Technology Acceleration Overview

Jesse Adams, HFTO - Technology Acceleration Program Manager

2022 Annual Merit Review and Peer Evaluation Meeting

June 6, 2022 – Washington, DC
Technology Acceleration Subprogram Overview

Technology Acceleration

- R&D
  - HYDROGEN TECHNOLOGIES
  - FUEL CELL TECHNOLOGIES

- Systems Analysis
  - IDENTIFY NEW MARKET OPPORTUNITIES

- Demonstrate Hydrogen Systems
- TECHNOLOGY VALIDATION
- SYSTEM DEVELOPMENT & INTEGRATION
- COMMERCIAL READINESS ASSESSMENT

Inform and Guide R&D and Analysis

End Uses

- CHEMICALS & INDUSTRIAL PROCESSES
- INTEGRATED CLEAN ENERGY SYSTEMS
- TRANSPORTATION

Enabling Activities

- MANUFACTURING
- SAFETY, CODES & STANDARDS
- WORKFORCE DEVELOPMENT
Current Focus Areas

- **Grid Energy Storage & Power Generation** including hybrid approaches
- **Chemical and industrial Processes** integrating H₂ technologies focusing on decarbonization
- **Transportation** and H₂ fueling demonstrations
- **Enabling Activities:** manufacturing, safety codes & standards, and workforce development

**Demonstrate** H₂ & fuel cell integration to accelerate market adoption and reduce GHG emissions **to enable** H₂@Scale vision

**HFTO Technology Acceleration** (TRL ~4-6) serves as **proving grounds for future** OCED H₂Hub deployments (TRL ~6-8+)
Hydrogen Safety: An Overarching Priority

Enabling the safe deployment of hydrogen and fuel cell technologies

Codes & Standards

• **Goal:** Support and facilitate development and revision of essential codes and standards to enable widespread deployment of hydrogen and fuel cell technologies

• **Approach:** Conduct RD&D to provide scientific basis needed to define requirements in developing and revising codes and standards

Safety

• **Goal:** Identify and develop best safety practices for hydrogen and fuel cell deployments

• **Approach:** Develop and enable widespread sharing of safety-related information resources and lessons learned with key stakeholders; Conduct workforce development activities with an emphasis on safety practices and culture
Technology Acceleration (System Development & Integration)

Tech Acceleration Funding:

- Grid Energy Storage & Power Generation
  - Wind to H₂ microgrids
- Transportation
  - SuperTruck III & HD fueling
- Chemical & Industrial Processes
  - Steel & Ammonia
- Enabling Activities (Manufacturing)
  - Continue QA/QC work, BOP standardization & Increase Supply Chain
- Enabling Activities (Safety, Codes & Standards)
  - Focus beyond vehicles (e.g., bulk storage) & Sensors

Program Direction

FY21 Appropriations: $51 million
FY22 Appropriations: $63.5 million

FY23 Request: $87 million
Clean H₂Hubs**: $8 billion over 5 years

*Includes $10M to fulfill congressional language requirement in coordination with AMO

**Through OCED, in collab with HFTO and all H₂ programs
Technology Acceleration: Grid Energy Storage & Power Generation
Enabling & Demonstrating Integrated Hydrogen Energy Systems

NREL – Advanced Research on Integrated Energy Systems (ARIES) (TA048)

Key Accomplishments:
- Overall site design & safety reviews complete
- Hybrid Controller developed to enable integration with Controllable Grid Interface (CGI), ARIES platform and virtual emulation environment
- All key pieces of equipment delivered or pending delivery
- Systems integration in progress

Goals:
- Integrate 1.25MW PEM electrolyzer, 600 kg H2 storage & 1MW fuel cell
- Provide test bed to demonstrate system integration, grid services, energy storage, direct renewable H2 production & end uses

2021 H2@Scale CRADA Call supporting ARIES

Projects selected under H2@ARIES Lab Call – Integrated Hydrogen Energy System Testing/Validation:
- NREL, GE Renewable Energy, Nel Hydrogen: Optimal wind turbine design for H2 production (TA061)
- NREL, SoCalGas, University of California Irvine: Validation of interconnection & interoperability of grid-forming inverters sourced by H2 technologies in view of 100% renewable microgrids (TA062)
- NREL, GKN Powder Metallurgy, SoCalGas: Metal hydride bulk (520 kg H2) storage system coupled with electrolysis and fuel cell systems (TA063)
- NREL, EPRI: Optimize H2 production via PEM electrolysis with grid integration and variable renewables (TA064)
Technology Acceleration: Grid Energy Storage & Power Generation

Demonstration of H2@Scale: Different Regions, Hydrogen Sources & End Uses

Frontier Energy – Demonstration and Framework for H2@Scale in Texas and Beyond (TA037)

**Goals:**
- Minimize H₂ cost through multiple generation sources
- Co-locate H₂ end uses (stationary power & vehicle fueling)
- 5-year H₂ Plan for Port of Houston

**Key Accomplishments:**
- Site plans/layout & engineering complete
- Began site construction (installation of utilities)
- Major equipment/systems procured (delivery pending in 2022)
- Port of Houston H₂ Framework – conducted workshops & completed preliminary TEA modeling

Caterpillar – Demonstration of H₂ Fuel Cell at a Data Center (poster - TA044)

**Goals:**
- Install 1.5MW stationary fuel cell at a Microsoft data center in Cheyenne, WY
- 48 hours of backup power using LH₂ onsite
- Increase confidence & comfort in H₂ / fuel cells for IT industry (document requirements and identify gaps)

**Key Accomplishments:**
- Completed Techno-Economic Analysis (TEA)
- System and component simulations performed showed power capability similar to diesel gensets for backup power
Technology Acceleration: Grid Energy Storage & Power Generation

Integration of Baseload Nuclear Energy with H₂ Production

**Constellation (formerly Exelon) – Demo of Electrolyzer Operation at the Nine Mile Point Nuclear Plant (TA028)**

**Goals:**
- Install 1.25MW PEM electrolyzer at a nuclear power plant
- Provide low-cost supply of in-house H₂ used for cooling
- Simulate scaled-up operation of a larger electrolyzer in nuclear power markets

**Key Accomplishments:**
- Completed 60% engineering design
- Completed procurement of long lead time items including Nel 1.25MW electrolyzer

**FuelCell Energy – Solid Oxide Electrolysis System Demonstration (TA039)**

**Goals:**
- Integrate high temp. 250kW solid oxide electrolyzer (SOEC) with nuclear plant emulator at INL
- Validate high efficiency & low-cost H₂ production from SOEC using electricity & waste heat from nuclear plant
- Increase operating flexibility & profitability by switching between power & H₂ generation

**Key Accomplishments:**
- Acquisition of all materials & tooling for stack assembly complete
- Initiated stack assembly and factory acceptance testing

Chemical Reaction:

\[
2\text{H}_2\text{O} + 4e^- \rightarrow 2\text{H}_2 + 2\text{O}_2
\]
Technology Acceleration: Grid Energy Storage & Power Generation

High Temperature Electrolyzer Modeling, Development, Integration and Testing

INL - High Temperature Electrolysis Test Stand (TA018)

Goals:
• Accelerate U.S. solid oxide electrolyzer competitiveness
• Independently validate stack performance
• Provide nuclear simulated integration/testing

Key Accomplishments:
• Commissioned HTE integrated system facility w/ emulated nuclear thermal energy delivery for large stack & system testing
• Initiated testing of 100kW Bloom HTE system at the integrated system facility
• >7,000 cumulative hours of performance & durability testing completed for multiple OEM SOEC stack sets

PNNL – Electrolyzer Stack Development and Manufacturing (TA043)

Goals:
• Improve the manufacturability, performance and durability of SOEC stacks & components
• Evaluate new cell and stack designs, as well as advanced manufacturing techniques to lower fabrication cost

Key Accomplishments:
• Assembled & tested 11 SOEC stacks (300 cm² active area cells)
• Engaged in SOEC manufacturing workshops to identify QA/QC gaps
• Performed post-mortem stack characterization on commercial stacks to identify operational and manufacturing issues

50kW test stand integrated with nuclear power plant emulator
Wind to H₂ - Electrolyzer Modeling, Development, Integration and Testing

Giner – Low Cost H₂ by Exploiting Offshore Wind & PEM Electrolysis Synergies (TA051)

**Goals:**
- Develop model to calculate LCOH for OSW (offshore wind) to H₂ w/ integrated electrolyzers
- Determine impact of seawater impurities on PEM performance
- Integrate and test 250 kW PEM electrolyzer with simulated wind turbine output

**Key Accomplishments:**
- Models predict ~$2.20/kg H₂ from OSW
- Tolerance of baseline Pt & Ir loading for common seawater ions determined
- Design for integrated 250 kW electrolyzer stack with simulated wind turbine input initiated

Alchemr - AEM Water Electrolyzer for H₂ Production from Offshore Wind (TA054)

**Goal:**
Develop a low-cost anion exchange membrane water electrolyzer (AEMWE) for direct coupling to OSW

**Key Accomplishments:**
- Demonstrated long-term performance of 5 cm² AEMWE cell with non-PGM anode & cathode catalysts at 0.3 A/cm², 60 C
- Demonstrated durability of MEA: 400 microvolts/hr degradation over 1000 hrs

NREL - Wind to Hydrogen (TA060)

**Goal:**
Create H₂ Scenario Analysis tool for rapid, high-resolution insights into future, optimized, clean H₂ pathways

**Key Accomplishments:**
- H2OPP tool developed
- Analysis shows potential for renewable H₂ <$2.50/kg in both near & long term

- **Location info & wind/solar resources**
- **Detailed system design**
- **Location-based cost of H₂**

- **System Sizing Design**
- **REopt: Optimize energy systems; optimal mix of technologies**
- **H2OPP: integrated design of hybrid plants at component level (wind turbine, solar panel, battery, PEM design, performance, and cost)**
- **H2A: Hydrogen production analysis**
Technology Acceleration: Transportation

[Diagram showing various components related to energy and transportation, including renewable energy sources, electric grid infrastructure, hydrogen generation, and transportation routes.]
SuperTruck 3 Demonstrations – Freight Efficiency (>75% GHG Reduction)

DAIMLER

Fleet Operators: Schneider National, Walmart

Goals:
- Demonstrate 2 total (Class 8) HD long-haul fuel cell electric trucks (B-sample & final truck demo)
- 6.0 mi/kg H2 fuel economy
- 600-mile range (onboard LH2 storage)
- 65,000 pounds GVW

GM

Fleet Operators: Southern Co, Metro Delivery

Goals:
- Demonstrate 8 total (Class 4-6) MD trucks
  - 4 fuel cell & 4 battery electric trucks
- Fuel Cell System Goals:
  - 65% peak efficiency
  - <$80/kW system cost (100K units/yr)
  - 20K-30K hour lifetime
- Demonstrate microgrid w/ electrolyzer & fuel cell (H2 fueling & fast charging)
  - Electrolyzer: >65% efficiency & 10-year lifetime

Ford Motor Company

Fleet Operators: Consumers Energy, Ferguson, SoCalGas

Goals:
- Demonstrate 5 total (Class 4-6) MD vocational trucks
- 300+kW net vehicle power, H2 PEM FC + Li-Ion battery
- 300-mile range (700 bar H2 storage)
- 10K/20K pounds payload/tow capacity

The above image is not final product/visual and is subject to change.
**Technology Acceleration: Transportation (Medium / Heavy-Duty)**

**MD/HD Trucks Demonstrations**

**CTE – Fuel Cell Hybrid Electric Delivery Van (TA01)**

**Goal:**
Demonstrate hybrid electric delivery vans with fuel cell range extenders (75 to >125 mile range)

**Key Accomplishments:**
- 10 trucks built and entering service at UPS service centers in Ontario and Gardena, CA
- 5 more trucks in assembly
- Trucks to operate in disadvantaged community in CA to reduce local air pollution

**Army/DHS/Cummins – H2Rescue (IA001)**

**Goal:**
Develop & demonstrate disaster relief truck to provide victim aid, communication support, exportable power & potable water

**Key Accomplishments:**
- Developed vehicle design specs w/ team members
- Vehicle assembly started
Technology Acceleration: Transportation

HD Refueling & First of its Kind Maritime Demonstration

Electricore - High Pressure / Flow Rate Dispenser & Nozzle for HD Vehicles (TA049)

Goals:
- Develop dispenser & nozzle (receptacle, hose, breakaway) for HD vehicles
- 100 kg in 10 mins at 70 MPa
- Demonstrate system at NREL

Key Accomplishments:
- Completed design work
- Completed manufacturing of prototype nozzle components and procurement of external assembly parts
- Completed setup for dispenser manufacturing

Hornblower – Marine H₂ Demonstration (poster - TA045)

Goal: First of its kind maritime H₂ refueling infrastructure on water (530 kg H₂/day) - onboard a barge at the San Francisco Waterfront

Key Accomplishments:
- Evaluated equipment for marine environment
- H₂ barge design completed
Technology Acceleration: Transportation (Rail and Marine)

Total Cost of Ownership (TCO) / Target Setting for Rail and Marine Applications

Key Results:
• Fuel cost dominates TCO for passenger rail & ferries
• Both applications can be cost competitive with diesel with $60/kW fuel cell CAPEX & H₂ cost of $4.00-3.50/kg H₂
• For ferries, less onboard storage / increased # of refuelings = lower TCO than diesel
• For H₂ Electric Multiple Unit (HEMU) passenger rail, developing LH₂ refueling capability at rail yard is needed to compete with diesel
• DOE intends to release specific targets for both applications
Technology Acceleration: Industrial & Chemical Processes
Technology Acceleration: Industrial & Chemical Processes (Steel)

Decarbonizing Iron/Steel Production with Hydrogen (HySteel)

**Missouri U. of S&T - Grid Interactive Steelmaking with H₂ (GISH) (TA053)**

**Goals:**
- Demonstrate H₂-based direct reduction of iron & steelmaking
- 1 tonne/week iron production using variable H₂/NG content; scalable to 5,000 tonnes/day

**Key Accomplishments:**
- Preliminary TEA of GISH process
- Kinetic model for H₂, NG & mixed gas reduction, and a DRI melting model developed and verified
- GISH pilot reactor design completed / construction underway (operation expected 7/22)

**U. of California Irvine - H₂ SOEC integrated with Direct Reduced Iron (DRI) plants (TA052)**

**Goals:**
- Demonstrate a thermally and chemically integrated SOEC system with a DRI plant
- 1 tonne/week equivalent H₂-Direct-Reduction pilot system (design for 2 MT/year)

**Key Accomplishments:**
- System models show potential energy intensity of <8 GJ/ton (crude steel) compared to 19-20 GJ/ton for traditional blast furnace + basic oxygen furnace
- SOEC modelling predicts electric-to-H₂ efficiency <35 kWh/kg
- SOEC pressurized cell test matrix completed
Technology Acceleration: Enabling Activities (Safety, Codes & Standards)

Enabling Codes & Standards: ~40% Reduction in Footprint for Liquid Hydrogen
(NFPA 2, 2023 Edition)

SNL – R&D for Safety, Codes and Standards: H₂ Behavior (SCS010)
SNL – H₂ Quantitative Risk Assessment (SCS011)

Previous (18,000 ft²)*
2016 Edition NFPA 2

- Distances based on storage volume
- 22 individual exposures (5 distances)
- Non-repeatable basis

Proposed (10,800 ft²)
2023 Edition NFPA 2

- Distances now based on system pipe size & operating pressure
- 3 exposure groups
- Well-documented, repeatable, revisable basis

Next Steps: Enabling Codes and Standards Accessibility
- Improve accessibility of codes & standards that are often seen as complex / difficult to understand
- Develop a tool to connect developers to the appropriate codes & standards

*https://www.hydrogen.energy.gov/pdfs/19005_600kg_day_hydrogen_fueling_station_footprint.pdf
Activities to Monitor, Mitigate, and Understand H₂ Releases

**Goals:**
- Lab characterization & validation of several sensor technologies
- Indoor / outdoor modeling, characterization of releases, and sensor deployment guidance

**Monitoring the Environmental Impact of Unintended H₂ Release**

*Clean Hydrogen JU Expert Workshop on Environmental Impact of Hydrogen* (Co-hosted by DOE & European Commission, March 31 - April 1, 2022) identified technical needs such as:
- Reduction of intentional and unintentional H₂ releases
- Robust sensor and monitoring technology
- Improved modeling of H₂ releases & atmospheric impact

**Next Steps:**
- Collaboration with NOAA to improve modeling of atmospheric H₂ and its impact
- Support R&D activities to address these gaps, including monitoring and mitigation of H₂ releases from production to end-use
Technology Acceleration – Examples of International Collaboration

- Clean H₂ collaboration w/ EU, UK, Australia, Chile on H₂ production, storage, distribution and end uses
- End-use (Off-road working group)

Maritime collaboration w/ Denmark, Norway, UK on ships, fuel production, and port infrastructure

International Working Group for Offshore Wind to H₂
- Partnership between U.S. & Netherlands (DOE, NREL, TNO, and Hygro)
- Formed in 2021 as a part of U.S. strategy to engage international partnerships
- FY22 collaboration includes OSW to H₂ TEA & assessment of knowledge gaps for multiple OSW to H₂ pathways

- Co-Chair of IPHE RCSSWG alongside EC-JRC
- Newly restructured to form Task Forces focused on critical topics such as maritime usage, bulk storage, and bridges and tunnels

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HYDROGEN AND FUEL CELL TECHNOLOGIES OFFICE
### Technology Acceleration Program: Collaboration Network

**Fostering technical excellence, economic growth and environmental justice**

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**U.S. DEPARTMENT OF ENERGY**

**OFFICE OF ENERGY EFFICIENCY & RENEWABLE ENERGY**

**HYDROGEN AND FUEL CELL TECHNOLOGIES OFFICE**
## Technology Acceleration Program: Highlights and Milestones

### FY2021
- Awarded World’s first Large Scale Fuel Cell Powered Data Center (Caterpillar)
- Awarded World’s First Renewable H₂ Production Refueling Barge (Hornblower)
- Kicked off 2 HySteel projects to Demonstrate using H₂ to Decarbonize Iron & Steel Production (UCI and MS&T)
- Established an Integrated MW-scale H₂ Production, Storage and FC System at ARIES (NREL)
- Released SuperTruck III FOA
- Initiated CRADA Project on High-Flow Fueling Protocol in Concert w/ International PRHYDE project (NREL)
- Validated 2 High Temp Electrolyzers from Industry – including a 25kW stack that Surpassed 4,000 hrs with <0.5% Degradation / 1,000 hrs (INL)
- Kicked off H2EDGE Workforce Development Project (EPRI)
- Hosted International Workshop on Quality Control for Electrolysis & Fuel Cells w/ NRC (Canada) & Fraunhofer ISE (Germany) (NREL)
- Released Federal Regulatory Map Report (SNL)

### FY2022
- Regional Clean H₂ Hubs: Perform Stakeholder Engagement & Issue FOA (in collaboration w/ OCED)
- Utilize ARIES Capabilities to Advance Integration of H₂ Technologies in Energy Systems (NREL)
- Completed Design & Procurement for 1.25 MW Electrolyzer Installation at Nuclear Plant (Constellation)
- Tested 100kW Integrated HT Electrolysis System using Fully Emulated Nuclear Integrated Test Stand (INL/Bloom)
- Selected (3) SuperTruck III Projects Focused on M/HD H₂ Fuel Cell Trucks (Daimler, GM, Ford)
- Demonstrate 10 kg/min average H₂ fueling rate for heavy-duty applications (NREL)
- Held Workshop & Established International Off-Road Working Group (in collaboration w/ International Mission Innovation – Clean Hydrogen)
- Performed SCS Gap Assessments for Large Scale H₂ Applications, including Bulk Storage & Rail
- Utilized Bulk Cryogenic H₂ Behavior Validation Data to Enable 40% Reduction in H₂ Station Footprint based on NFPA 2 (SNL)

### FY2023
- Regional Clean H₂ Hubs: Select at least 4 H₂ Hubs (in collaboration w/ OCED)
- Demonstrate 1.25 MW Electrolyzer Installation at Nuclear Plant (Constellation)
- Test 250kW HT Electrolysis System using Fully Emulated Nuclear Integrated Test Stand (INL/FCE)
- Initiate Design of Full Thermal Integration at a Nuclear Plant with HT Electrolyzer
- Develop Reference Design & TEA for Direct Coupled Wind to H₂ to Industrial End-Use
- Demonstrate 1.5 MW H₂ fuel cell for data center resiliency (Caterpillar)
- Demonstrate 15 Fuel Cell Electric MD Delivery Trucks Operating in Disadvantaged Community (CTE)
- Begin demonstrating 1 tonne/wk reduction of iron with H₂ (UCI/MS&T)
- Develop tools to improve accessibility of codes & standards to assist permitting of demonstration projects
- Study Environmental Impact of Unintended H₂ Release, Quantify Background Levels of H₂, & Develop Sensors to Measure / Mitigate Release

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HYDROGEN AND FUEL CELL TECHNOLOGIES OFFICE
Regional Clean Hydrogen Hubs
Regional Clean Hydrogen Hubs (H2Hubs) – Bipartisan Infrastructure Law (BIL)

BIL’s Stated Purpose: “Establish a program to support the development of at least 4 regional clean hydrogen hubs that:

1. demonstrably aid the achievement of the clean hydrogen production standard* developed under section 822(a);
2. demonstrate the production, processing, delivery, storage, and end-use of clean hydrogen; and
3. can be developed into a national clean hydrogen network to facilitate a clean hydrogen economy.”

$8 Billion over 5 years

H₂ Ecosystem concept:
Potential for different clean H₂ production methods, end uses & necessary infrastructure all in close proximity

Additional Key Items beyond H₂ Technology:
- Environmental Justice
- Community Engagement
- Job Creation
- Workforce Development
- Labor Standards
- Diversity, Equity, Inclusion
- Commercial Sustainability
- U.S. Manufacturing

*H₂ produced with carbon intensity ≤ 2 kg CO₂e/kg H₂ produced at the site of production [Section 40315 of the IIJA U.S.C. § 16166(b)(1)(B)]
H2Hubs: Update

• **Public Webinars:** Held 12/8/21* & 2/24/22**
  - Over 300 responses / thousands of pages

• **Request for Information (RFI):** Issued 2/15/22
  - Over 300 responses / thousands of pages

• **H2 Matchmaker:** Launched 2/15/22

• **EJ & Tribal Listening Sessions:** Feb - May

• **Notice of Intent (NOI):** Released Today!
  - Provides additional details on the planned strategy & requirements

• **Funding Opportunity Announcement (FOA):** Targeting September/October

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**H2Hubs: Key Points from NOI**

*NOI presents preliminary plan that will likely be refined and evolve during the FOA development process*

- **DOE Office of Clean Energy Demonstrations (OCED)** – anticipates issuing FOA in September/October 2022 timeframe in collaboration with EERE-HFTO and the DOE Hydrogen Program

- **FOA will solicit applications** covering all 4 phases (8-12 years):
  - Phase 1 – Detailed Project Planning (12-18 months)
  - Phase 2 – Project Development, Permitting, and Financing (2-3 years)
  - Phase 3 – Installation, Integration, and Construction (2-4 years)
  - Phase 4 – Ramp-Up and Sustained Operations (2-4 years)

- **Initial FOA launch**: 6-10 H2Hubs (total of $6-7 billion)
  - **DOE Share**: min range of $400-$500 million / max range of $1-1.25 billion per H2Hub
  - **Cost Share**: min of 50% non-federal cost share

- **H2Hubs must meet or exceed the clean hydrogen production standard** (preference given to H2Hubs that reduce GHG emissions across the full project lifecycle)

- **Minimum** rate of at least 50-100 metric tons (MT) per day and in-line with proposed project budget

- **H2Hubs will include substantial engagement of local and regional stakeholders** to ensure that they generate local, regional, and national benefits while mitigating any environmental or community impacts

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**NOI (DE-FOA-0002768):**
https://oced-echange.energy.gov
H₂ Matchmaker (https://www.energy.gov/eere/fuelcells/h2-matchmaker)

H₂ Matchmaker aims to facilitate the development of high-quality Hydrogen Hubs

277 Activities Added

- 47 H₂ Producers
- 28 H₂ Consumers
- 80 Infrastructure Providers
- 122 Supporting Stakeholders

Voluntary, self-identification of potential partners

Request from DOE: Help publicize & encourage data entry
The U.S. Department of Energy (DOE) is looking for talented, bright, early career professionals to partner with DOE Hydrogen Program Managers working to achieve the Hydrogen Energy Earthshot goal of $1 per 1 kilogram in 1 decade (“1 1 1”).

Are you graduating soon or just starting your career in hydrogen?

Do you want to help make clean hydrogen affordable for all?

The Hydrogen Shot Fellowship might be the opportunity you’re looking for!

Apply today at: www.zintellect.com Keyword: Hydrogen Shot
Technology Acceleration Team – THANKS!

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- Gary Robb
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Backup Slides
Sec 40314 (EPACT Sec. 813): Regional Clean Hydrogen Hubs

- (A) FEEDSTOCK DIVERSITY —
  o at least 1 regional clean hydrogen hub using fossil fuels; 1 using renewables; 1 using nuclear
- (B) END-USE DIVERSITY — at least 1 with end use in
  o electric power generation sector;
  o industrial sector;
  o residential and commercial heating sector; and
  o transportation sector.
- (C) GEOGRAPHIC DIVERSITY —
  o be located in a different region of the United States; and
  o use energy resources that are abundant in that region.
- (D) HUBS IN NATURAL GAS-PRODUCING REGIONS—
  o at least 2 regional clean hydrogen hubs shall be located in the regions of the United States with the greatest natural gas resources.
- (E) EMPLOYMENT—
  o Prioritize those likely to create opportunities for skilled training and long-term employment to the greatest number of residents of the region.
- (F) ADDITIONAL CRITERIA—The Secretary may take into consideration other criteria that, in the judgment of the Secretary, are necessary or appropriate to carry out this title.