Van Ness Feldman LLP

Carbon Intensity of Hydrogen

Enabling an Accelerated and Affordable Clean Hydrogen Future

DOE-GTI Virtual Workshop

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Carbon Utilization Research Council (CURC)

Equipment Suppliers
General Electric
Mitsubishi Heavy Industries America, Inc. (MHIA)

Labor Unions
International Brotherhood of Boilermakers
International Brotherhood of Electrical Workers

Producers
Consol Energy
Lignite Energy Council
Occidental Petroleum
Peabody Energy

Technology Developers
Bloom Energy
Bright Energy
ION Engineering
Jupiter Oxygen Corporation
NET Power

Research Organizations
Battelle
Electric Power Research Institute (EPRI)
Gas Technology Institute
University of North Dakota Energy & Environmental Research Center

State Organizations
Kansas State Geological Survey
Southern States Energy Board
Wyoming Infrastructure Authority

Trade Associations
American Coal Council
American Coalition for Clean Coal Electricity (ACCCE)
Edison Electric Institute (EEI)
National Rural Electric Cooperative Association (NRECA)

NGOs
ClearPath Action
EnergyBlue Project

Universities
Lehigh University
Ohio State University
Pennsylvania State University
Southern Illinois University
University of Illinois/PRI
University of Kentucky/CAER
University of Texas – Austin
University of Wyoming
West Virginia University

Utilities
Basin Electric Power Cooperative
Duke Energy Services
Minnkota Power Cooperative
Nebraska Public Power District
Southern Company
Tri-State Generation & Transmission Association

Orange = Steering Committee Members

CURC CARBON UTILIZATION RESEARCH COUNCIL
ADVANCING FOSSIL ENERGY SOLUTIONS

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ADVANCING FOSSIL ENERGY SOLUTIONS

UNIQUE MISSION

With a global focus on reducing emissions from fossil fuel utilization, CURC's nonpartisan, technology-driven mission ensures the long-term value of fossil energy resources in an increasingly carbon-constrained world.

CONSENSUS DRIVEN & TECHNICALLY INFORMED

CURC brings technology developers and end users together. Our recommendations represent the consensus of our membership, including cutting-edge technical experts from a diverse set of interests in power generation.

SKILLED FACILITATORS

CURC is an established facilitator and trusted authority on advanced fossil energy technologies. We maintain productive working relationships with Members of Congress and the Department of Energy, and these entities turn to CURC for the most recent, fact-driven expertise and recommendations on federal policies affecting technology.

PIONEERING RESEARCH & GLOBAL COLLABORATION

CURC collaborates with world-class U.S. and international research organizations, and has been a driving force behind the crafting and passage of federal legislation, creating financial incentives for fossil fuel technology development and Funding for research programs at the U.S. Department of Energy.

CURC.NET

Clean Hydrogen Future Coalition

174 Power Global
American Gas Association
American Public Gas Association
Bayotech
bp
California Fuel Cell Partnership
Chevron
ClearPath Action
Duke Energy
EN Engineering
Energy Infrastructure Council
Engie
Gas Technology Institute
GE Gas Power
Int'l Brotherhood of Boilermakers
Int'l Brotherhood of Electrical Workers
INGAA
LanzaTech
Linde
Nikola
North America's Building Trades Union
North Slope Borough
Nuclear Energy Institute
ONE Gas
Sempra Energy
Siemens Energy
Southern Company
Tennessee Valley Authority
U. of Wyoming School of Energy Resources
UND Energy & Environmental Research Center
Voice of the Arctic Inupiat
Wabash Valley Resources
Williams Companies

CHFC Foundational Principles

(1) Clean hydrogen is a critical pathway to achieve U.S. decarbonization objectives.

(2) Investments in the full value chain of clean hydrogen production, transport and delivery, storage and use, as well as the infrastructure across multiple sectors, will be necessary to scale clean hydrogen in the U.S.

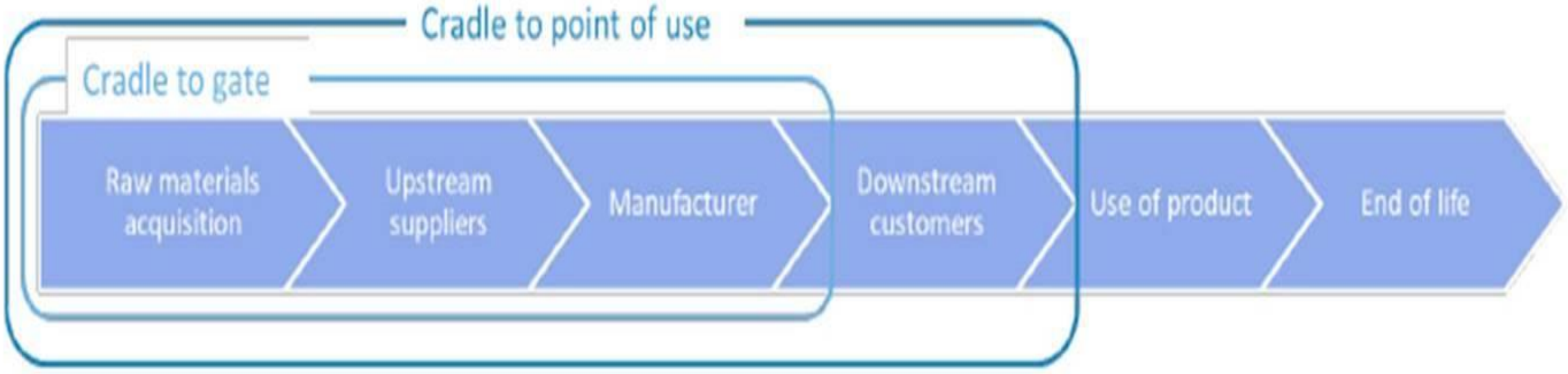
(3) Policies designed to stimulate clean hydrogen production and use throughout the U.S. economy should be fuel agnostic and technology neutral, and focus on the carbon intensity of CO_2 hydrogen production method.

(4) Skilled labor and the use of existing infrastructure are essential to the deployment of clean hydrogen throughout our economy.

Carbon Intensity of Hydrogen

- What is the baseline – Steam Methane Reforming?
- What will be the acceptable low carbon intensity for hydrogen produced from fossil fuels?
  - Tax legislation starting at 40%-50% GHG reduction from SMR
  - RD&D legislation starting with a carbon intensity of 2 kg/CO2 per kg/H2
- What are the boundaries for calculating carbon intensity?
- What methodology is being used in other countries?

Boundary Considerations



- Upstream including raw materials input to point of production
- Upstream to point of end use
- Upstream to use of product

Existing U.S. Carbon Intensity Framework – Clean Air Act Renewable Fuel Standard

- The term “lifecycle greenhouse gas emissions” means the aggregate quantity of greenhouse gas emissions (including direct emissions and significant indirect emissions such as significant emissions from land use changes), as determined by the Administrator, related to the full fuel lifecycle, including all stages of fuel and feedstock production and distribution, from feedstock generation or extraction through the distribution and delivery and use of the finished fuel to the ultimate consumer, where the mass values for all greenhouse gases are adjusted to account for their relative global warming potential.

Key Upstream Issues for Hydrogen Production

- Water acquisition and transport
- Natural gas (or other fossil fuel) production and transport
- Biomass production and transport
- Production of raw materials for solar panels, wind turbines, nuclear materials, electrolyzers
- Manufacture of solar panels, wind turbines, nuclear components, and electrolyzers, and transport to point of production
- Renewable energy credits considered an “offset”?
- CO_2 sequestered in accordance with 45Q be subtracted from process emissions?

Key Downstream Issues for Hydrogen Production

- Liquefaction and compression – should this be point of production or downstream?
- Delivery methods to point of end use:
  - Trucking
  - Pipeline
  - Rail
- End use emissions?
  - GHG emissions of hydrogen are being evaluated by ENGOs and deemed to have some lifetime emission associated with it

Carbon Intensity of Fossil with CCS

- Legislation pending in Congress for hydrogen production tax credit requires use of the CAA RFS to determine the carbon intensity of the hydrogen, and ties the GHG reduction to the value of the tax credit.
- The tax credit is valued at $3.00 per kg of clean hydrogen and pro-rated for percentage reduction of GHGs from steam methane reforming without capture.

Lifecycle GHG Emission	PTC $Value per kg (% of credit)	ITC % Value (% of credit)
95 - 100%	$3.00 (100%)	30% (100%)
85 – 95%	$1.02 (34%)	10.2% (34%)
75 – 85 %	$0.75 (25%)	7.5% (25%)
50 - 75%	$0.60 (20%)	6% (20%)

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Questions . . .

Contact information

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