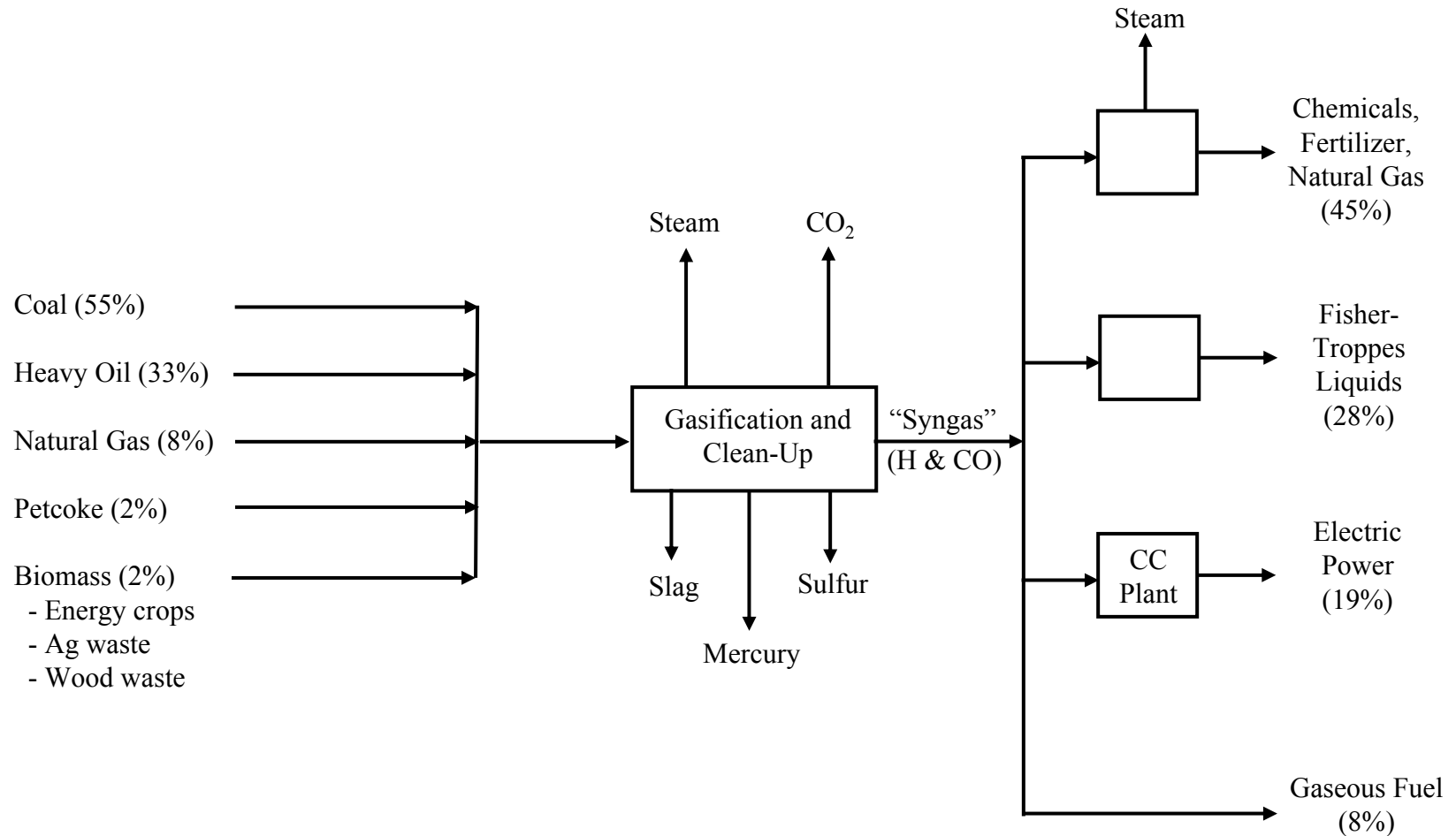
by

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Worldwide Gasification in 2007



Source: Gasification World Database 2007; NETL, USDOE

Worldwide Syngas Capacity Operating in 2007

Worldwide Syngas Capacity: 56,238 MW_{th}
144 operating plants
427 gasifiers

- South Africa 27% (97 gasifiers)
- China 24% (44 operating plants)
- Europe 24% (50 operating plants)
- North America 14% (20 operating plants)

Source: Gasification World Database 2007; NETL, USDOE

Gasification Market Drivers

- 1. Escalating and fluctuating price of natural gas***
 - Base Price: \$2/10⁶ Btu (2000) → \$6/10⁶ Btu (2007)
 - Periodic Price Spikes: to \$9/10⁶ Btu in January, 2001
to \$12/10⁶ Btu in Winter, 2006
- 3. Projected availability and low cost of refinery residuals (petcoke; heavy oil; asphalt) due to anticipated decreasing quality of crude oil**
- 4. Opportunity to sell CO₂ for enhanced oil recovery (EOR) in west Texas, Gulf Coast, California, and elsewhere**
- 5. Cancellation of several conventional coal projects**
(over 40 projects and more to come)

*Source: Gasification World Database 2007; NETL, USDOE

Gasification Market Hurdles

- 1. Inflated cost of fabrication, design, and constr of large projects**
 - 2004 to 2007: 30% to 40%
- 2. Uncertainty of meeting expected future CO₂ emission regs**
 - \$5 to \$40/ton of CO₂ (excluding comp & sequestration)
- 3. Unavailability of cost and performance guarantees from EPC contractors while they are so busy**
 - Makes financing difficult

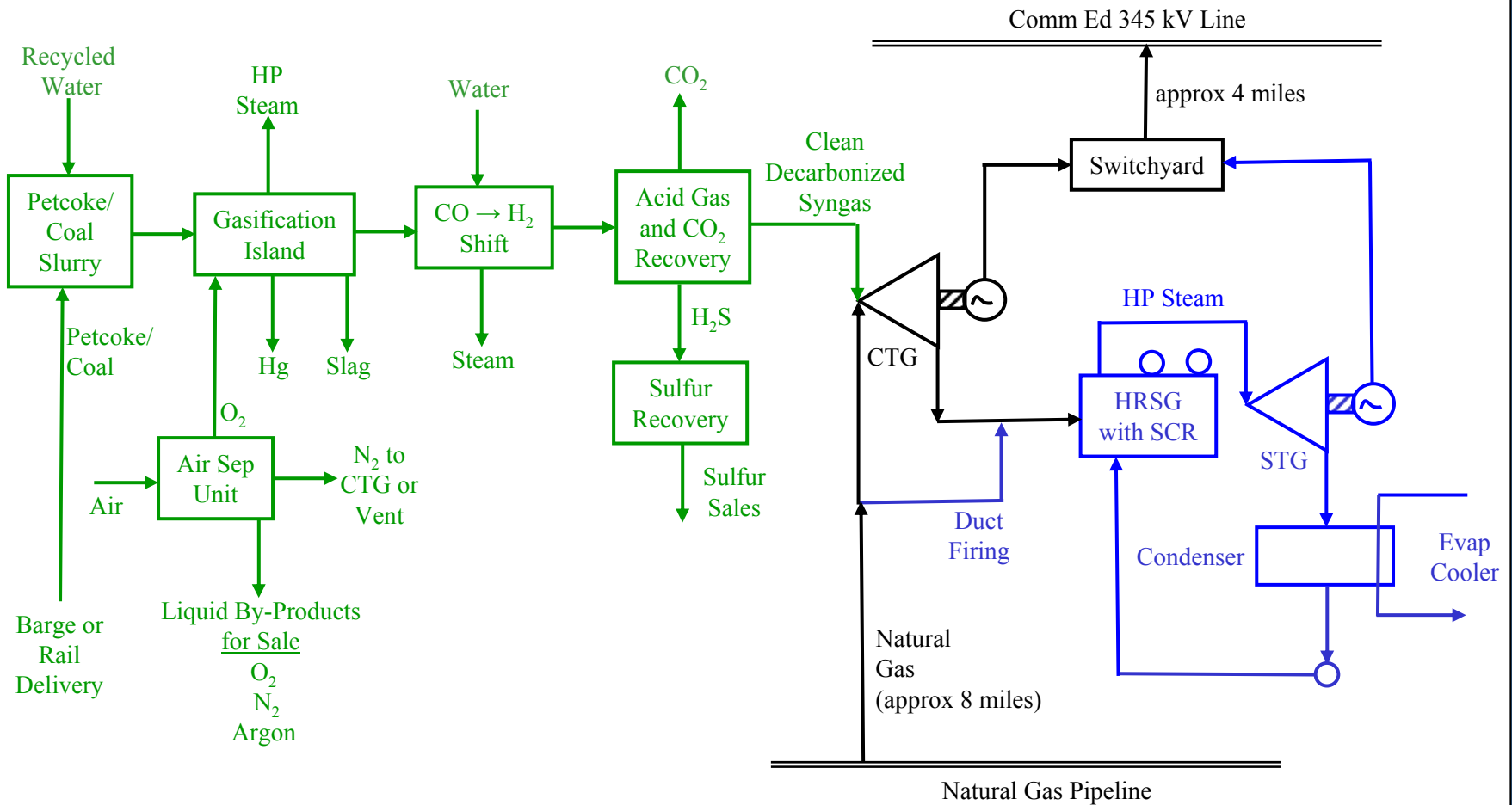
*Source: “Rising Utility Construction Costs: Sources and Impacts”;
Brattle Group; September, 2007

Four Gasification Projects under Development by Steelhead Energy

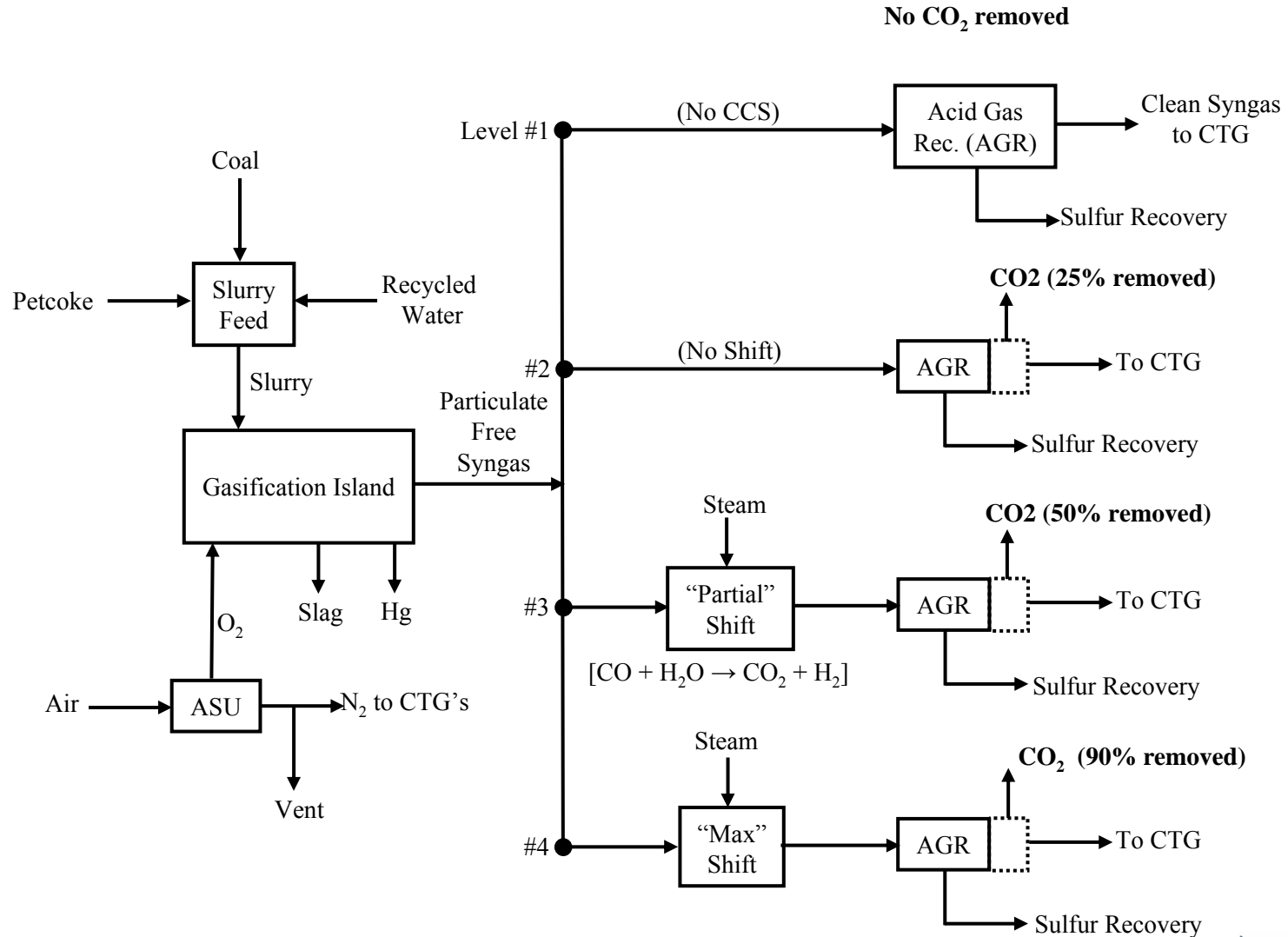
Steelhead Energy: Owned by ArcLight Capital (Private Equity)
Managed by Madison Power Corp

- 1. Phased IGCC Project** on the Illinois River (Petcoke/Illinois Coal)
- 2. SNG Project** on the Illinois River (Petcoke/Illinois Coal)
- 3. Heavy Oil Polygeneration Project** at a Refinery on Gulf Coast
- 4. Heavy Oil Upgrading and Syngas Refueling Project** for a large oil company in California

Phased IGCC Project in Illinois



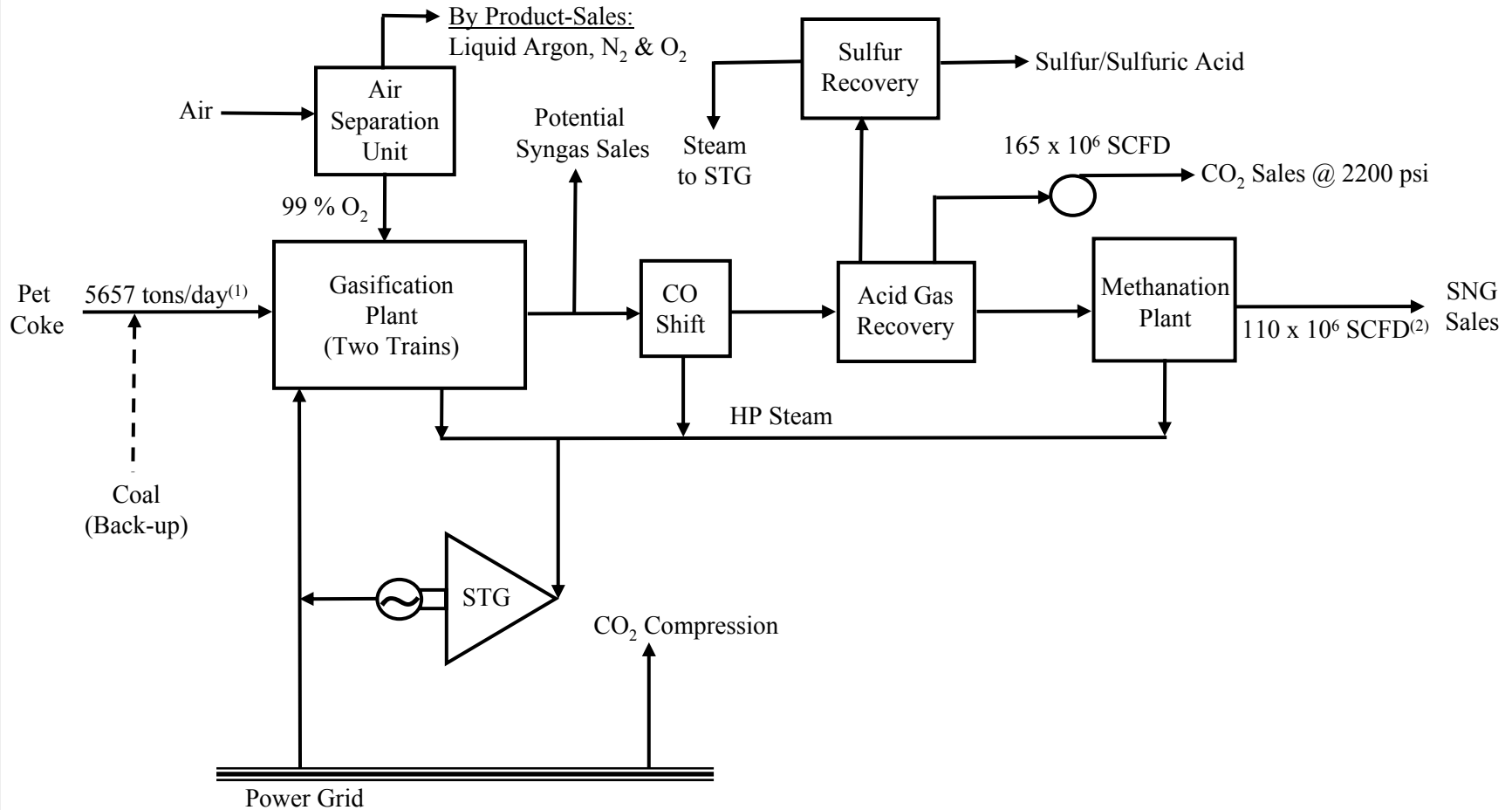
Levels of Carbon Capture and Sequestration (CCS)



IGCC Options

1. **Repowering** existing CC plant vs. **greenfield** development
2. **Phased installation**: simple cycle vs. combined cycle vs. IGCC
3. **Energy Storage** to maximize on-peak generation and sales
4. **Extent** of sulfur removal
5. **Redundant gasifier** capacity
6. **Percent CO₂** capture and sequestration
7. **Dry cooling** to minimize water consumption
8. **ASU by-product sales** (LIN, LOX, LAR)
9. **Sulfur product**: elemental sulfur vs. sulfuric acid
10. **Extent** of compressed air integration

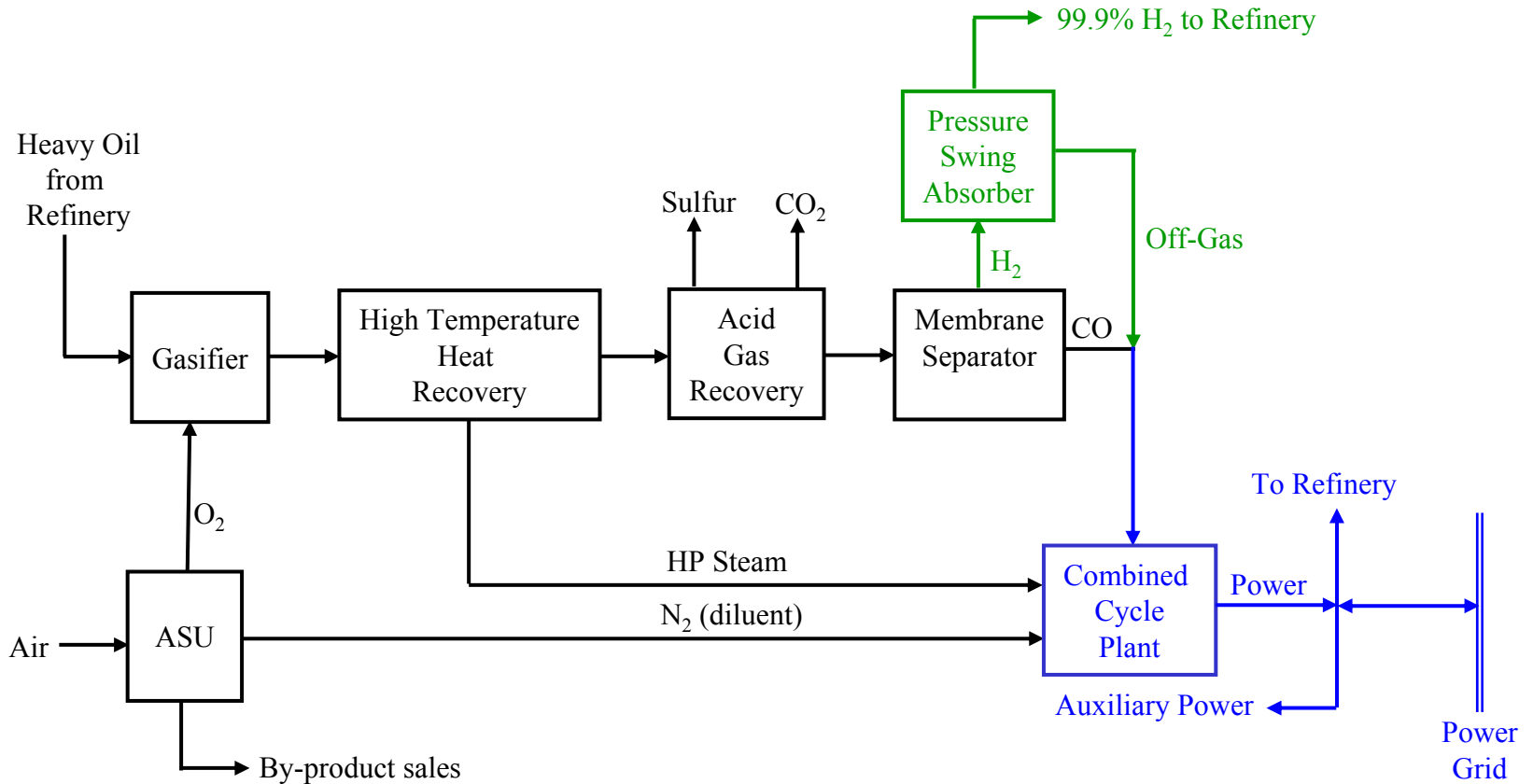
SNG Project in Illinois



Notes:

1. Based on a HHV of 14,000 Btu/lb for Pet Coke.
2. Cold gas efficiency (fuel to SNG) = 67%.

Heavy Oil Polygeneration Project at a Refinery in Louisiana



Heavy Oil Upgrading and Syngas Refueling Project for an Oil Company in California

