Gasifier Feedstock Hydrokinetics

A SUNY Cobleskill Initiative

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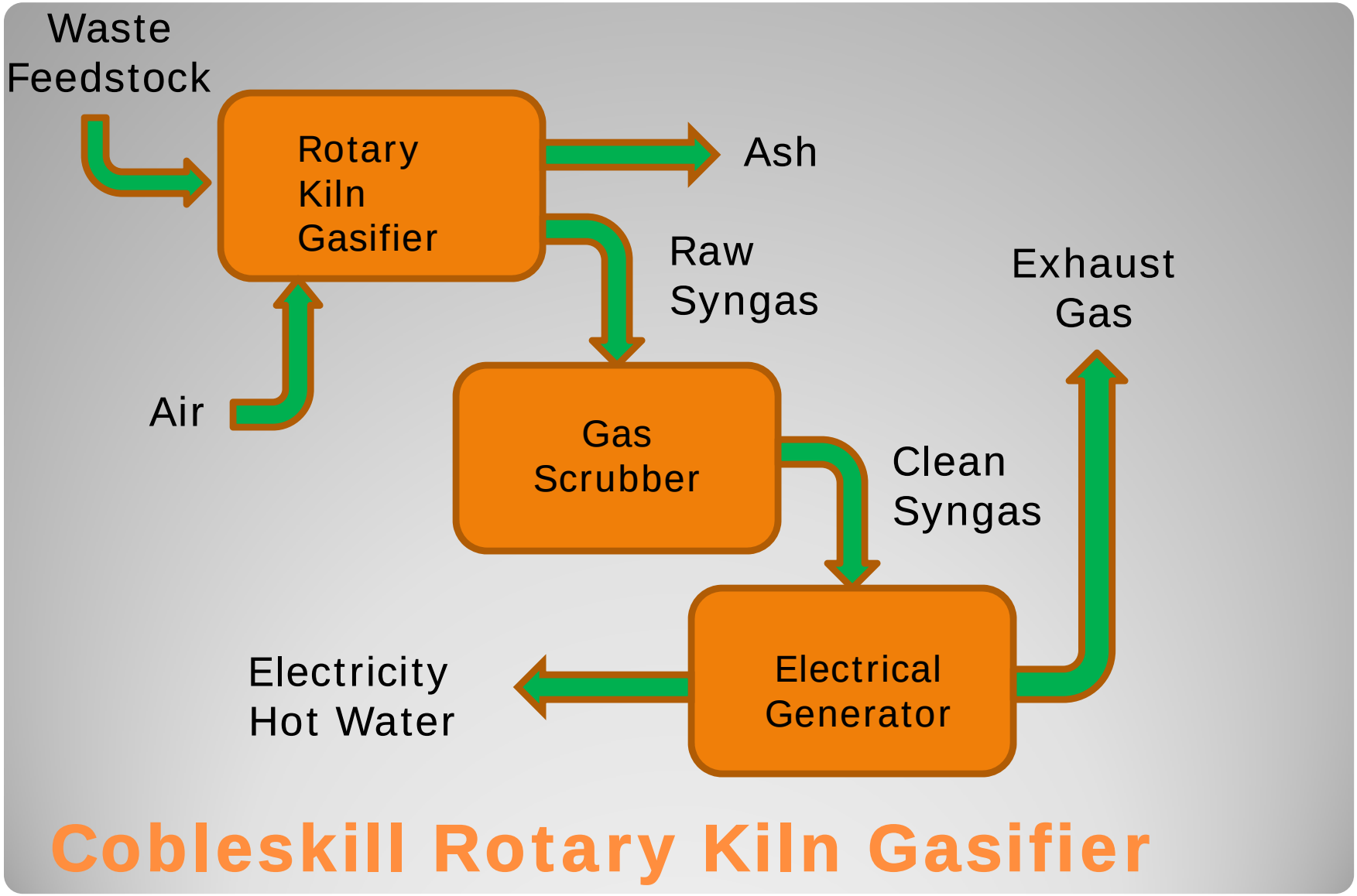
Contract funded through:
- US Department of Defense (DOD)
- US Department of Energy (DOE)

Simple Gasification Concept

- Pyrolytic process of converting any material (feedstock) that burns into a fuel gas (syngas).
- Operates in an oxygen starved environment, creating H_2, CO, and small amounts of CH_4 as flammables.
- Syngas can be used to operate various combustion based equipment including boilers, gas turbines, and I/C engines.

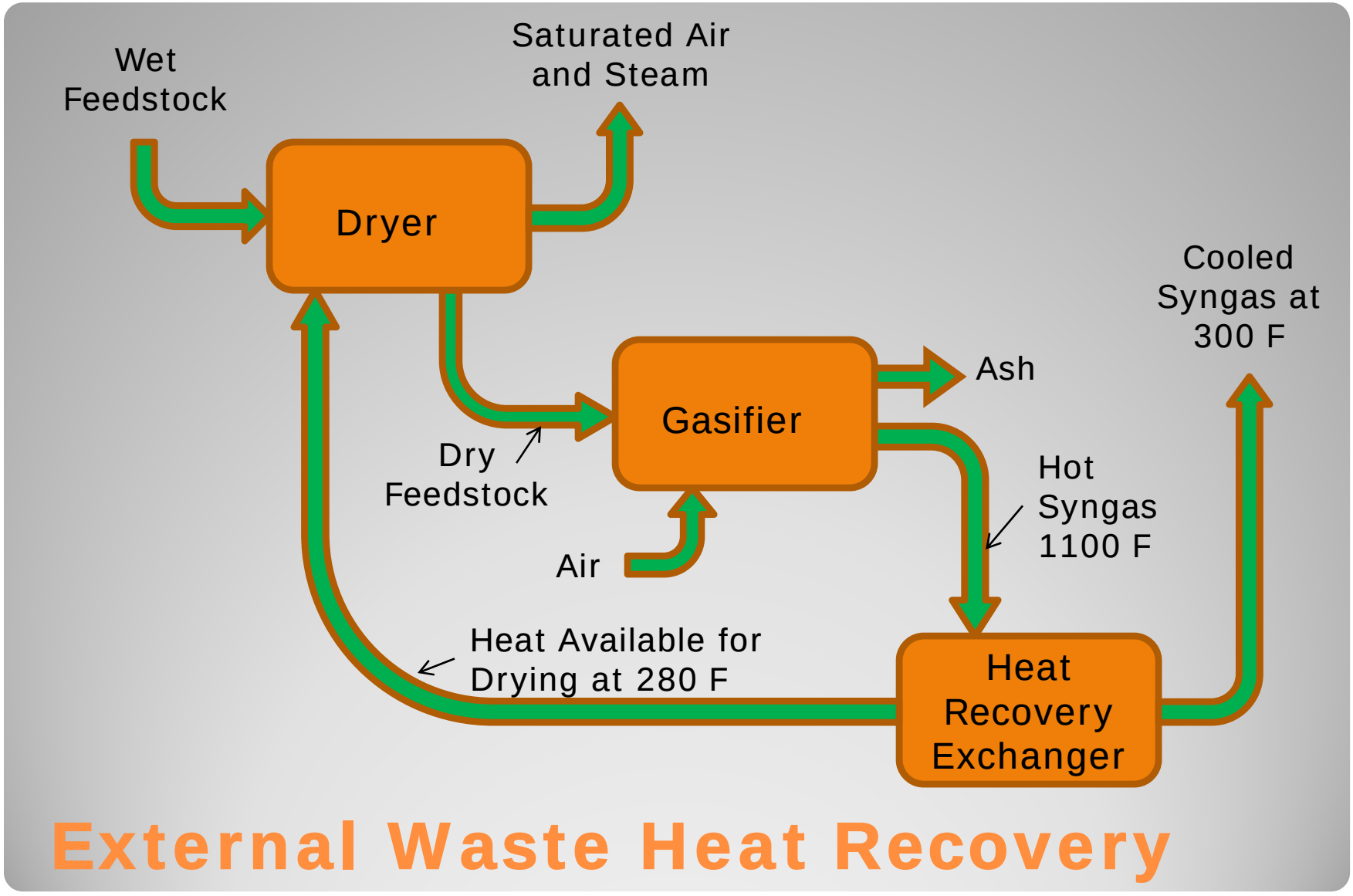


Cobleskill Rotary Kiln Gasifier

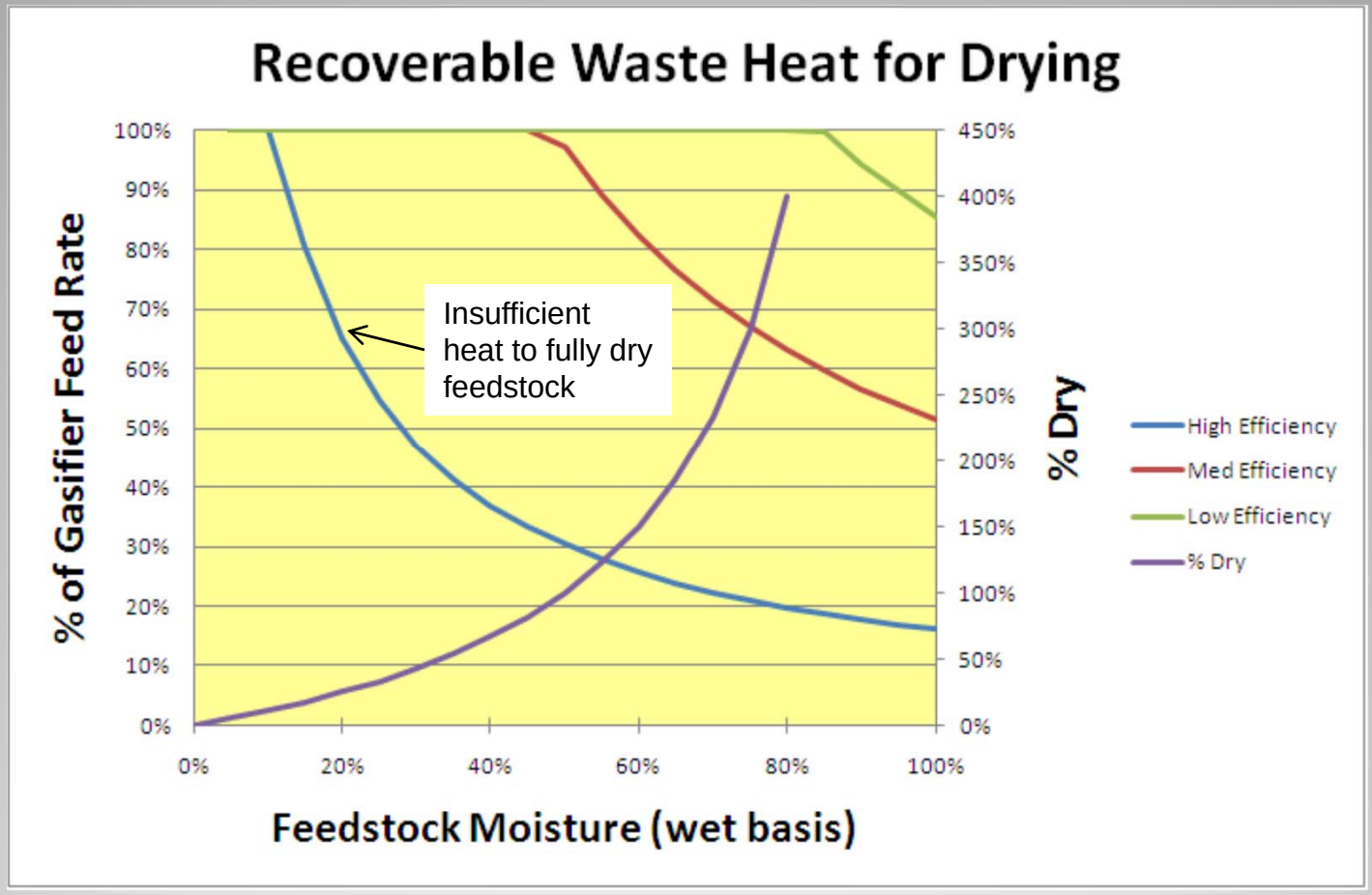
Waste to Energy Gasification Plant

Moisture can be Problem

- Many waste materials have excessive moisture.
- Moisture creates a significant heat load, reducing reaction temperatures.
- > 1600 F is essential to fully remove volatile matter and thermally crack tars.
- Common practice is to dry the feedstock prior to gasification.



External Waste Heat Recovery Method for Drying



High efficiency gasifiers (high calorific value gas) do not have sufficient recoverable waste heat for adequate feedstock drying.

Notes:
High efficiency = 140 BTU/scf, 650 F exit temp
Medium efficiency = 100 BTU/scf at 1100 F exit temp.
Low efficiency = 60 BTU/scf at 1100 F exit temp.

Waste Heat Available for Drying

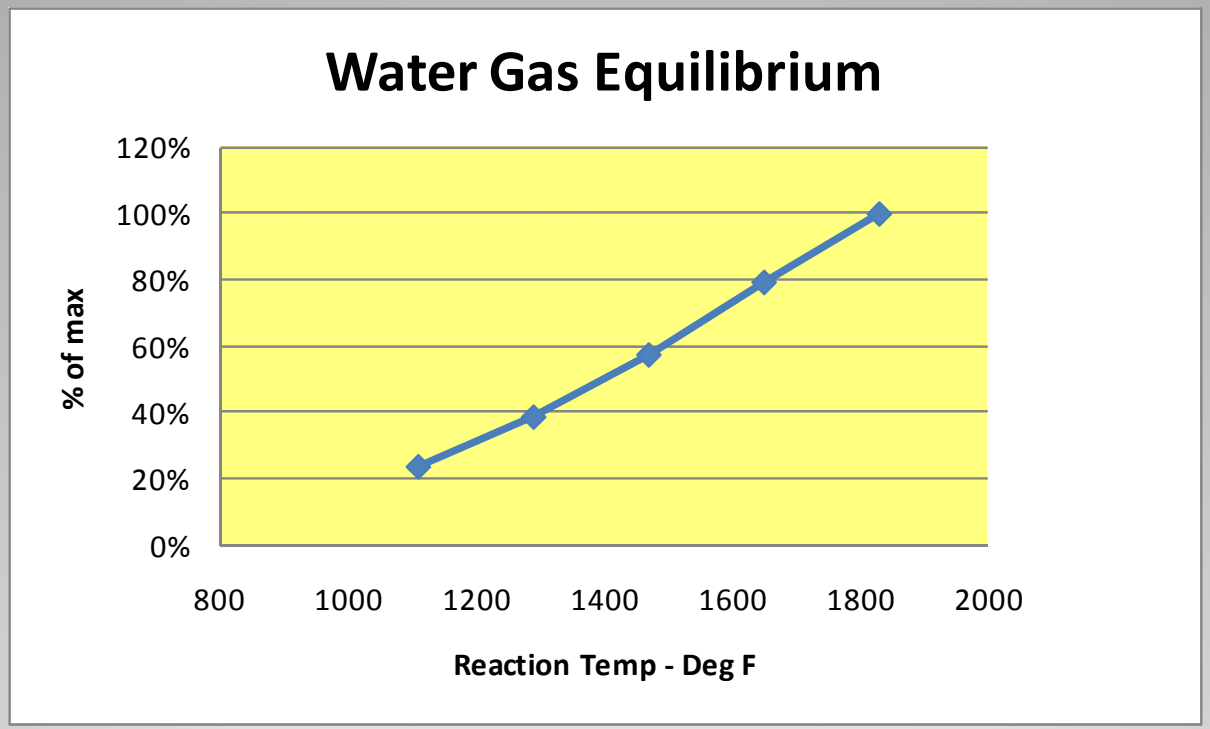
- Blending with bone dry feedstocks.
- Blending with high calorific feedstocks that do not absorb moisture (rubber, plastic, etc).

Best solution is to have a gasifier design that can handle the highest level of moisture, produce the highest heating value gas possible and internally recover waste heat to support chemical reactions.

Other Means of Moisture Reduction

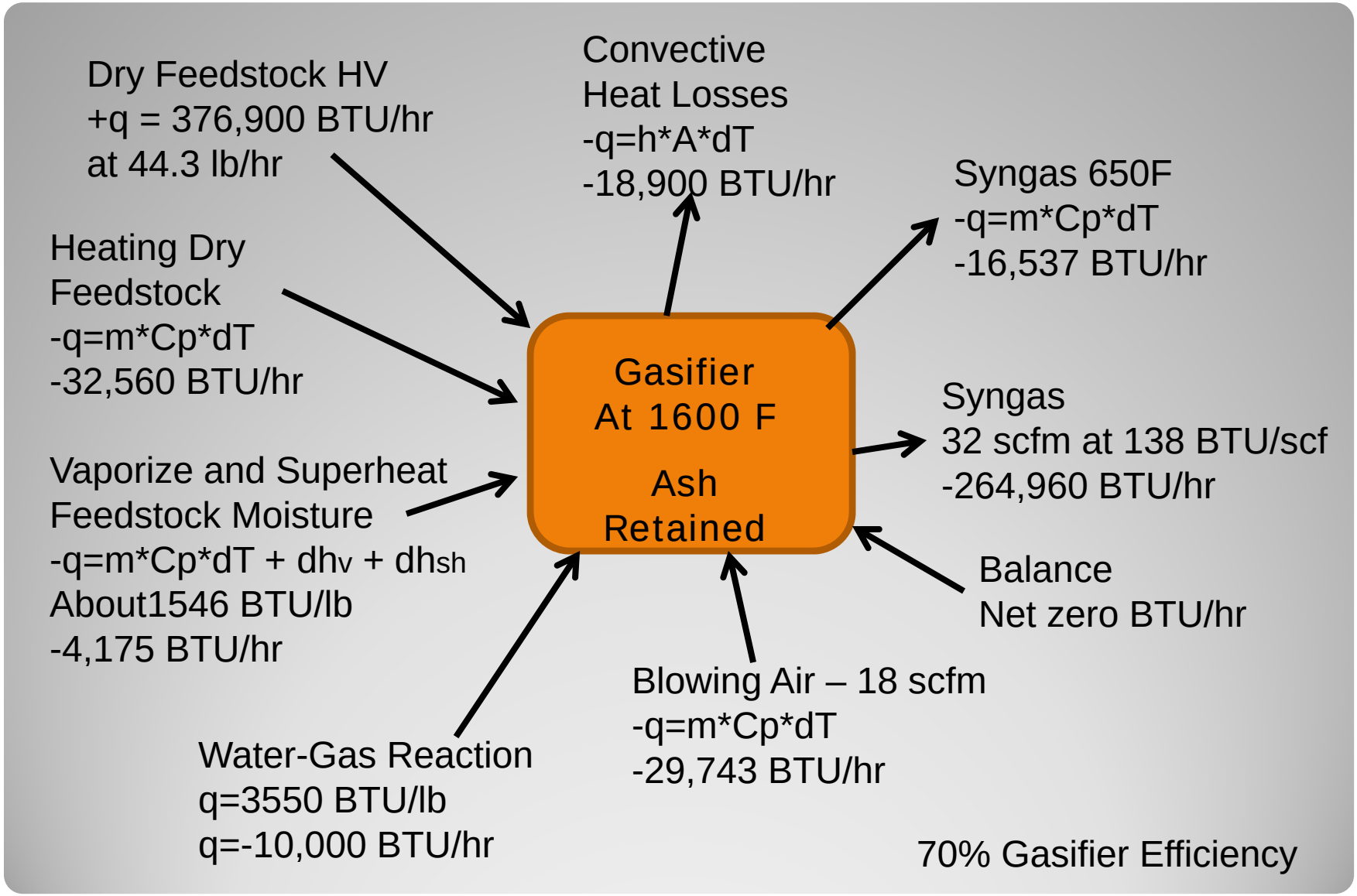
- $C + H_2O \rightarrow CO + H_2$
- Reaction is endothermic and requires passing water vapor over hot carbon.
- 1 lb of water can be converted to 14,300 BTU's (about 44.3 SCF) of flammable gas.
- About 3550 BTU's of thermal energy is required for each lb of water reacted.
- Optimum reaction temperature is about 1600 to 1800 deg. F.

Moisture can be Converted to Gas….Water Gas Reaction

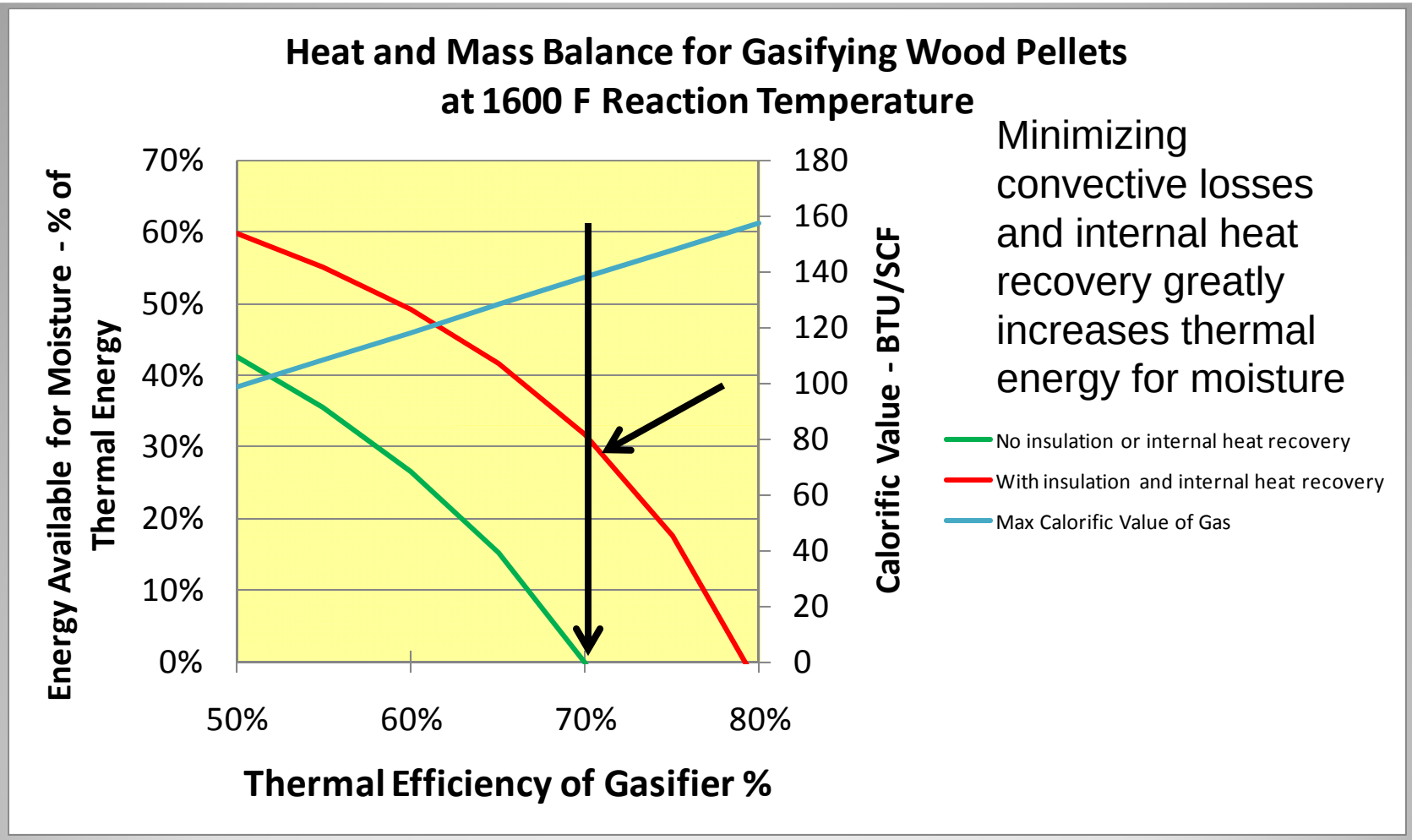


Optimum Reaction Temperature is between 1600 and 1800 F

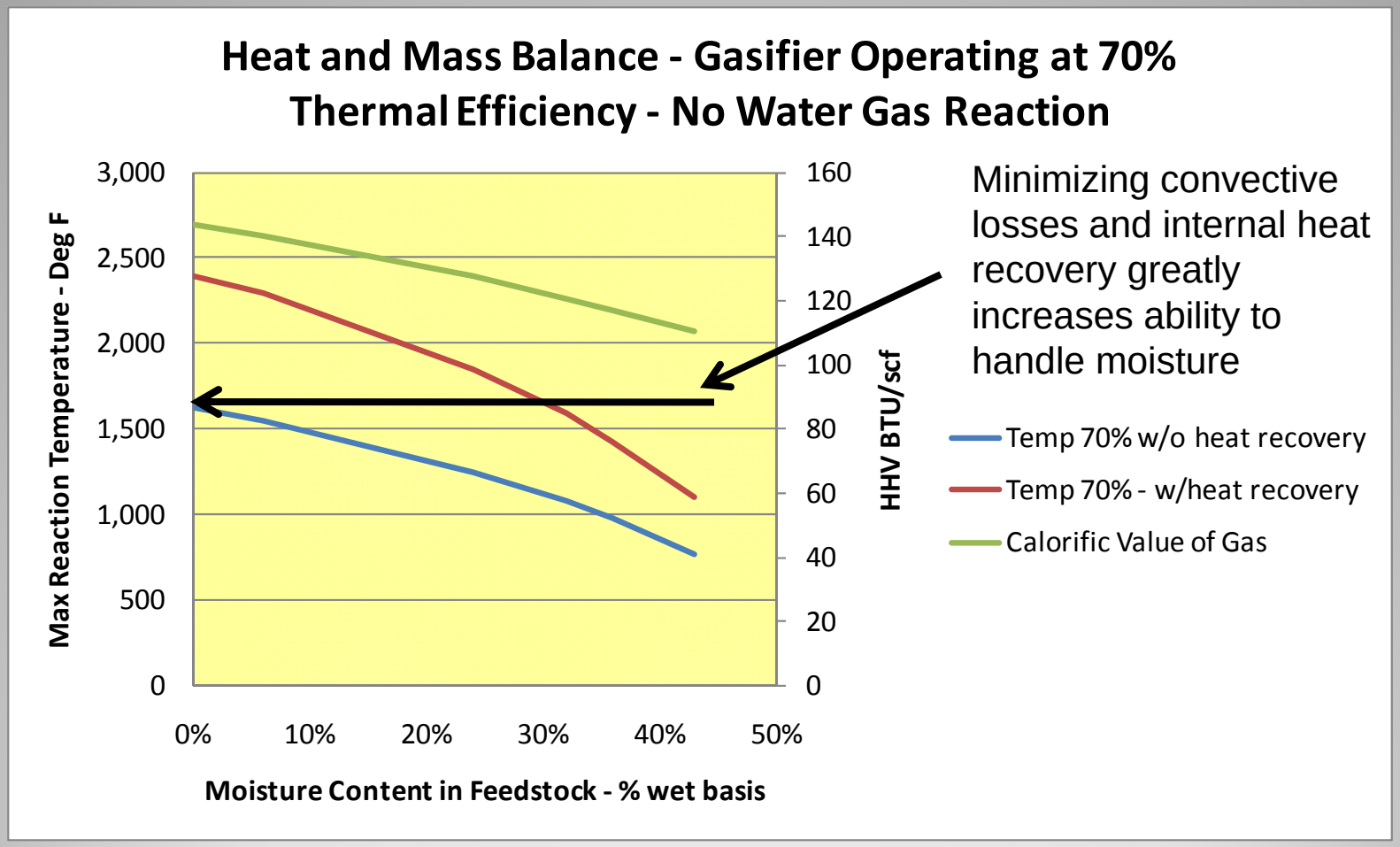
Water Gas Reaction



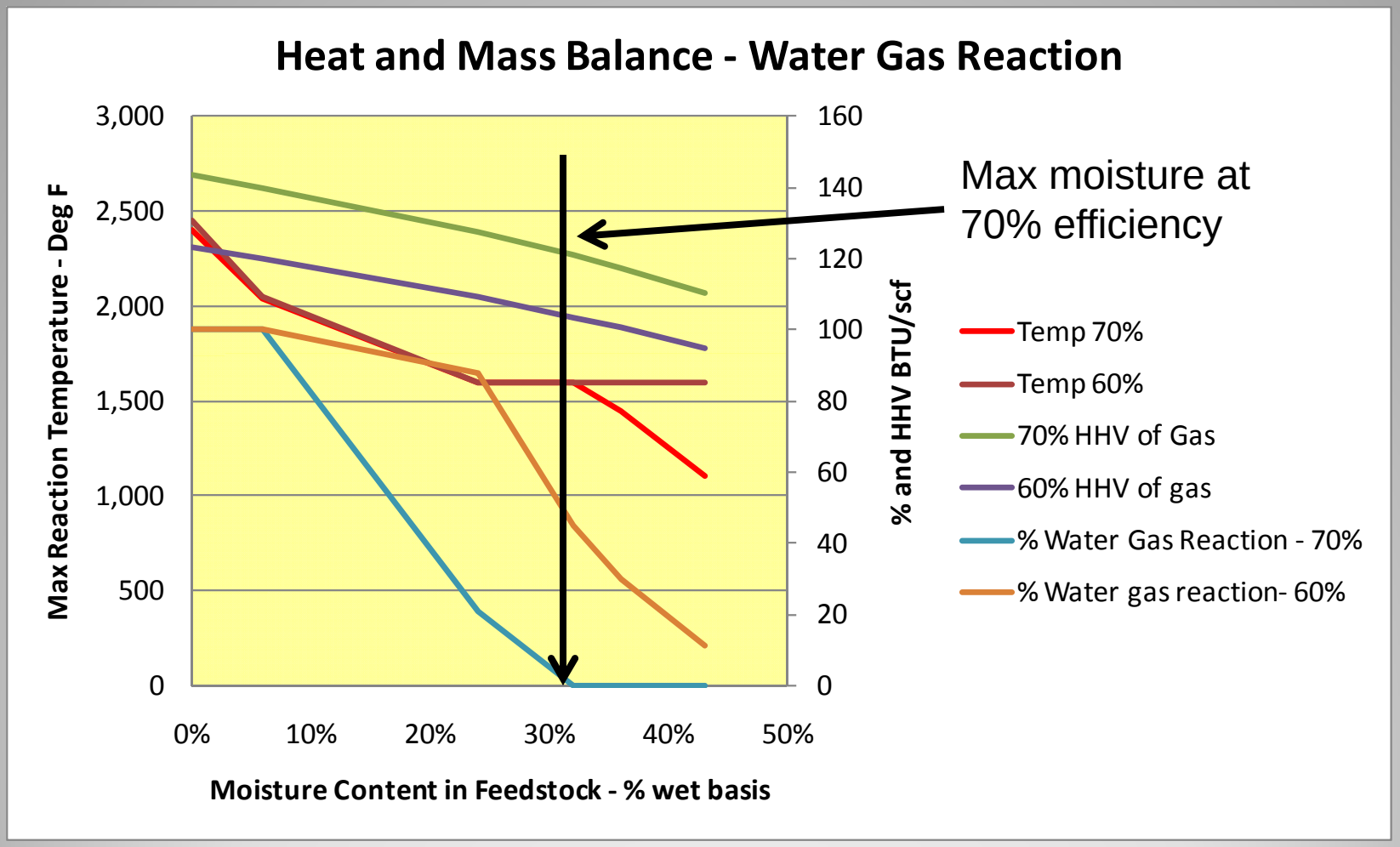
Gasifier Heat and Mass Balance



Heat Management Frees Thermal Energy for Moisture



Temperature can be Maintained with Heat Management



Maximum Moisture Possible

- Feedstocks can be mechanically pressed to reduce the moisture within the acceptable range without drying.
- Design gasifier to operate at the highest thermal efficiency to maximize gas heating value.
- Possible to gasify wastes with moistures up to 30%, at maximum efficiency, with high reaction temps, and with minimal tar.

Summary