TRANSFORM MATERIALS

Breakthrough Technology – Carbon-Negative Hydrogen from Methane

Hydrogen and Mines Virtual Summit Australia

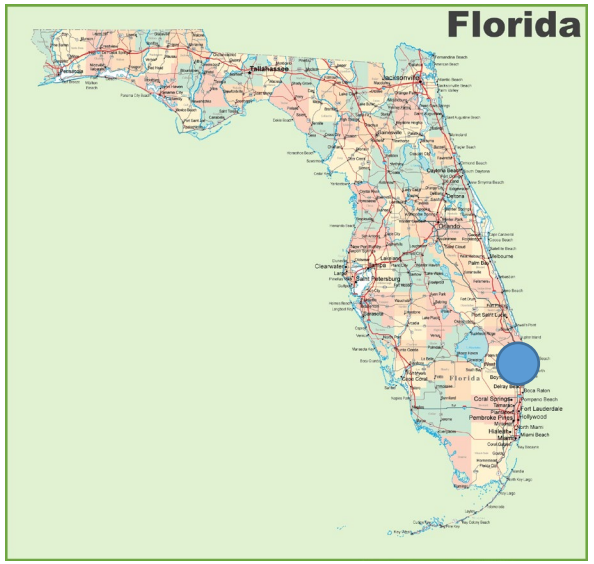
October 6-7, 2020

Outline

- Introduction – David Soane - Founder and CEO
- Technology Overview – Nathan Ashcraft - VP R&D
- Transform Value Proposition – Jeff Mason – COO
- Summary – David Soane

Transform Introduction

- Formed in 2014, Florida USA
- Founded and led by seasoned entrepreneur David Soane, PhD
- Technology developed to utilize abundant natural gas to produce hydrogen while capturing carbon in valuable end-products



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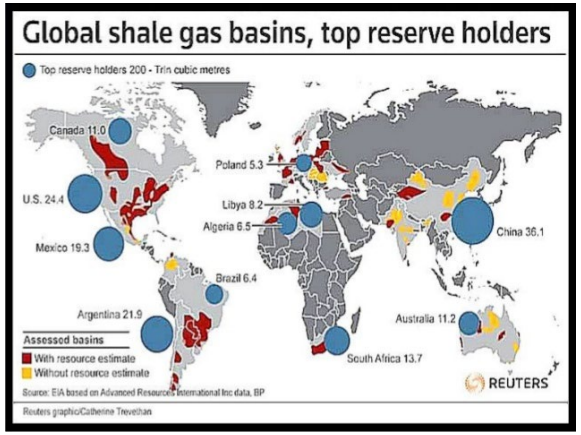
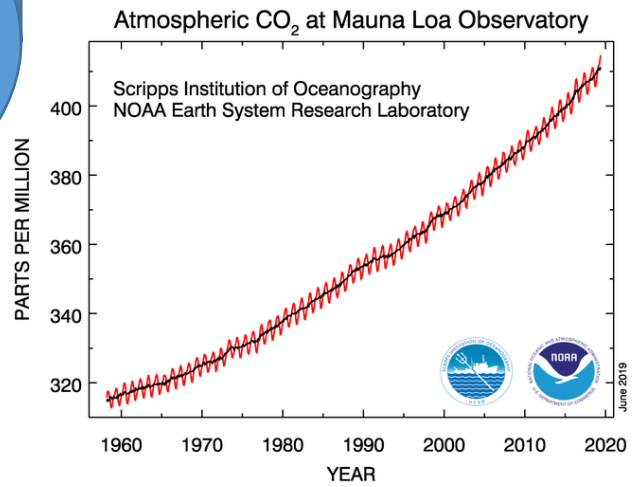
Our Mission: Sustainable Methane Utilization

Abundant global natural gas from shale formations, in addition to waste gas utilization opportunities



Significant amounts of flared gas, generating waste heat and emitting GHG

Transform's Technology Rapidly Converts Methane to Hydrogen plus High-Value, Zero-GHG Chemicals/Materials



Climate change is accelerating due to increasing GHG (here, CO_2) in the atmosphere

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Transform's Plasma-Conversion Technology

- Transform uses plasma, an energetic, ionized, gas-like state of matter, to convert natural gas into acetylene and hydrogen without oxidation
- Sub-ambient pressure assures safety
- Process allows rapid startup/shutdown to match product demand
- In addition to natural gas, coalbed methane, bio-gas, and other similar light hydrocarbon gases (e.g., ethane, propane, or mixtures, etc.) can equally serve as feed for Transform's reactor

Technology Overview

Technology Overview

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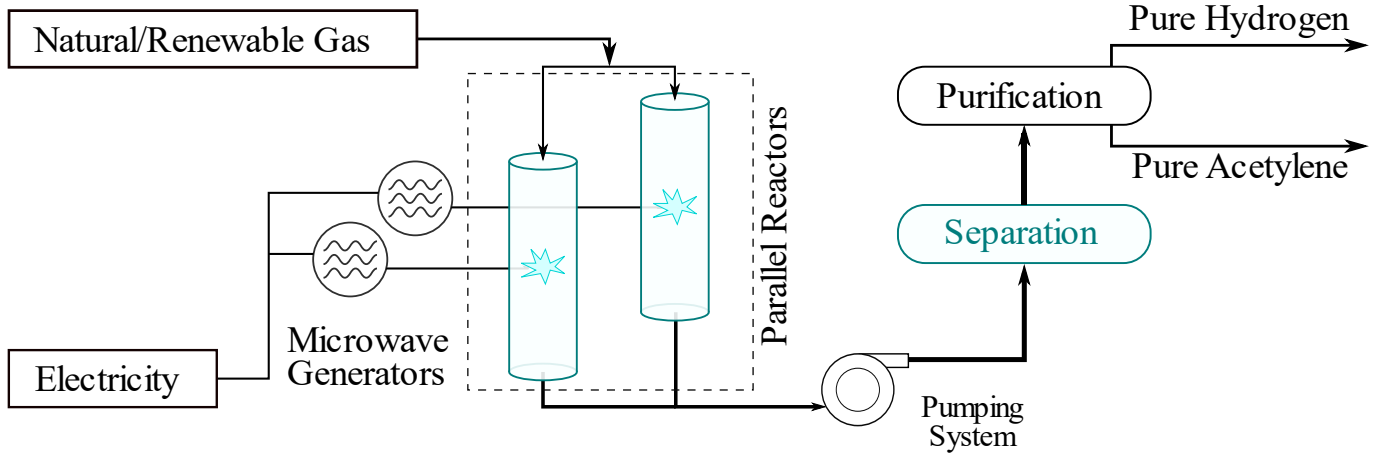
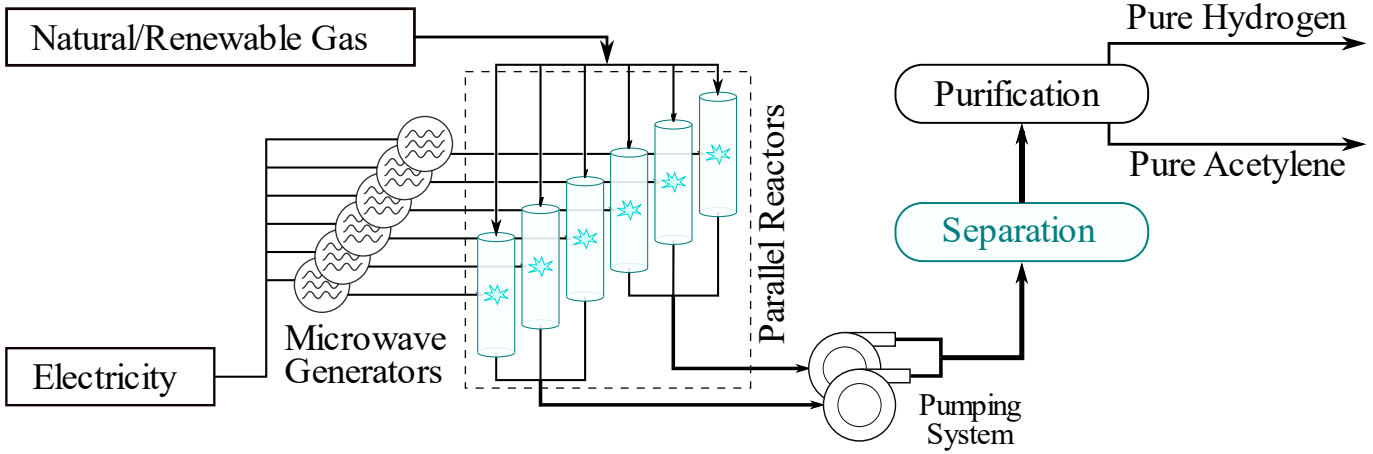
Transform's Process is Modular and Scalable

Pilot Plant



Commercial Plant



Additional volume is achieved by adding more plasma reactors

Note: Equipment in blue is proprietary; all other equipment is industry-standard

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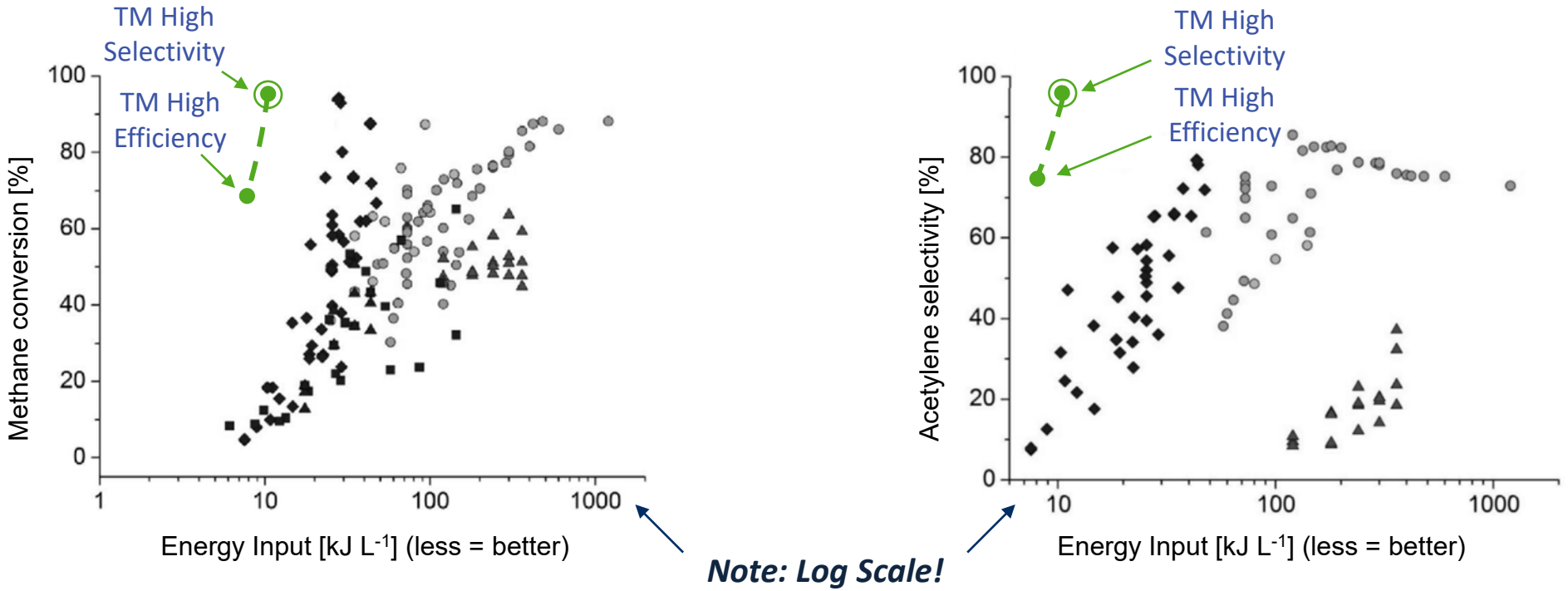
Transform's Technology Breakthrough

- Transform's technology vastly outperforms state-of-the-art competition* in energy efficiency, methane conversion, and acetylene/hydrogen selectivity



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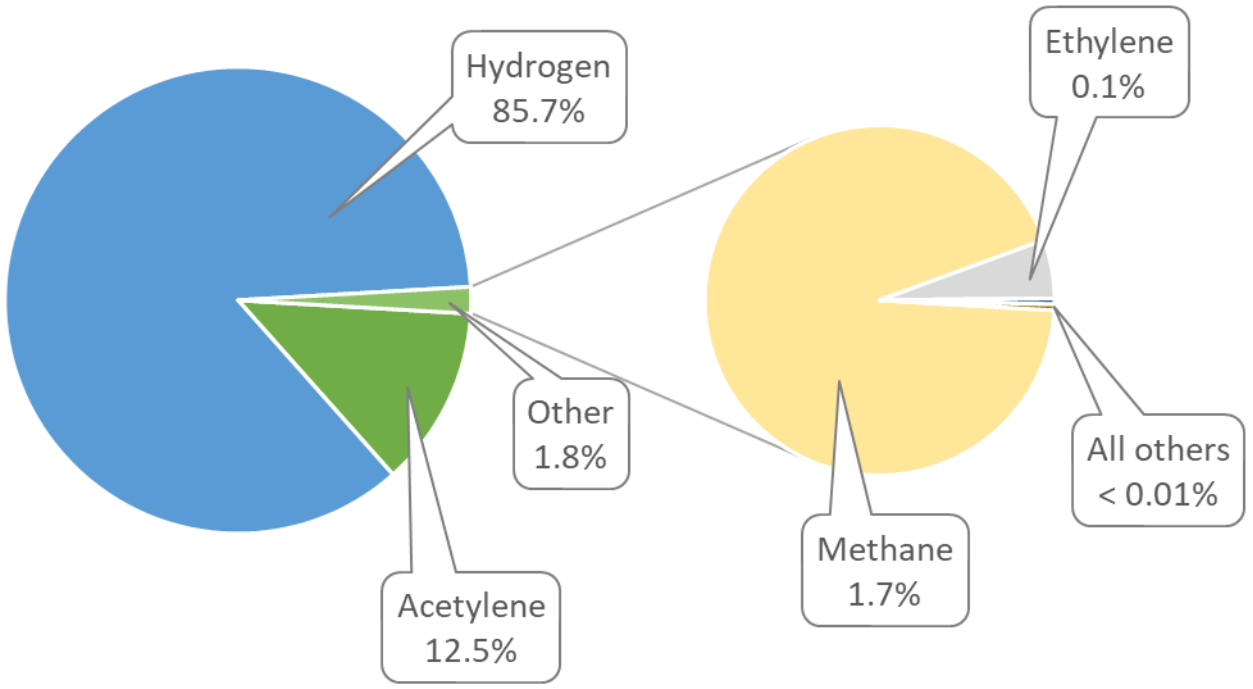
* M. Scapinello, E. Delikonstantis, G. D. Stefanidis, The panorama of plasma-assisted non-oxidative methane reforming, Chemical Engineering and Processing: Process Intensification 117 (2017) 120-140

Reactor Effluent: High Conversion & Selectivity

- >95% single pass conversion, highly selective for acetylene and hydrogen
- System is tuned to produce maximal yields at high energy efficiency
- Minimal byproduct impurities are easily removed by our proprietary separation process

Reactor Effluent Composition (vol %)



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Dual Reactor Pilot System

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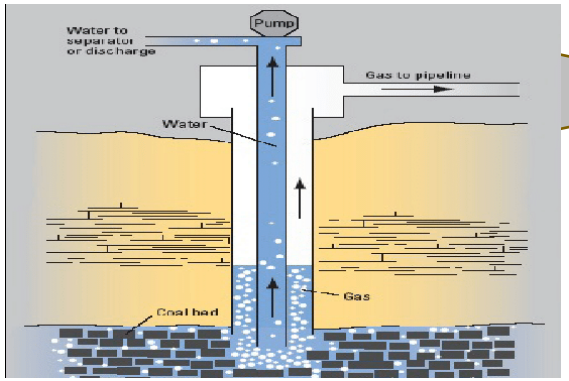
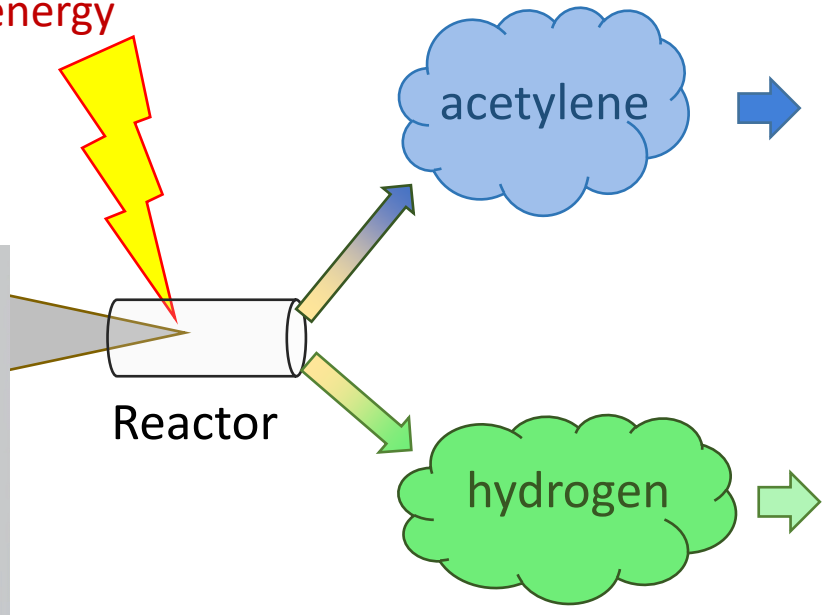
Transform Value Creation

Mining Value Creation with Transform Technology



Coalbed methane

Microwave energy



Acetylene black

Acetylene for PVC, Poly-lactic acid, etc.

Fuel cell operated mining equipment

Hydrogen distribution

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Transform vs Electrolysis Hydrogen Production

Performance Data	Transform	Electrolysis
Hydrogen Source	Methane	Water
wt. % Hydrogen in source	25%	11%
Energy input, kWh/kg H_2	37*	60
Co-products	Acetylene / Acetylene Black	Oxygen
Co-product value	High	Low
H_2 cost per kg	Lowest including co-product credit	High

Transform requires ~40% lower energy requirement, and produces valuable co-products

*Transform process from methane to hydrogen plus carbon black

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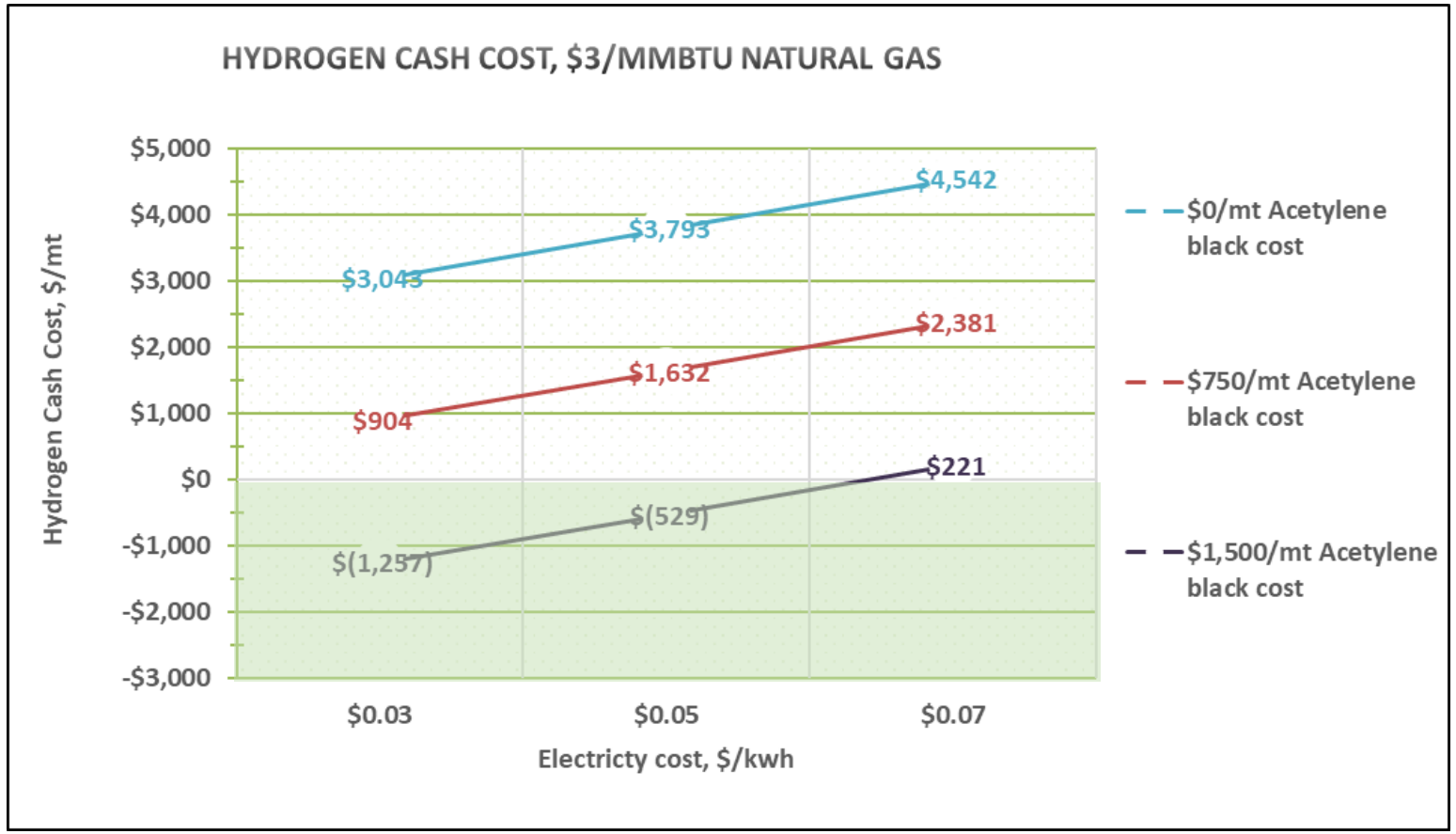
Transform Hydrogen Cost Example

Hydrogen plus Acetylene Black Process



- Hydrogen cash cost at various acetylene black and electricity cost assumptions
- Cash cost includes natural gas, electricity, utilities, labor, and maintenance.
- Example shown for plant size:
  - 2,670 mt/y hydrogen
  - 8,300 mt/y acetylene black

Valuable Acetylene Black Subsidizes Hydrogen Cost to Below 0!
Note that market price for acetylene black is $3000+/mt

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Summary

- Pioneering platform technology that exploits robust microwave hardware in conjunction with significant process innovation to produce sustainable hydrogen and acetylene (acetylene black) at high efficiency, high purity, and low cost
- Technology vigorously vetted via systematic progression from bench-top experiments, to proof-of-concept scale-up, to fully-integrated pilot and finally to the current demo-scale installation
- With green electricity, Transform creates sustainable hydrogen for clean energy, while removing carbon from the emission source by chemically locking it in high-value co-product acetylene (used for downstream synthesis of high-value, high-volume polymers or directly into high-conductivity acetylene black)
- Visit our website: www.transformmaterials.com for more information