

Technoeconomic and Life Cycle Assessment of H2STAR Technology – A Novel Hydrogen Technology from Waste Materials

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TC Biomass Conference, April 21, 2022

fast, simple,
safe, and
better for the
environment





Who we are

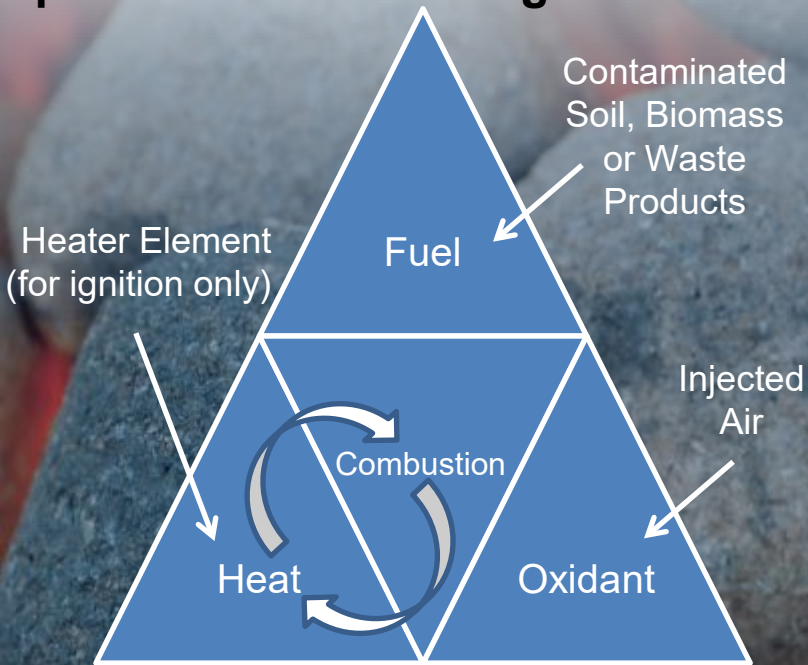


**Savron is a multi-national provider
of applied smoldering solutions
focused on sustainability and
energy transition**



Smoldering Combustion

STAR and STARx are based on the process of smoldering combustion:

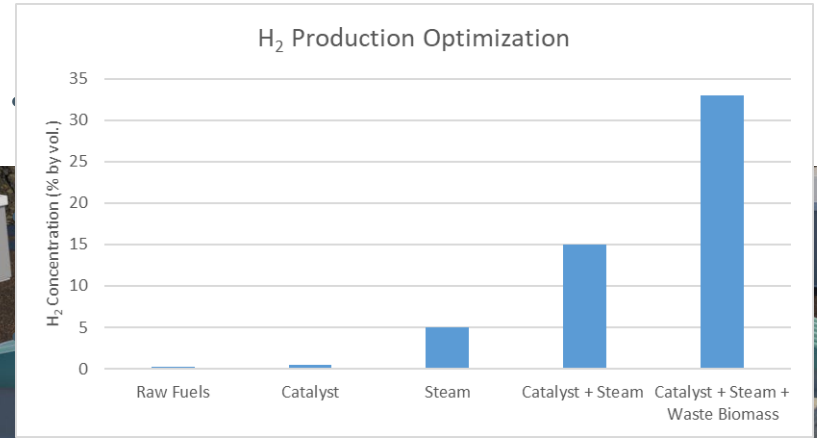
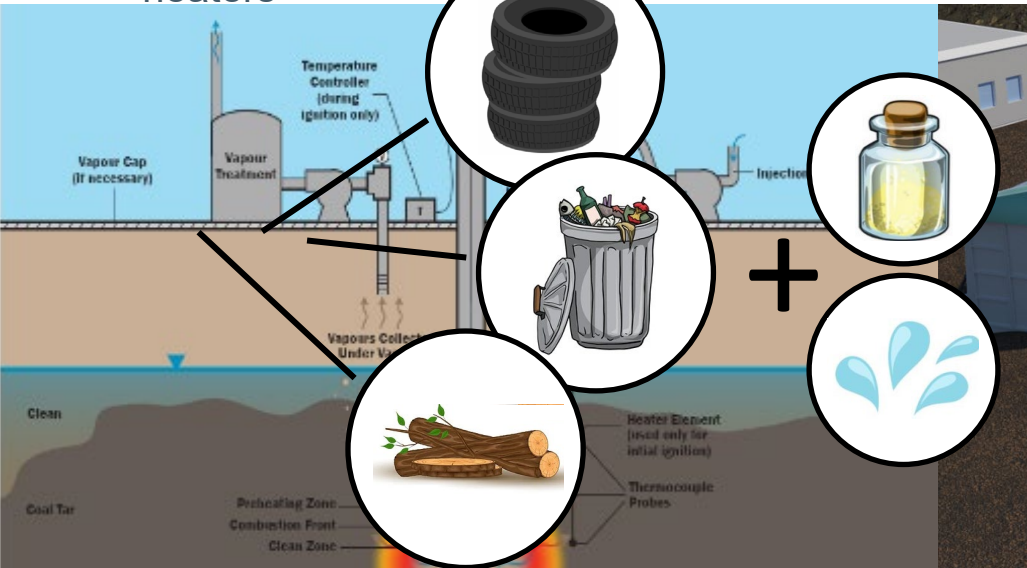


STAR / STARx is a flameless combustion process: only smoldering is possible within a porous matrix (i.e., soil, biomass)

Modes of Application

STAR_x

- In situ (below ground)
- Applied via wells in portable in-well heaters



H₂ STARx completely destroys waste
Balancing combustion (Power) and gasification (Production) to efficiently generate large quantities of H₂

H2STAR Plant Capacity

1,000m³ **H2STAR Plant**
(comparable to mid-scale gasifier*)

10-13 MW

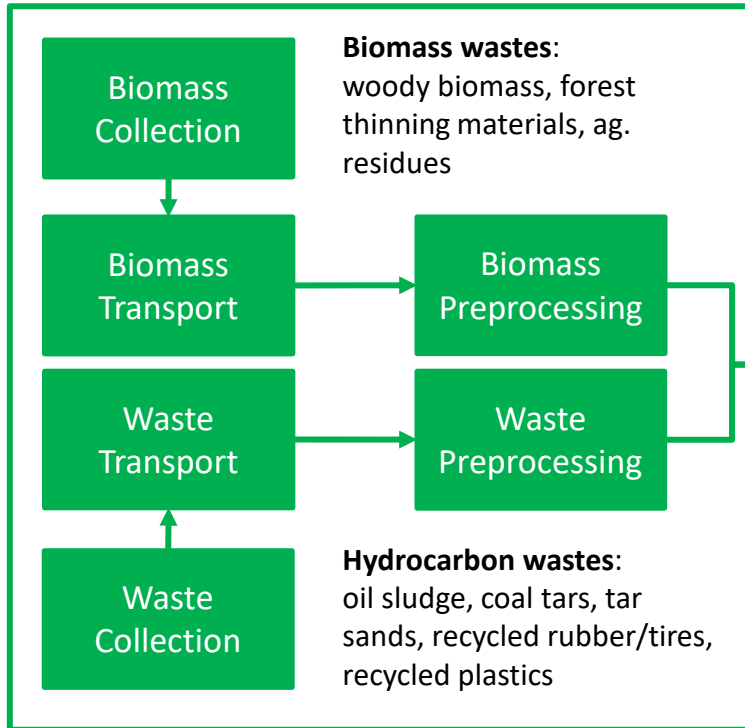
30-35k
tonne/yr
feedstock

Diverse
feedstock
capability

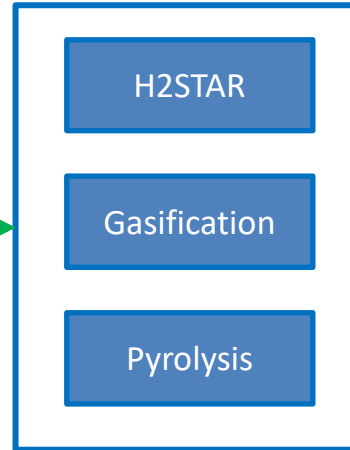
*Jafri, et al., 2020. Emerging Gasification Technologies for Waste and Biomass, IEA Bioenergy Technology Collaboration Programme.

LCA System Diagram

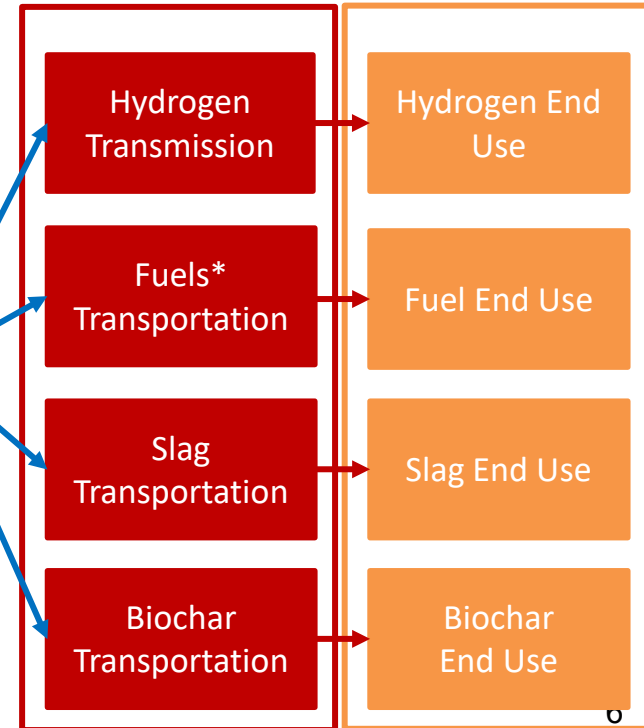
1: Feedstock Collection, Transport and Pre-Processing



2: Conversion Technologies



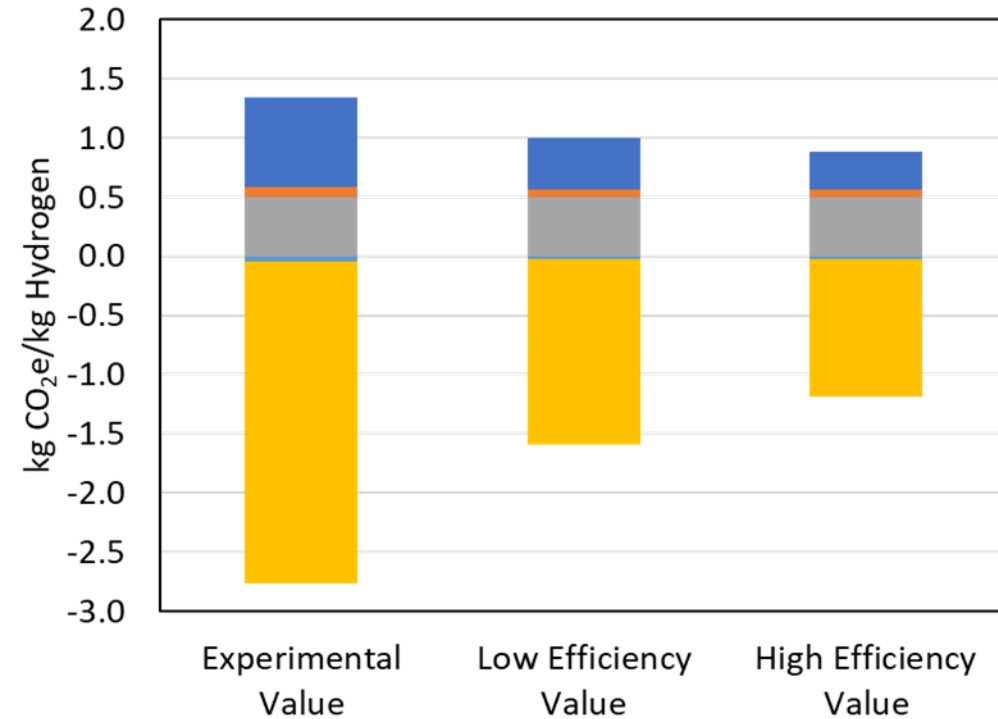
3: Product Transport



Fuels*: gasoline, diesel, LPG

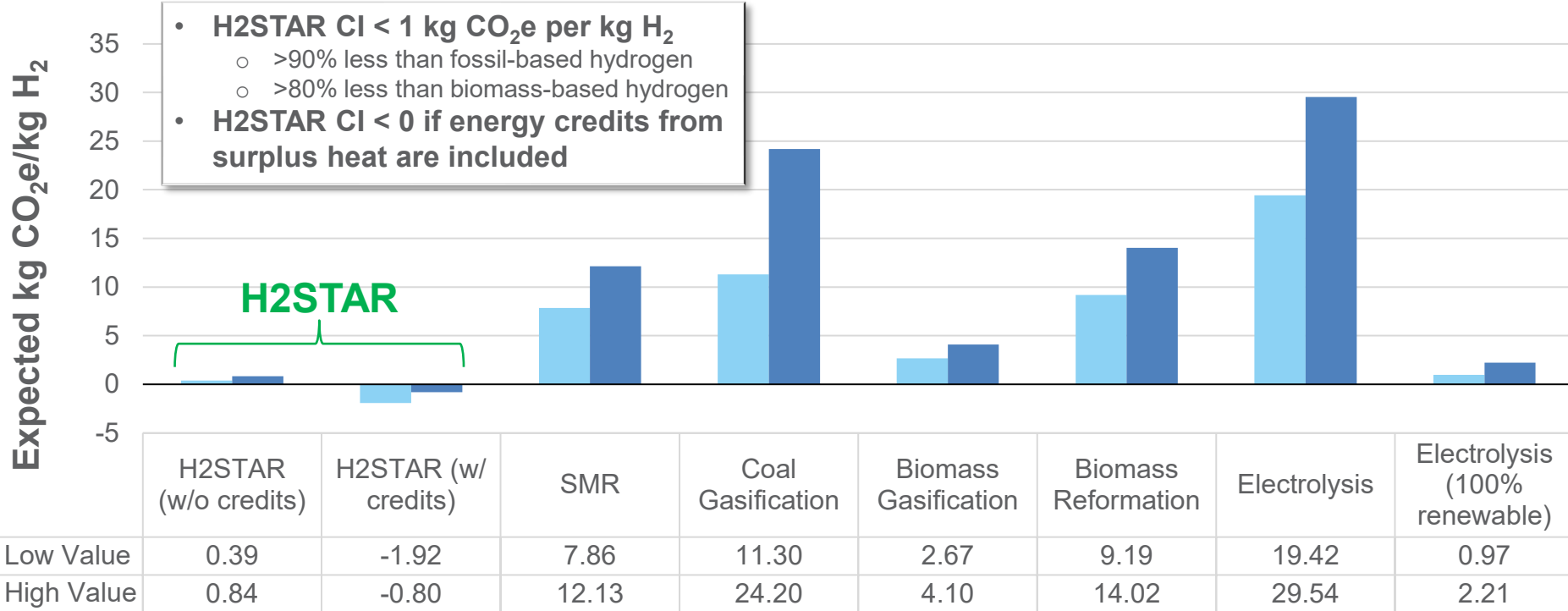
LCA Results and Sensitivity Analysis

H2STAR™ Cradle-To-Grave Carbon Intensity



	Without Credits	With Credits
Experimental CI	1.3	-1.4
Low Efficiency H2STAR CI	1.0	-0.6
High Efficiency H2STAR CI	0.9	-0.3






“Cradle-to-Gate” Carbon Intensity (CI)

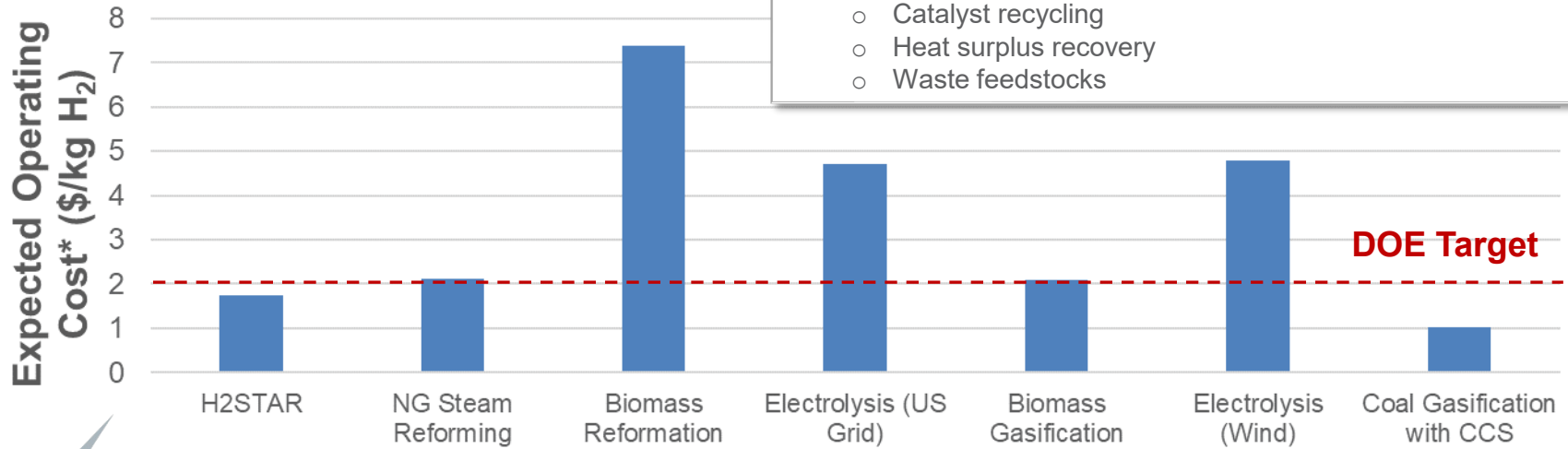


Assumptions:

- Does not include Compression, Storage, Distribution (CSD) or end use of hydrogen
- H2STAR input data based on bench scale experiments

The H2STAR Process

	 BROWN	 GREY	 BLUE	 GREEN	 H2STAR
Feedstock	Coal	Natural Gas	Natural Gas or Coal	Renewable Electricity	Biomass
Process	Gasification	SMR	SMR or Gasification with CCS	Electrolysis	Smoldering Combustion
By-Products	Syngas	Steam	Steam, Syngas	Oxygen	Heat
Carbon Intensity Range¹	High (11.3-24.2)	High (7.9-12.1)	Low (2.7-4.8 kg)	Negligible (1.0-2.2)	Negligible (-1.9-0.8)

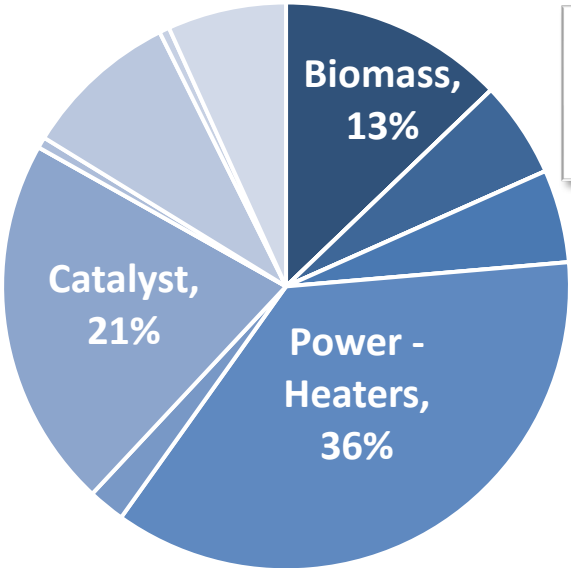


- H2STAR operating costs less than DOE production target of \$2.00/kg H₂
- Future investment can reduce H2STAR costs:
 - Catalyst recycling
 - Heat surplus recovery
 - Waste feedstocks

Assumptions:

- Cost scaled to 2021 accounting for inflation
- Excludes CAPEX and Compression, Storage, Distribution (CSD)
- Biomass feedstock included as a cost (NOT a waste stream); dehydration NOT required for H2STAR
- NO catalyst recycling or heat recovery assumed

Current Cost Distribution

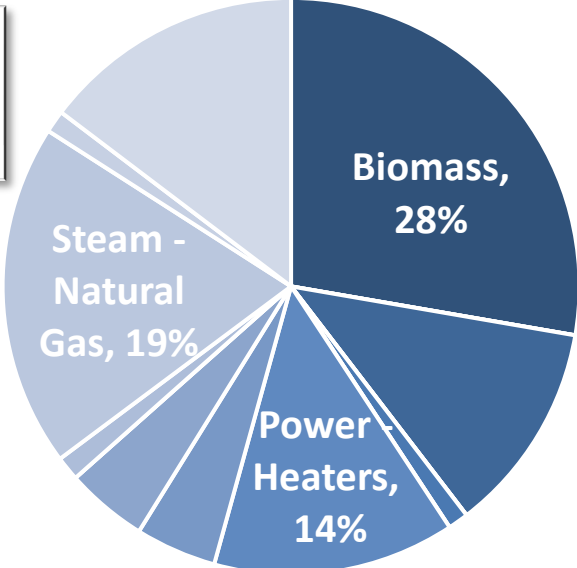


Current Operating Cost:
\$1.74/kg H₂

- **Future investment:**
 - 90% catalyst recycling
 - 80% efficient recovery of surplus heat



Target Cost Distribution

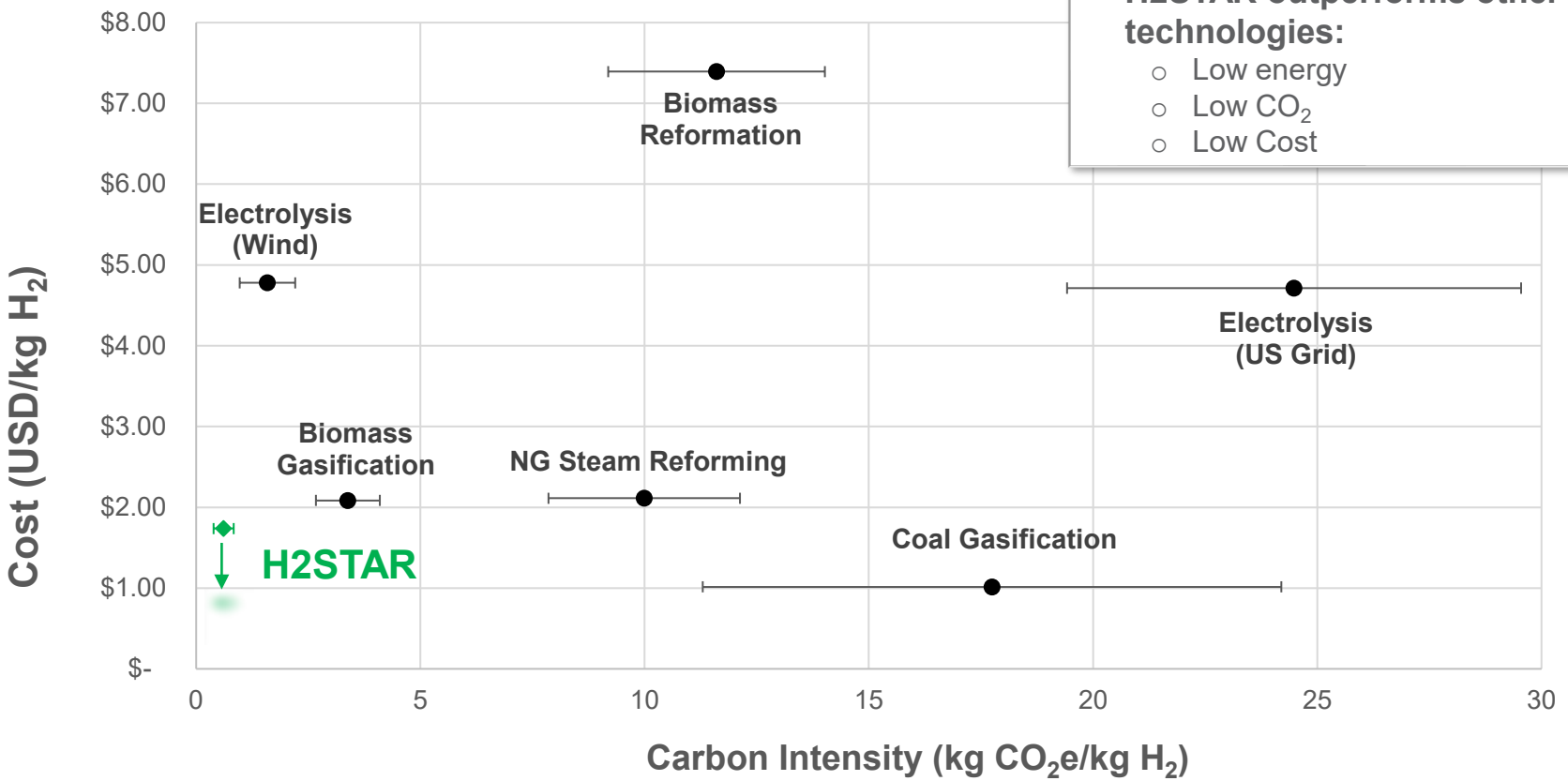


Target Operating Cost:
\$0.80/kg H₂



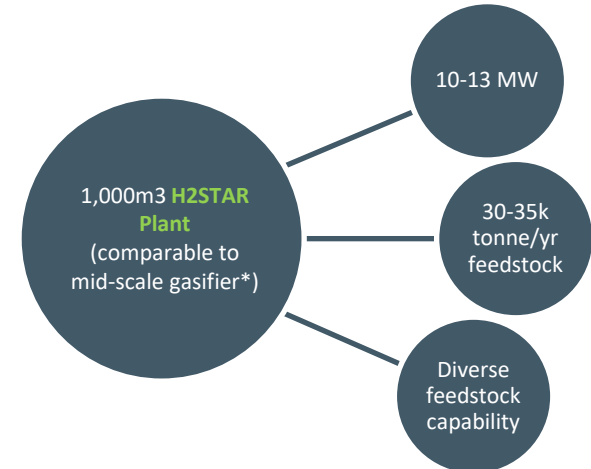
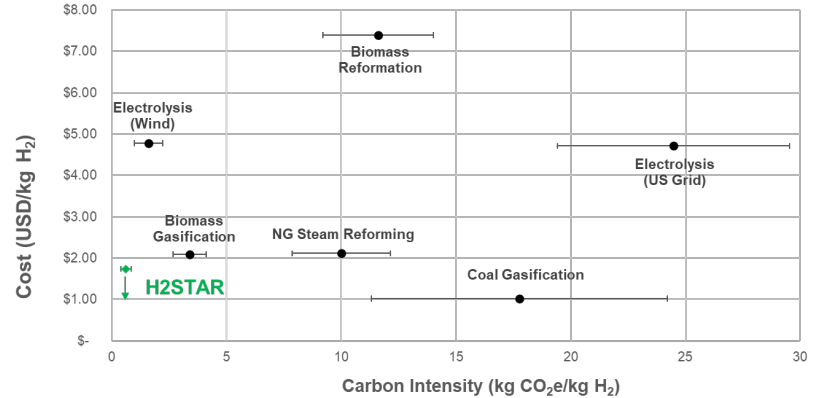
Cost vs. Carbon Intensity

- H2STAR outperforms other technologies:
 - Low energy
 - Low CO₂
 - Low Cost



H2STAR Conclusions

- **H2STAR™** is can produce **high yields of hydrogen** from biomass and other challenging feedstocks
- Carbon Intensity of **H2STAR™** process is extremely low and **comparable to green hydrogen**
- Operating cost is **lower than DOE's \$2.00/kg H₂ target** with ability to be under \$1.00/kg H₂
- **H2STAR™** is a simple, low-energy, low-carbon technique for generating **Sustainable Hydrogen via smoldering combustion**



H2STAR Team



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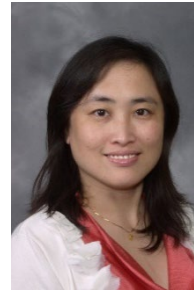
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