



IDEA2021

Powering the Future: District Energy/CHP/Microgrids
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Green Energy Burning Blue





Problem: Keep Downtown Fairbanks, Alaska Safe

Details

- Fairbanks has a long, cold winter
 - Average winter low temperature: -15°F to -25°F
 - School recess is cancelled below -20°F
 - Snow and ice for up to 9 months/year
- Downtown walkways are kept ice-free by a district heating system powered by coal-fired boilers
- EPA PM2.5 Nonattainment Status –“Serious”

Solution: Use the patented Dynamic Combustion Chamber (DCC™) hydrogen boilers to replace coal-fired boilers - as part of a comprehensive approach to their pollution problem

Goal:

- Contribute to carbon, particulate and Green House Gas emissions reduction to meet EPA guidelines without having to discontinue district heating
- Provide same quality and quantity of steam currently used
- Use existing steam distribution infrastructure, if possible
- Integrate solution into existing facilities
- Provide Process and Balance of Plant recommendations

Solution continued:

Work Performed:

- Developed conceptual process design
- Performed preliminary engineering on coal fired boiler replacement with DCC™
 - Size and capacity adequate to meet goal
- Performed very preliminary CapEx cost calculations for Electrolyzer and DCC™

cleanH₂steam

Dynamic Combustion Chamber



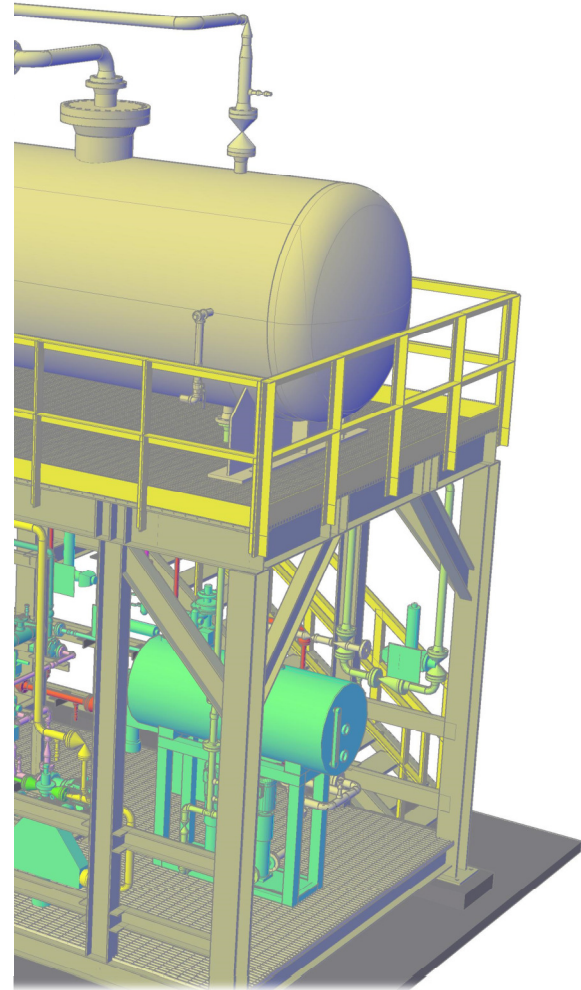
Green burning Blue – Facts about Hydrogen

- Hydrogen and oxygen react with an explosive release of energy to create water
- Hydrogen and Oxygen do not react with each other at room temperature
- Requires spark to start chemical reaction – low activation energy
- Highly exothermic chain reaction
- Hydrogen and Oxygen react across the emissions spectrum with primary release in the UV range



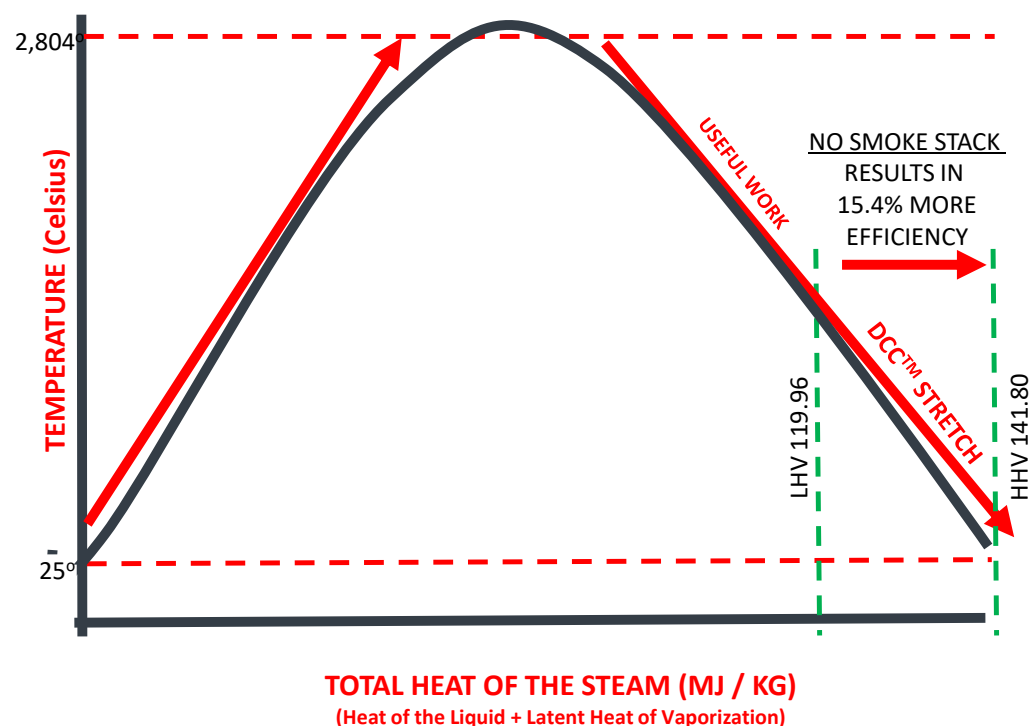
About the cleanH2steam DCC™

- Patented and patent pending technology
- Tube-fired steam condensing design
- Produces energy in the UV range
- No introduction of air – no opportunity to emit GHG
- No exhaust stack - >95% efficient
- Designed to US, UK and EU standards



Chemical Reaction Solution

- **cleanH2steam DCC™** boiler is HTI's proprietary hydrogen-based boiler
- The scalable process is based on combining pure hydrogen and pure oxygen to form water molecules – this reaction releases 61,000 BTUs (heat index) per pound of hydrogen
- Pure hydrogen and pure oxygen combine (in the presence of a spark) which exothermically converts back to water (think: steam) in a high-temperature reaction, creating a mild vacuum owing to the condensing characteristic of the chemical reaction
- The chemical reaction fully captures the total heat of steam, allowing for the greatest amount of heat retained in the combustion reaction of hydrogen and oxygen (**GRAPH => "DCC™ Stretch"**)
- The boiler system has been specifically designed based on the chemical reaction to function as a closed-loop system, eliminating all need for typical combustion exhaust
- Its extraordinary simplicity allows us to fundamentally rethink hydrogen boilers



Non-Pressure Vessel

Heat Generation for Space Heat and Hot Water Applications

Commercial

- Shopping malls
- Universities and institutions
- Airports and hotels
- Stadiums and venue halls
- Hospitals and government buildings

Pressure Vessel

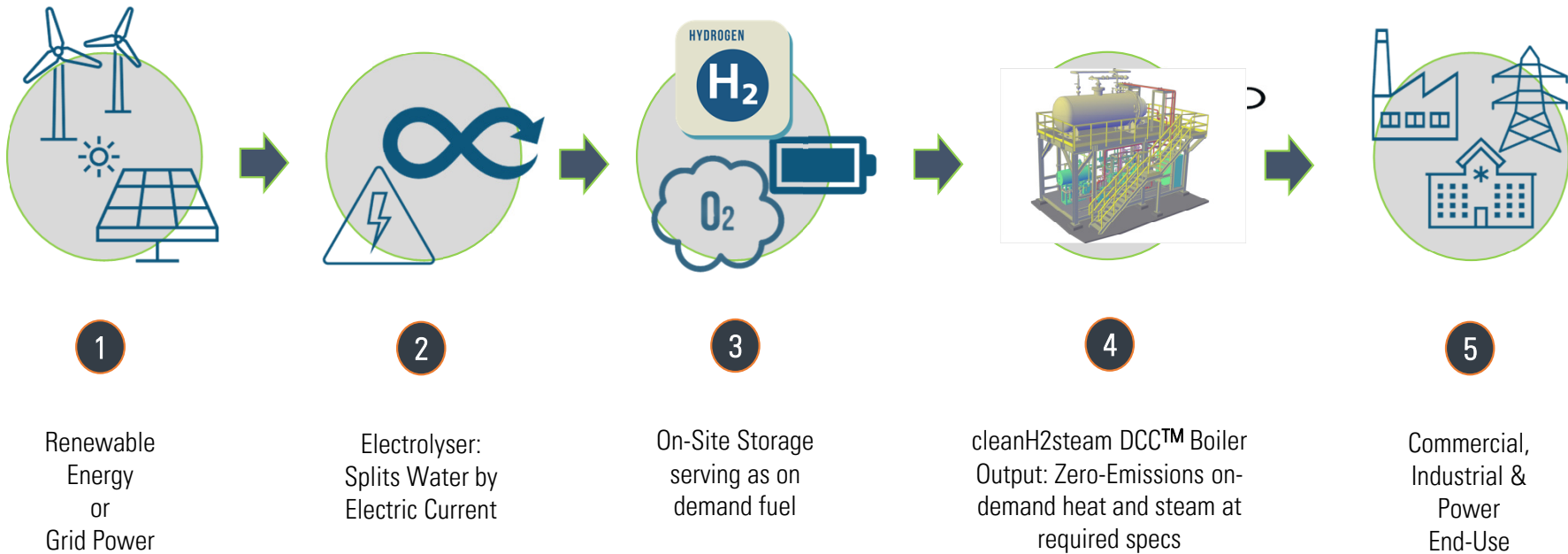
Generate Steam for Industrial Processes

Generate Steam for Combined Heat & Power ("CHP") Applications

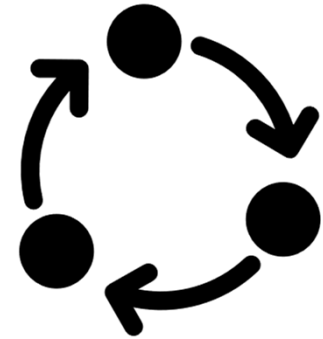
Industrial

- Refining and petrochemical
- Pulp and paper
- Chemical and pharmaceutical
- Food Processing
- Refrigeration
- Metals and mining
- Composite and carbon fiber
- Utility Power Generation
- Energy Storage
- On-site distributed energy
- Universities and institutions
- Building HVAC
- Data Centers

Conceptual Process Overview



- Focus on a Total Process Solution
 - Customers often want a holistic approach to their problem solution – both at a process level and at a system level
 - Refocus effort to building a team of technology partners to address the problem comprehensively.
- Advocate for policy support for hydrogen technologies and early adoption
 - Europe, Australia, Canada, and California have created incentive structures that have accelerated the adoption of clean energy transition technologies.



Q&A



Thank You!

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Additional Information

