

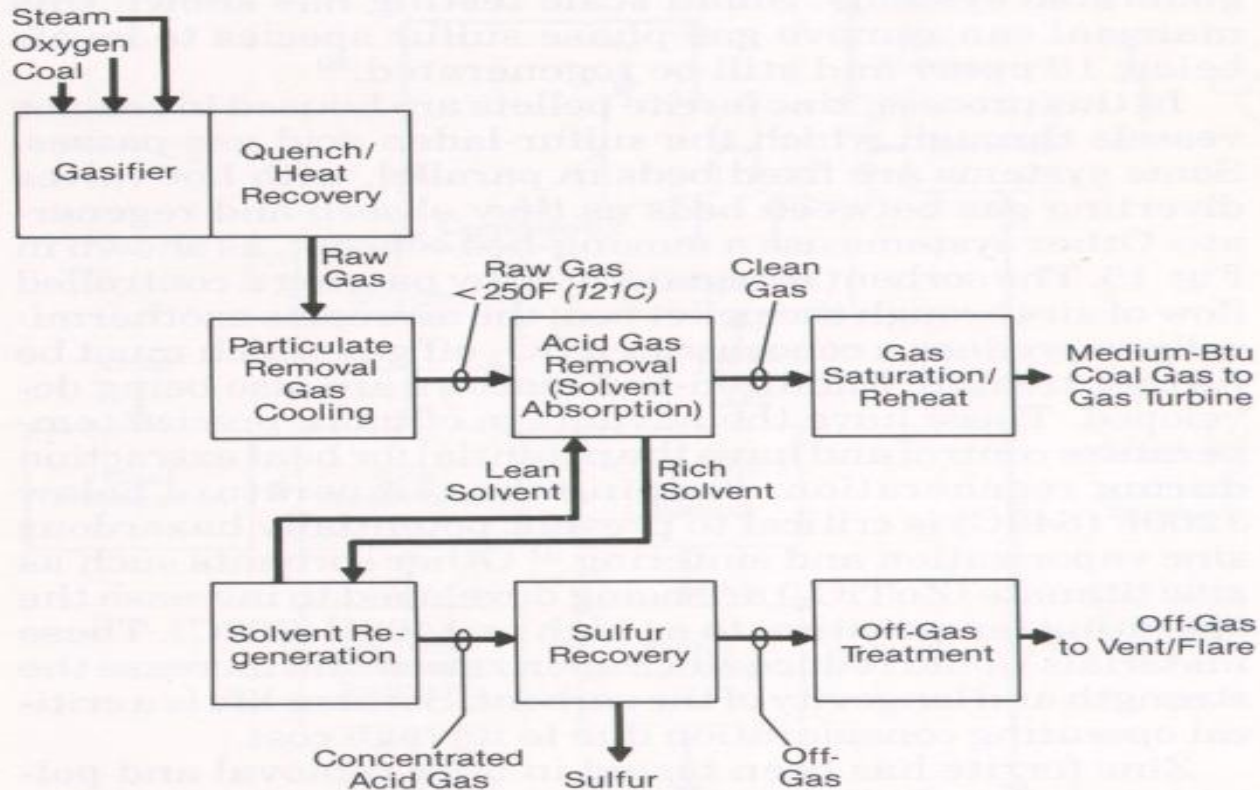
# **Gasification of Biomass**

**Lyman Frost**

Western Hydrogen LTD

Ceramatec, Inc

# Typical Coal Gasification Unit

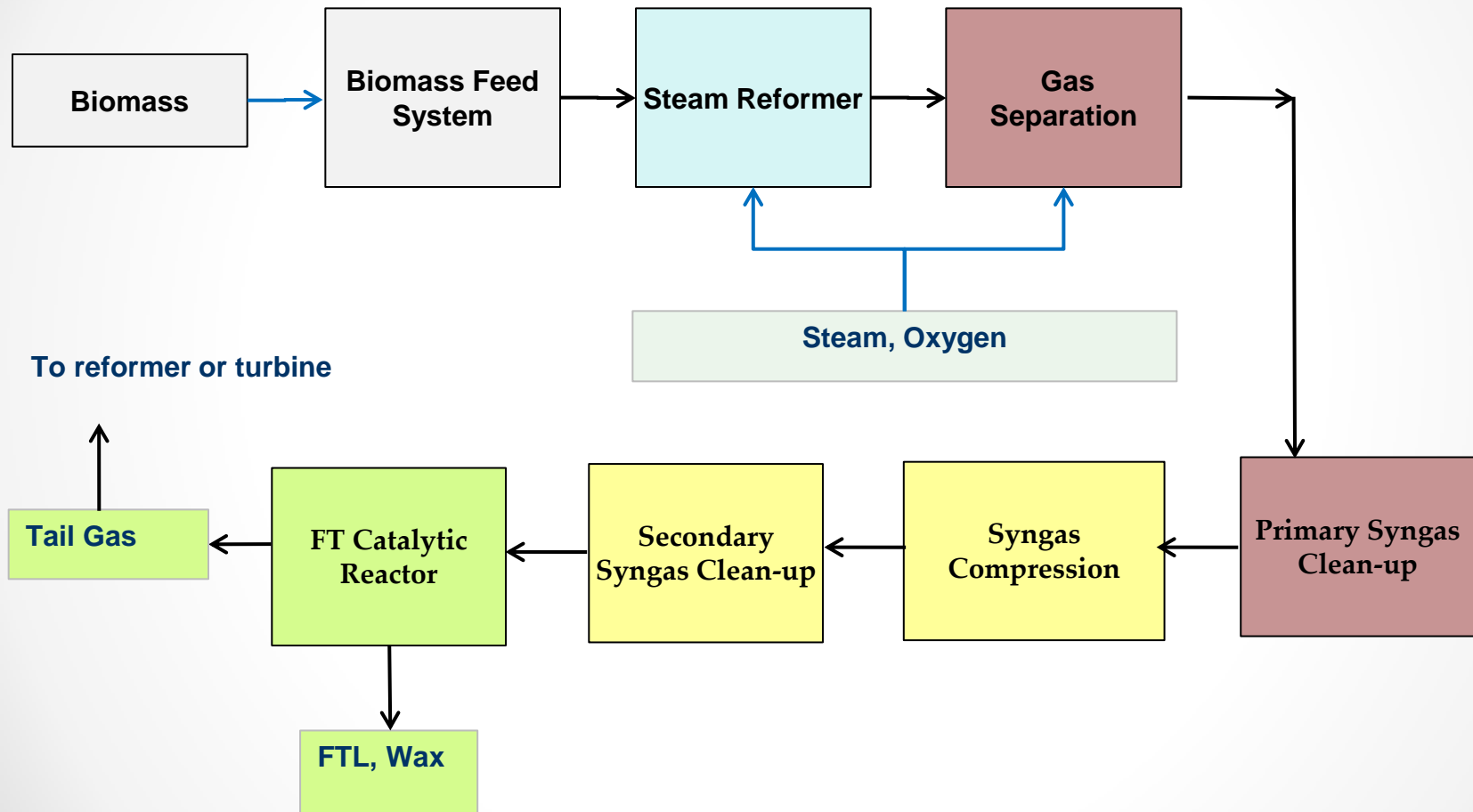


**Fig. 14** Schematic of a typical gas cleanup system for an entrained-flow oxygen-blown gasifier.

**Typical plants: Cool Water – 1000 tpd, 92 MW; Buggenum – 2000 tpd, 250 MW**

**Heat rate/efficiency: Cool Water – 9060 / ~38%; Buggenum – 8000 / ~43 %**

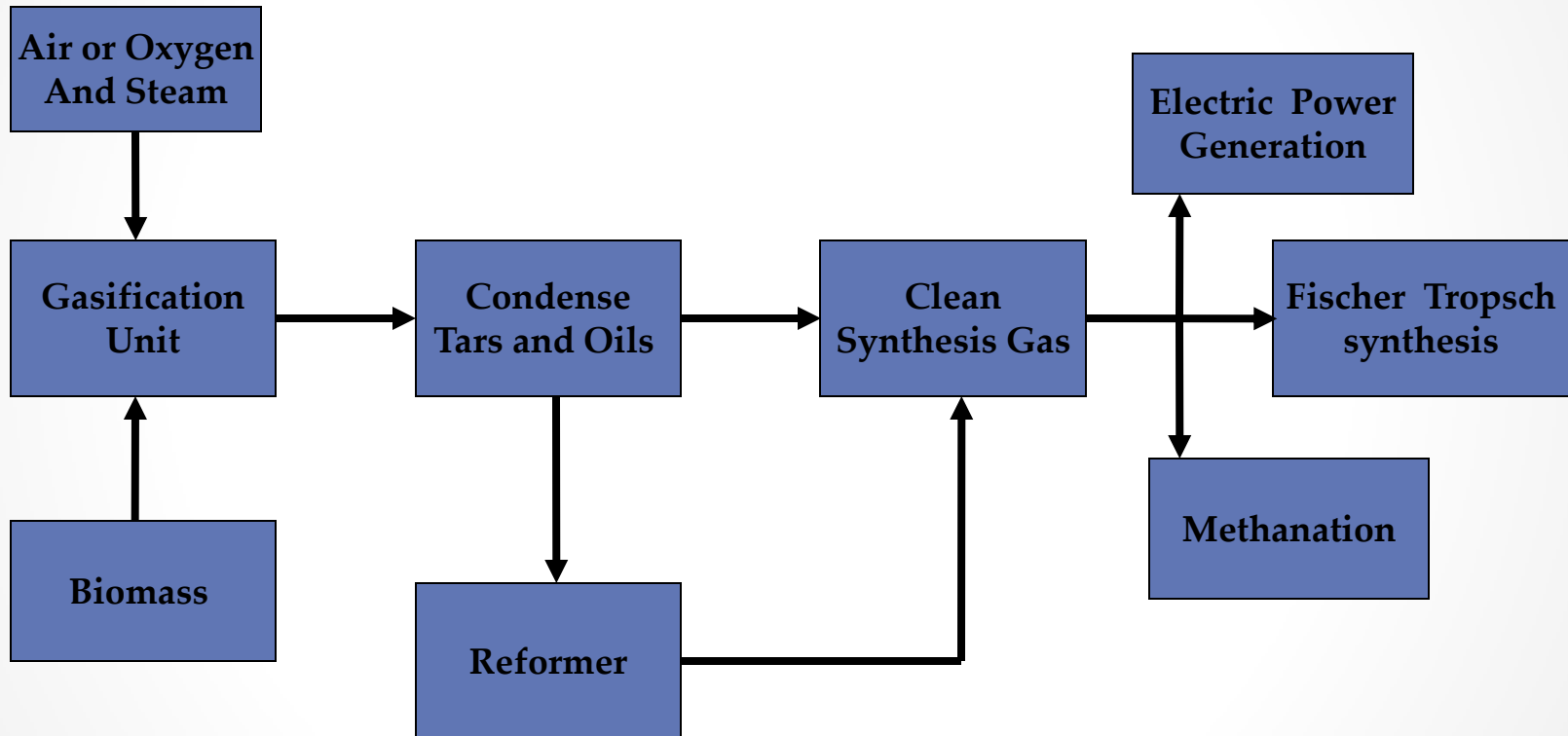
# Typical Process Flow – Biomass



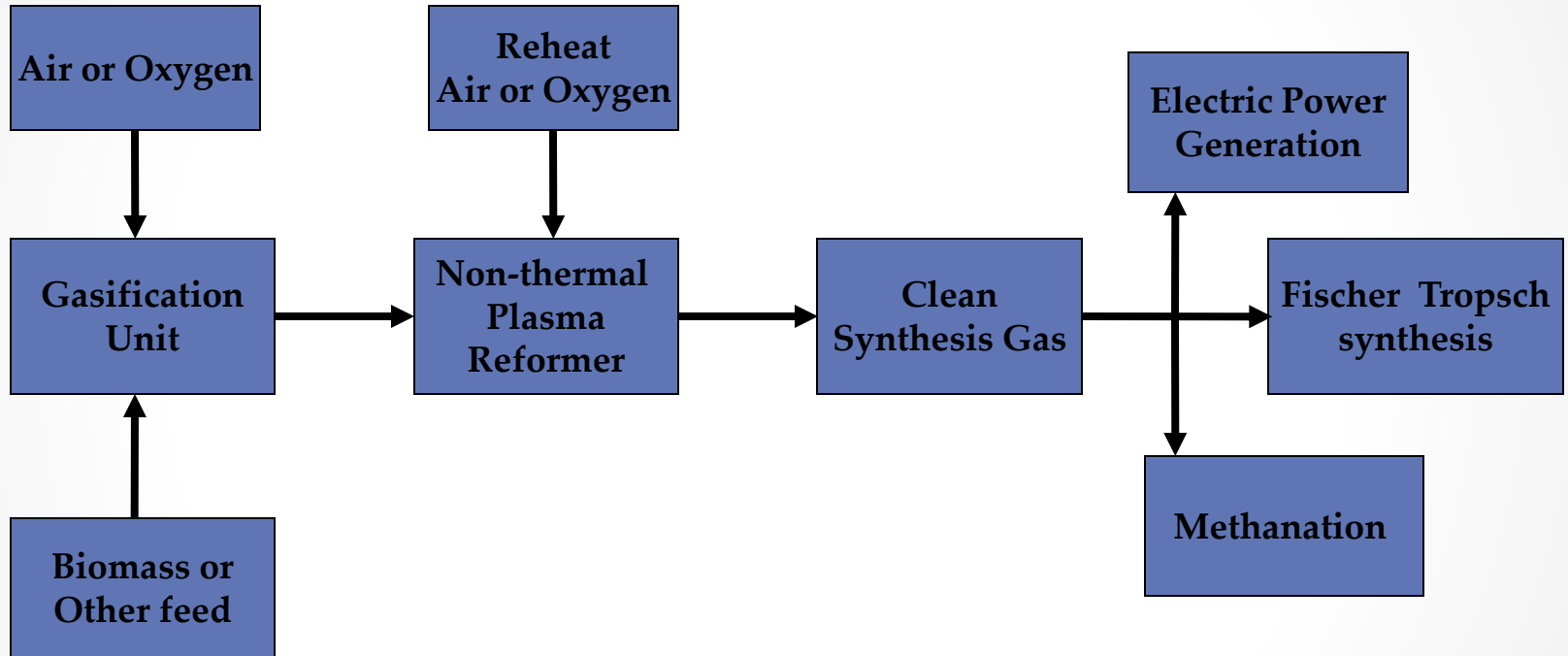
# Biomass Gasifier Problems

- **Formation of refractory tars and oils**
  - **Viscous, sticky, smelly, and carcinogenic**
  - **Refractory materials that are difficult to reform**
  - **Condensing tars gum up engines & turbines**
  - **Tar poisons catalysts (Biomass to liquids)**
  - **Tar represents lost energy**
- **Tar removal**
  - **Toxic soluble fraction (phenols) in scrubbing water**
  - **Produces a hazardous waste disposal stream**
  - **Can condense the tars for disposal**

# Condense and Reform Tars & Oils



# Directly Reform Tars & Oils

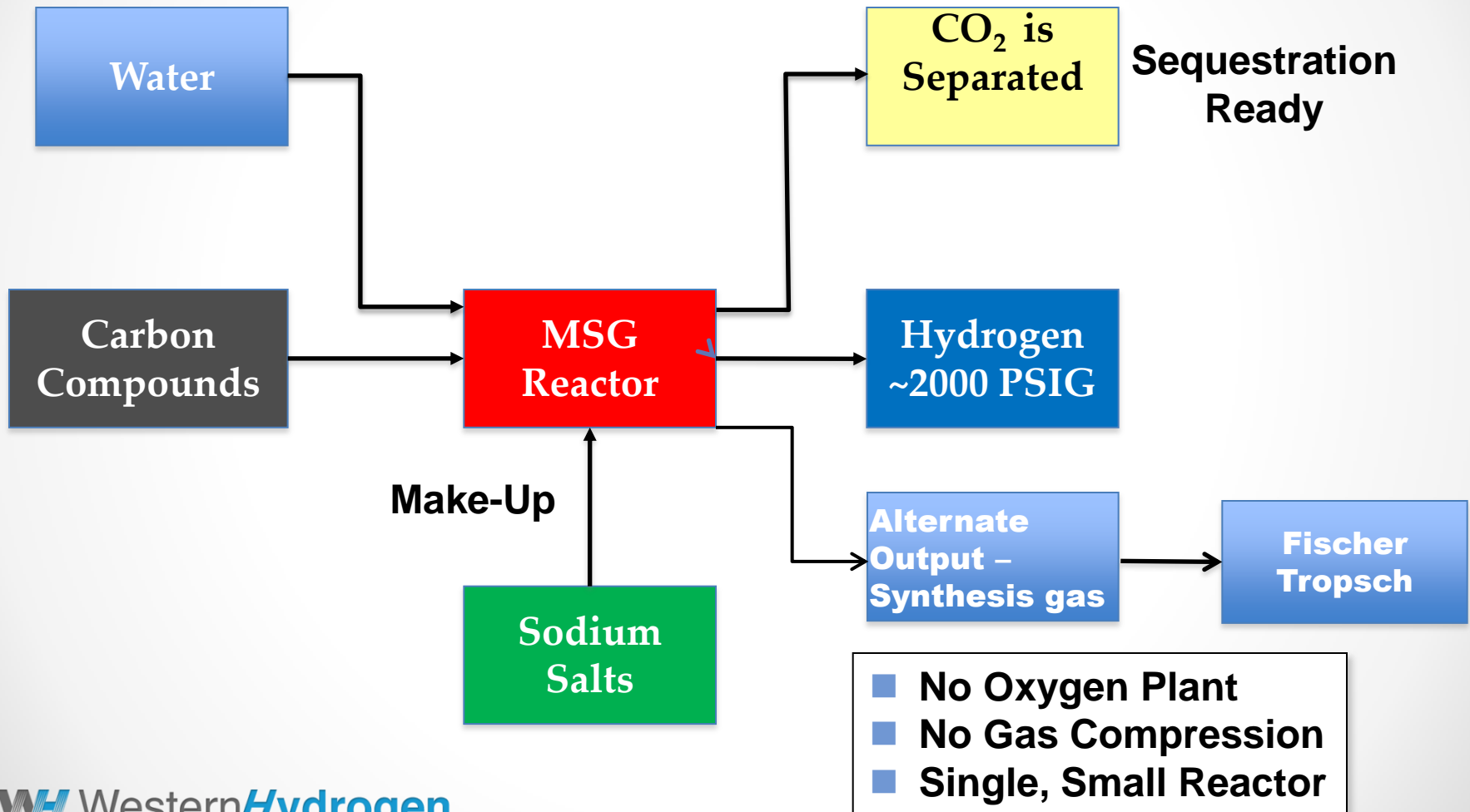


# Test of In-situ Reforming



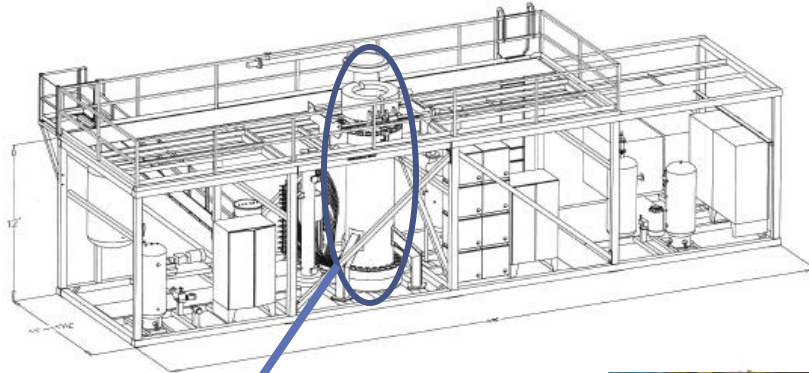
- **Emery Energy 10 TPD biomass gasifier**
- **Ceramatec non-thermal plasma catalyzed reformer**
- **Located at Western Research Institute, Laramie, WY**

# Another Option – Molten Salt Gasifier

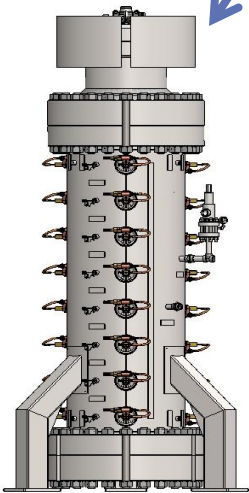




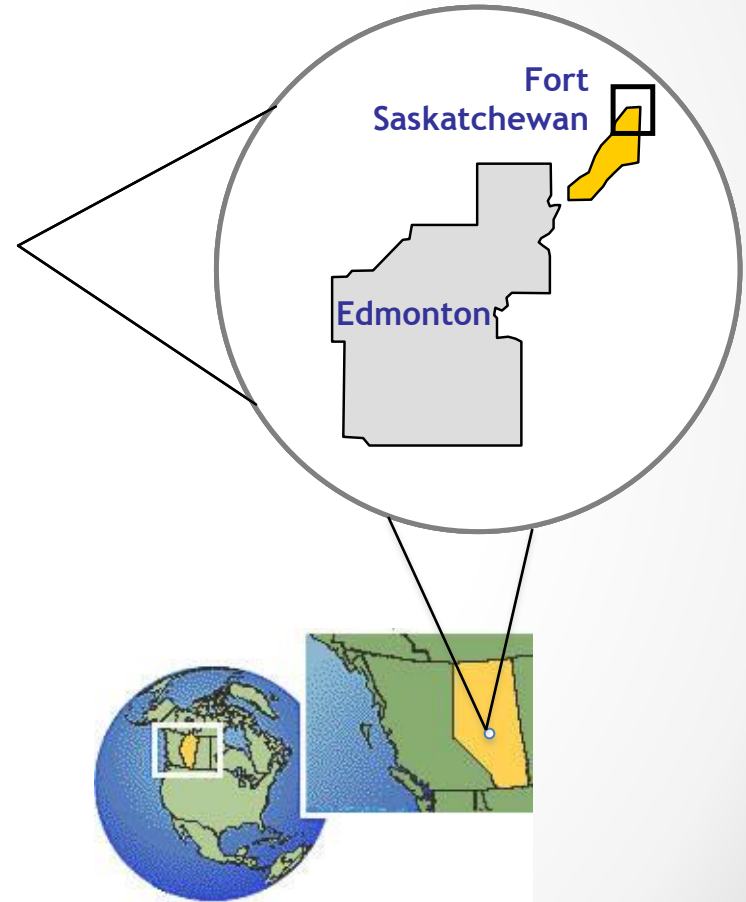
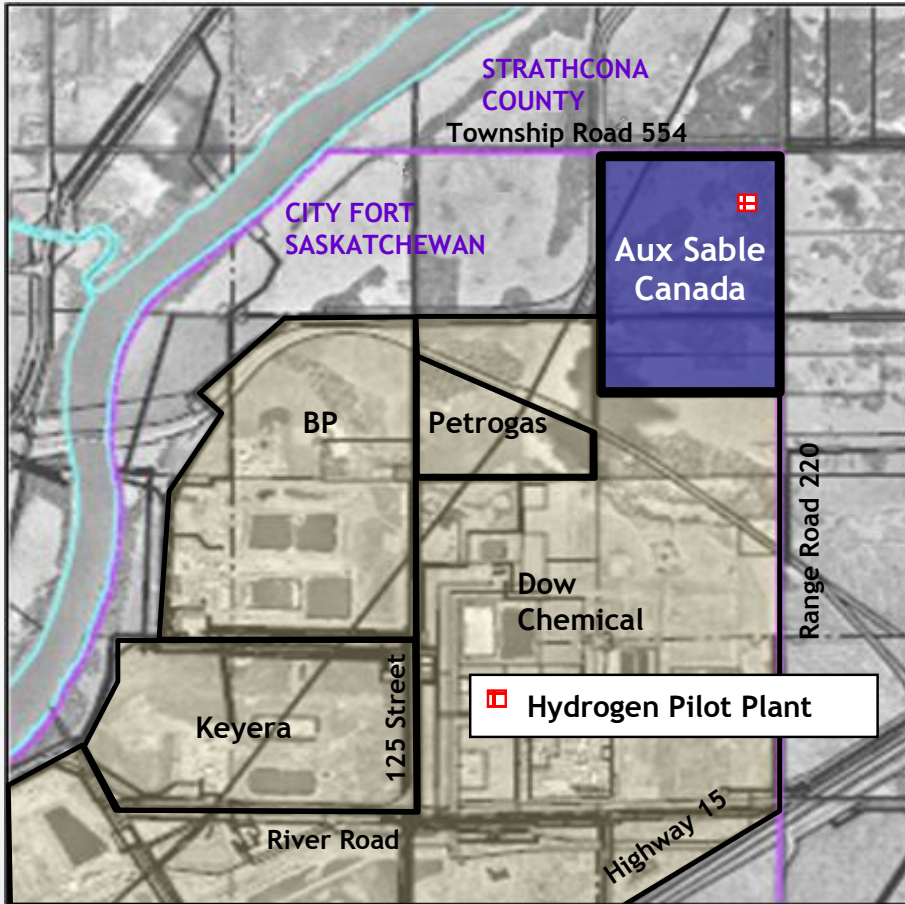
# Currently Constructing Pilot



- ~ 200,000 SCF/d H<sub>2</sub>
- Operates at:
  - 2000 psi
  - ~900 deg C



# Pilot & Demo Plant Location



# Summary

- **Biomass gasification based on previous technology**
- **Unique problem is the formation of refractory tars and oils**
- **Methods to address that formation**
  - **Condense and dispose**
  - **Condense and reform**
  - **In-situ reforming**
  - **High pressure – high temperature gasification**