U.S. DEPARTMENT OF ENERGY | Office of NUCLEAR ENERGY

Clean. Reliable. Nuclear.

# Annual Feedback Meeting and Webinar

October 30, 2019

## Gateway for Accelerated Innovation in Nuclear (GAIN) NE Voucher Program

## U.S. Industry Opportunities for Advanced Nuclear Technology Development

# Agenda

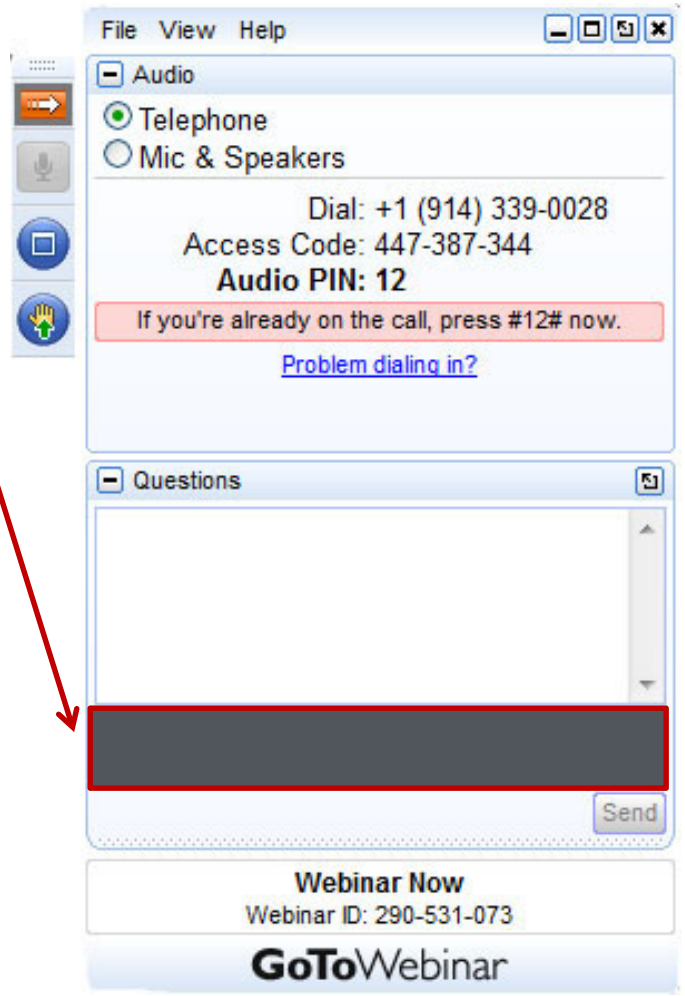
- Welcome
- US DOE Lessons Learned and Feedback
- US Industry Lessons Learned and Feedback
- General Discussion

# First Things, First….

- Emergency Exits
- Bathrooms

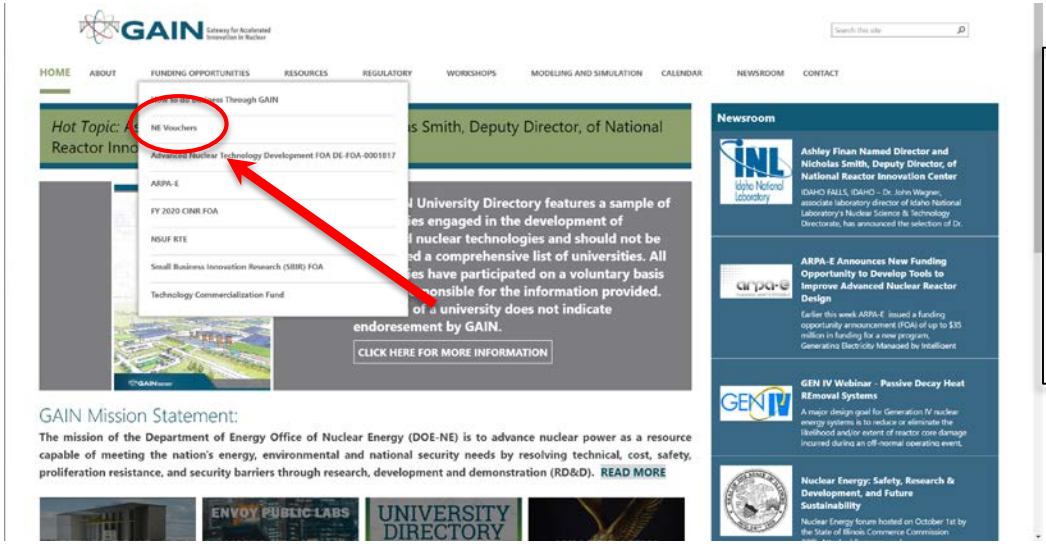

# How to Ask Questions During This Webinar

- Submit questions using the GoToWebinar software by typing in the Webinar "Questions" field.
- Questions that do not get answered during the allotted time will be answered and posted on www.id.doe.gov.
- Specific questions on individual eligibility should be addressed offline.



# Accessing GAIN Voucher and related information

- GAIN website (http://gain.inl.gov)




- Copy of RFA
- CRADA templates
- List of awardees
- Dates to remember
- Hints for success

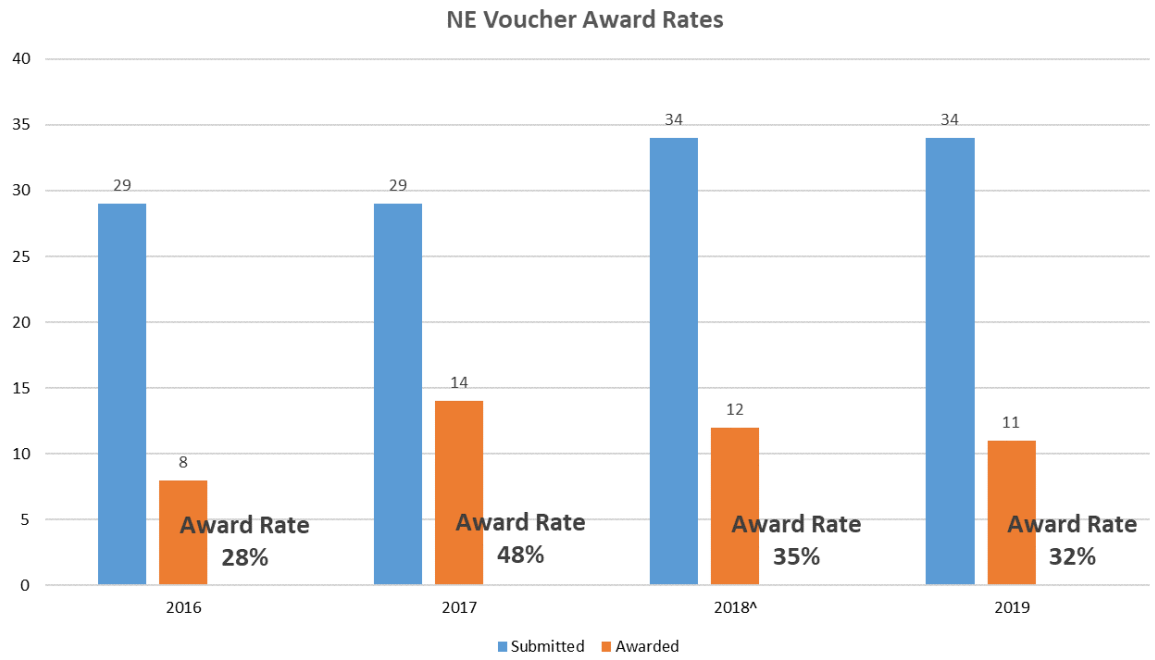
# What are vouchers?

- Competitively awarded access to facilities and staff in the DOE national laboratory complex – **not a financial award**. Funds go directly to lab to perform work.
  - Access to capability that isn't available in the private sector
  - Awardee directs work through interaction with lab staff
- Opportunity for industry to work with the laboratories and establish relationships
- Tangible advancement of innovative technologies toward market readiness
- Available to businesses that are majority (51% or greater) U.S. owned and established in the U.S.
  - No size restriction on companies – small businesses receive extra consideration
  - Foreign affiliation will involve extra review

# What we look for

- Proposed work
  - Accelerates/enables commercialization of an innovative technology
  - Makes use of unique DOE laboratory capability
  - Promotes private-public partnerships (builds relationships)
  - Leverages additional company investment (cost share)
- Problems must be defined by industry (not laboratory initiated!)
- Work scope is clear, feasible in ~1year, and aligns with laboratory capability
- Overall impact of underlying technology accelerates deployment of new nuclear or improves viability of existing plants
- No sustained, fundamental R&D
- **Does not replace or supplement DOE-NE Programmatic work**

# GAIN Voucher statistics



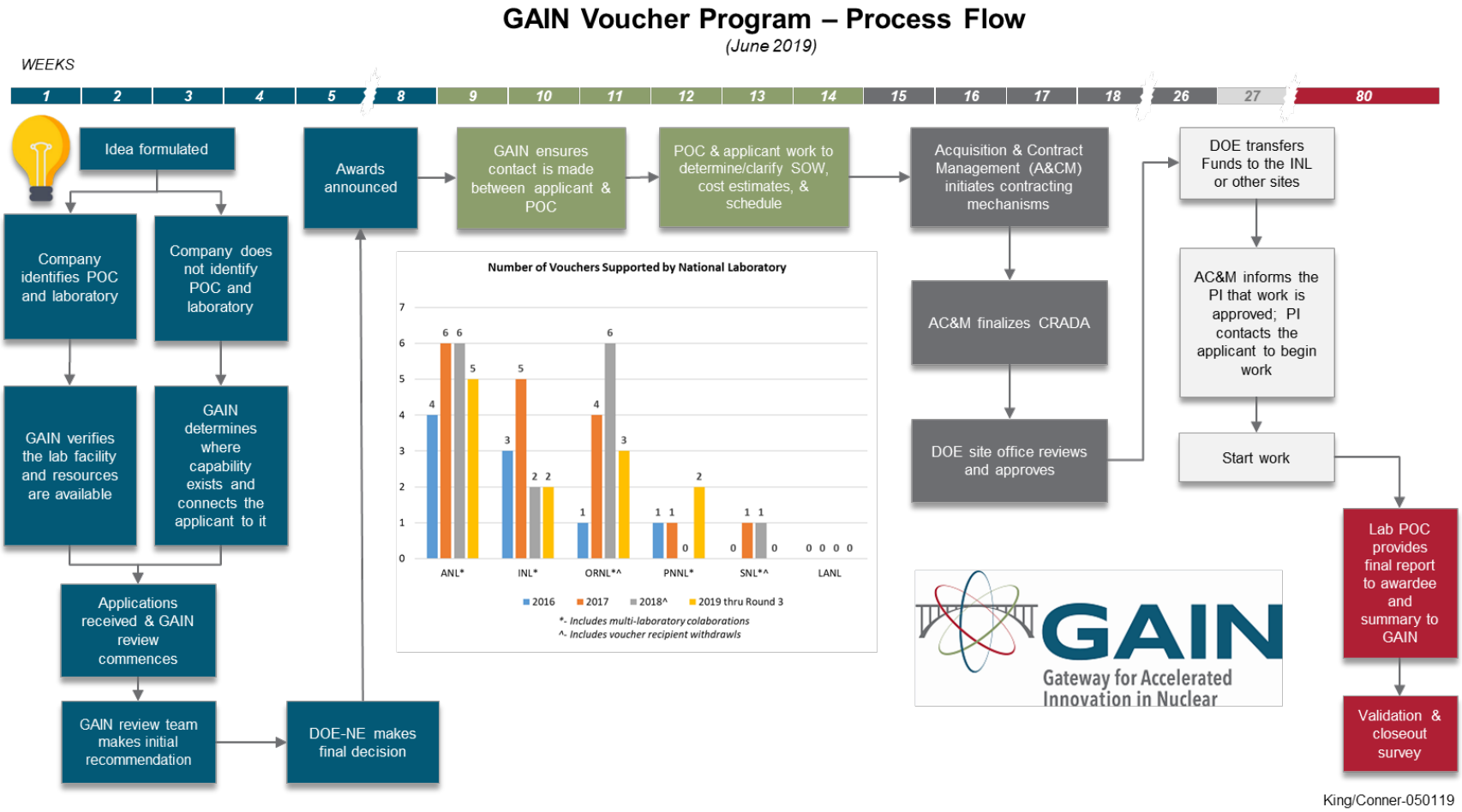

## *GAIN NE-Vouchers*

- 20 Completed Vouchers
- 45 Awarded
- $14.7M to National Labs
- Total Project Costs $18.4M

# GAIN Vouchers – Recent improvements/Recurring issues

- Voucher timing
  - No longer tied to iFOA
  - Reduced time to award to ~7 weeks (most recent)
  - Improved efficiency of review process
- Recurring Issues:
  - Foreign notification process, DOE P485.1 – confusion remains in process
  - Extended negotiation of scope and IP issues (both lab and awardee)
  - Lack of prioritization by laboratory contracting offices

# Refined Voucher Process Flow



# Lessons Learned and Feedback – GAIN Vouchers

**General reasons for non-award**

- Focused on technology outside the scope of the RFA
  - Isotope production, decay heat for power production, fusion, infrastructure development, etc
- Requesting explicit development of a technology or innovation
  - Vouchers *enable* acceleration of *your* technology development
  - Includes software/code development
- Requesting sustained R&D effort
- Lack of clear objective
- High alignment with existing DOE-NE programs
- Requesting a capability that is available outside DOE
- Requesting work more appropriately aligned with other FOA

# GAIN Vouchers - 10 Hints for success

1. If you have a DOE national laboratory point of contact (POC), identify them in the appropriate section in the electronic application system. Don't include the POC as part of the proposing team in your proposal, since they are part of the resource you are requesting.
2. If you don't have a DOE national laboratory POC, the GAIN team can help identify the right national laboratory and appropriate technical leads to assist you in your research needs.
3. Articulate your objective as clearly as possible. Keep this question in mind: Why do I specifically need the DOE national laboratory or resource?
4. Remember, DOE national laboratories are prohibited by law from competing with the private sector, so a voucher that is asking for general services will not be considered. For example, structural analysis of a reactor building using commercial finite element analysis software is a general service.
5. Vouchers are not intended to assist you with the fundamental design of the technology you are developing. If you need assistance with a specific design aspect or component of your technology, you must be clear about the requirements and constraints that apply to this component.
6. In general, a voucher that asks a DOE national laboratory to complete general design work or make decisions on a design, will not be awarded. The laboratories' role is to provide you with the data necessary to make those decisions on your own.
7. Vouchers are not an appropriate mechanism for tackling large, sustained research and demonstration (R&D) projects or design efforts. A voucher will not generally be awarded for continuation of a previously awarded voucher. It should be clear that the requested assistance will advance a well-defined aspect or component of your overall technology.
8. Make sure that the assistance that you are requesting can reasonably be completed within one year. Seek the advice of the national laboratory POC to determine cost and schedule estimates.
9. Vouchers should not be used as a means to request upgrades or additions to DOE infrastructure. They are intended to help you advance your technology using existing national laboratory capability.
10. Think about how your voucher will enhance or enable development of a technical relationship with the national laboratory, which can be a resource for you all the way to commercialization of your technology.

U.S. DEPARTMENT OF ENERGY

Office of ENERGY EFFICIENCY & RENEWABLE ENERGY

**Jason Marcinkoski, Technology Manager**
**Fuel Cell Technologies Office**

Annual Feedback Meeting –

*U.S. Industry Opportunities for Advanced Nuclear Technology Development FOA*

Washington, D.C. – October 30, 2019

# FCTO Focus Areas

**Early R&D Focus**

**Applied research, development and innovation in hydrogen and fuel cell technologies** leading to:

- Energy security
- Energy resiliency
- Strong domestic economy

## Key R&D Sub-Programs in Budget Request

### Fuel Cells

- Cost, durability
- Components - catalysts, electrodes, etc.
- Increase focus beyond LDVs

### Hydrogen Fuel

- Cost of production across pathways
- Cost and capacity of storage, including bulk/ energy storage

### Infrastructure R&D

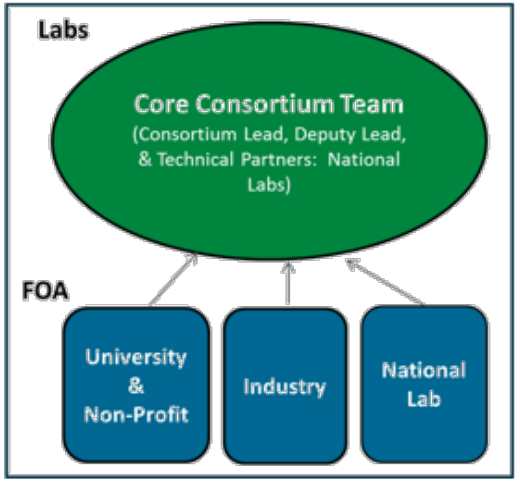
- Cost and reliability of infrastructure
- Delivery components, supply chain
- Safety

LDV: Light Duty Vehicle

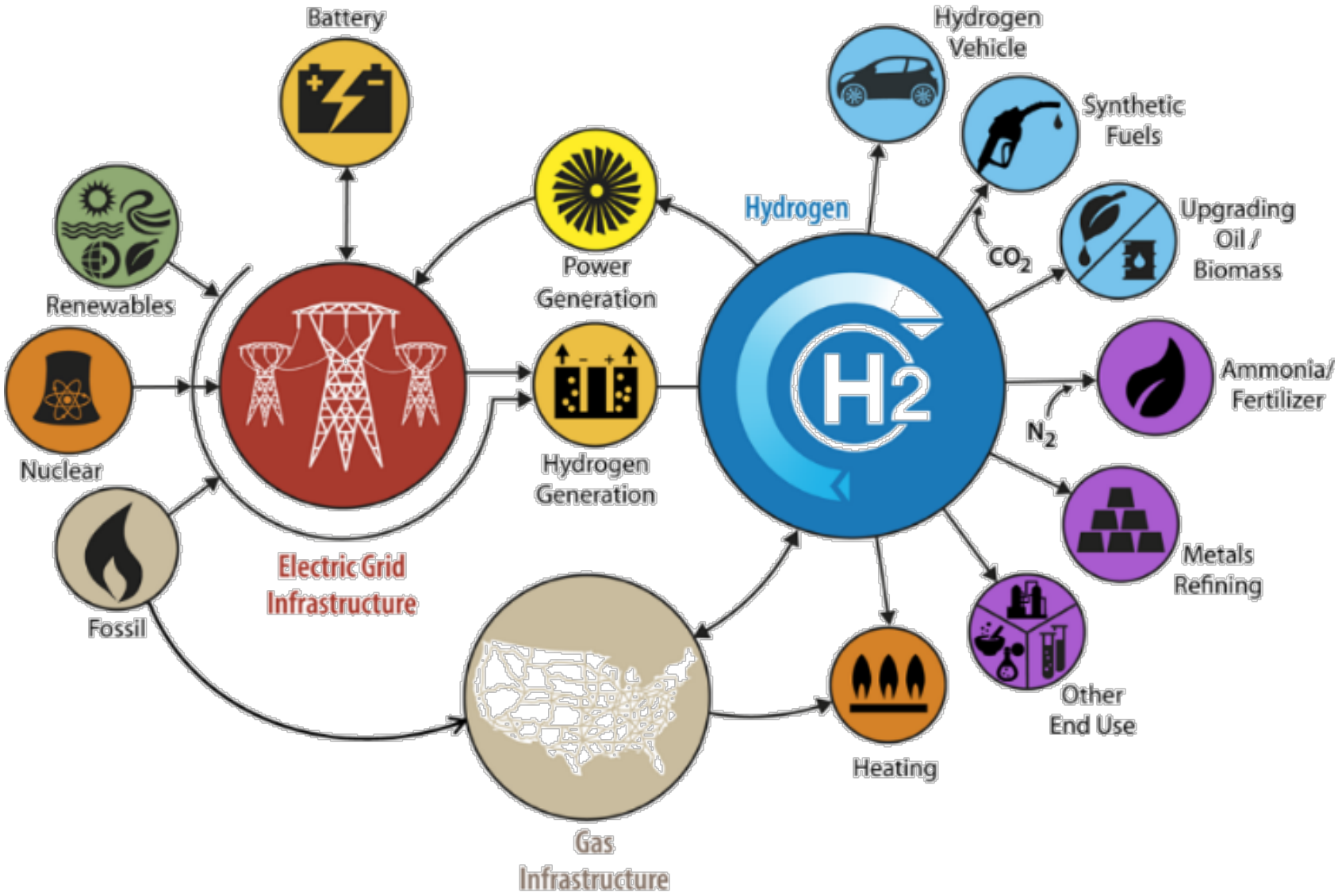
**Enabling**

H2@Scale
U.S. Department of Energy

Leveraging industry and labs through the **Consortia Approach**



H2@Scale: Enabling affordable, reliable,
clean, & secure energy across sectors

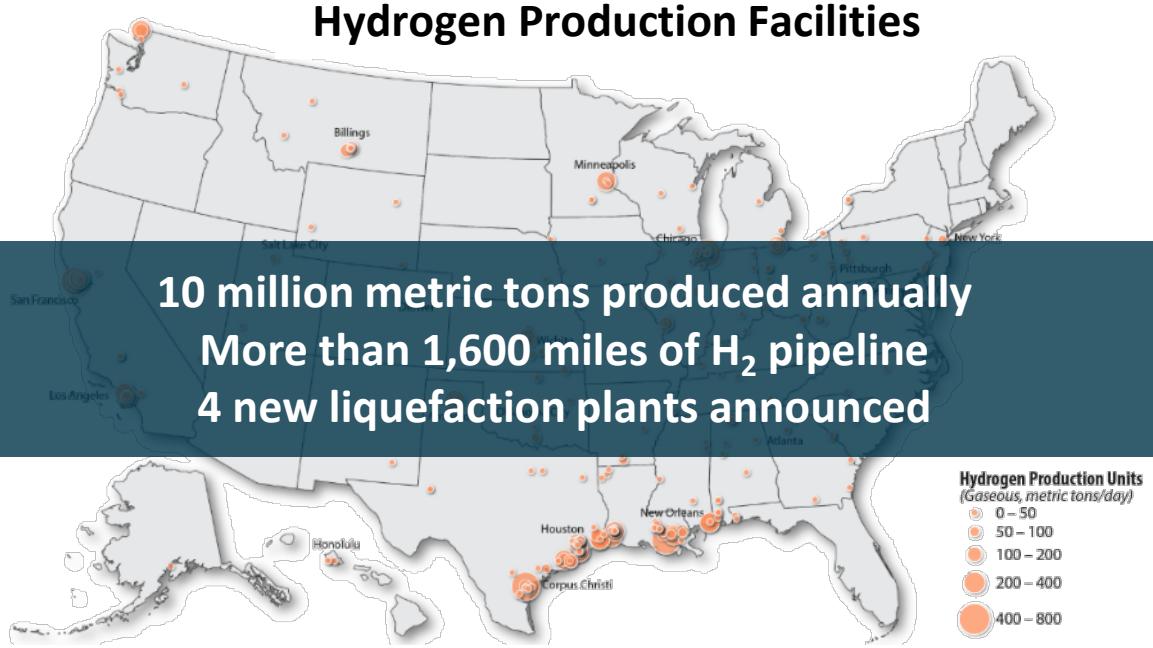


# U.S. Snapshot of Hydrogen and Fuel Cells
## Applications

### Examples of Applications in the United States

- **>240MW** Backup Power
- **>25,000** Forklifts
- **>30** Fuel Cell Buses
- **>40** $H_2$ Retail Stations
- **>7,500** Fuel Cell Cars

### Hydrogen Production Facilities




**10 million metric tons produced annually**
**More than 1,600 miles of $H_2$ pipeline**
**4 new liquefaction plants announced**

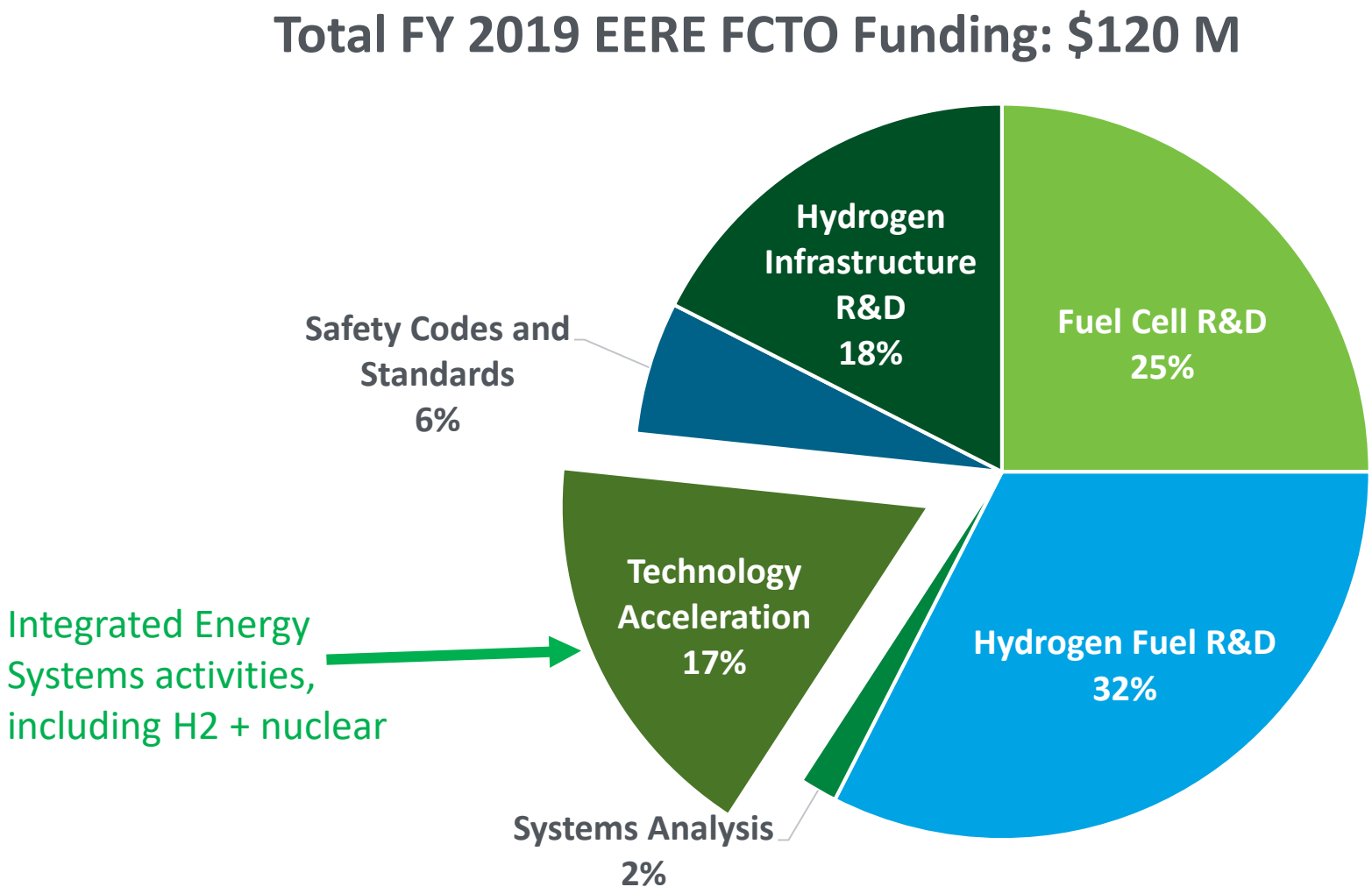
### Hydrogen Stations: Examples of Plans Across States

**California**
1,000 stations by 2030

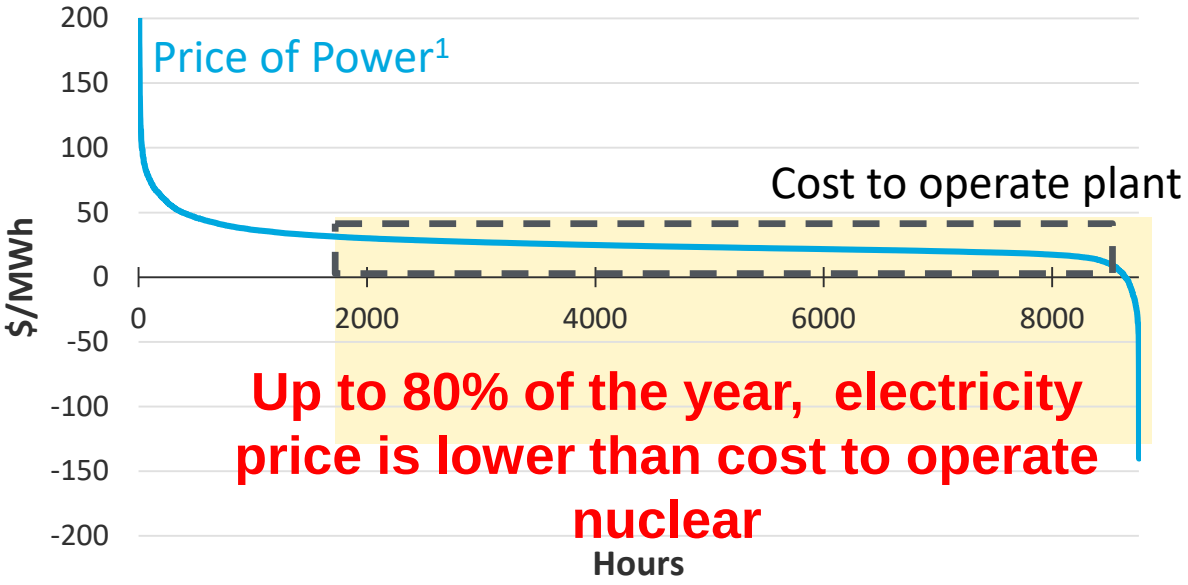
**Northeast**
12 – 20 stations planned

**HI, OH, SC, NY, CT, MA, CO, UT, TX, MI, and others**
with interest

# Fuel Cell Technologies Appropriations - FY 2019



# Value Proposition for Nuclear Hybrid Systems

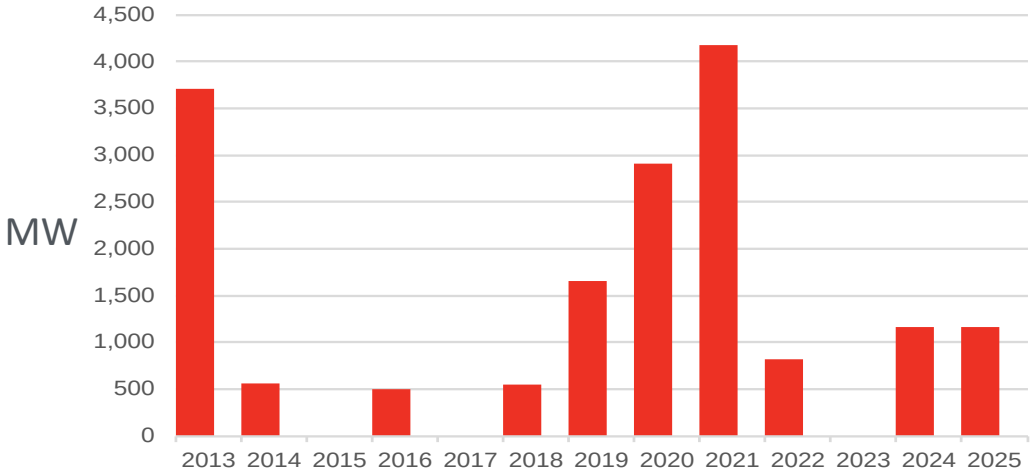



*The challenge in some regions:*

Localized marginal price of electricity **<** Cost of generating electricity at nuclear plant

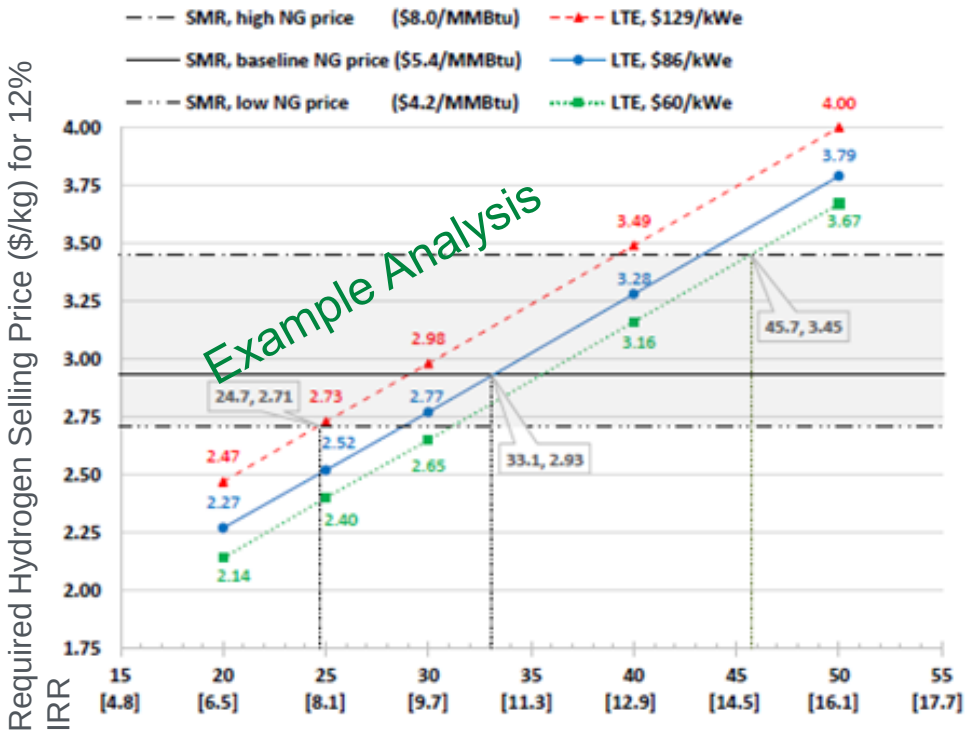
**Co-production of hydrogen can create a value stream for nuclear plants to supplement revenue from power generation.**

**Historic and Projected Nuclear Plant Closures in the U.S. (MW)[2]**

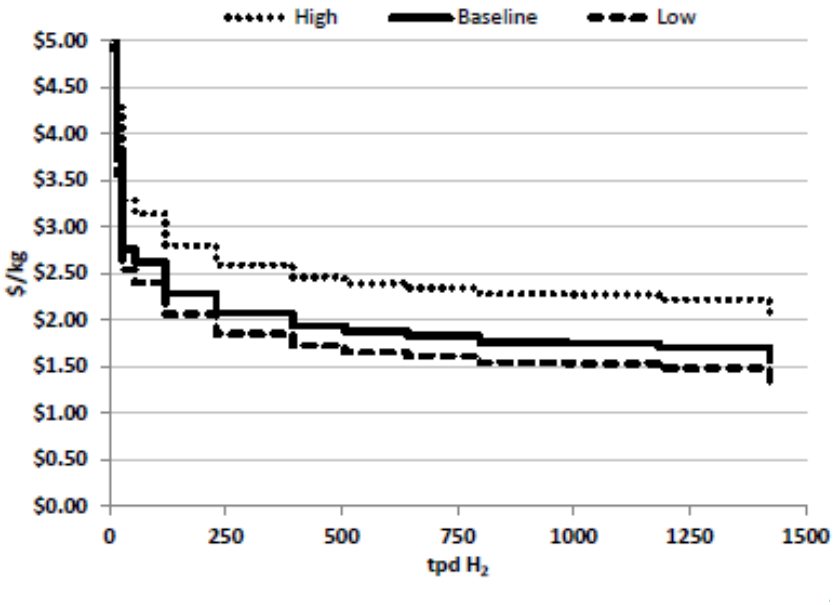



Sources:
1. 2017 data from PJM-NI Hub; R. Boardman, et. al. INL
2. Bloomberg New Energy Finance, 2019

# Benefits Analysis of Nuclear Hydrogen Production




Small-scale (24 tpd) hydrogen production.
Bracketed values are steam costs applying thermal efficiency of 32.3%



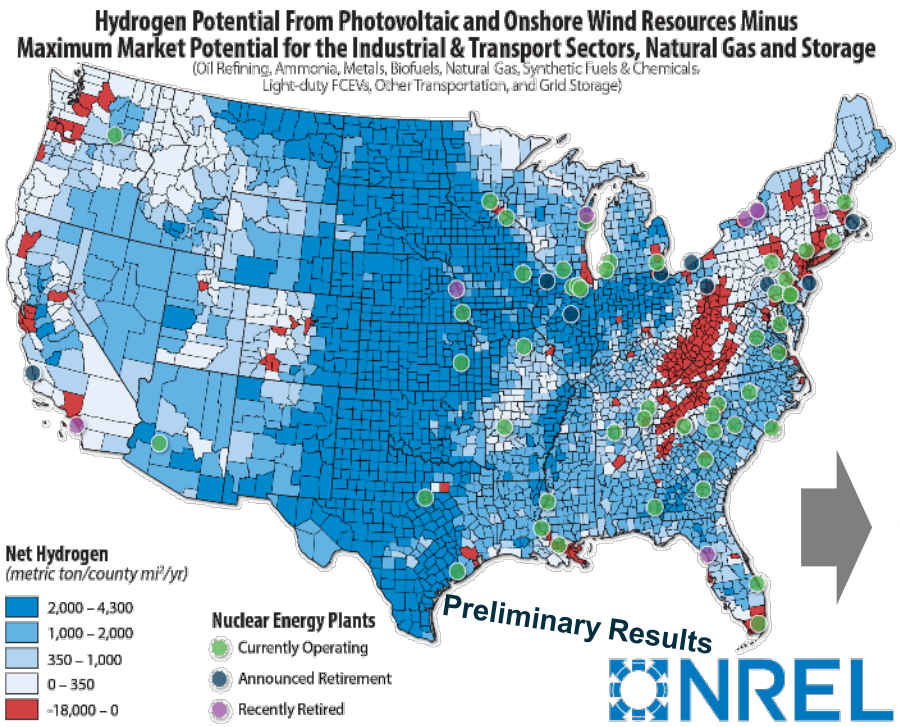

Potential future demand for hydrogen and varying prices of natural gas, near a nuclear plant in the Midwest

**Analysis indicates that high- and low-T electrolysis can be competitive at amortized nuclear plants, but require significant materials R&D to reduce capital cost and improve durability.**

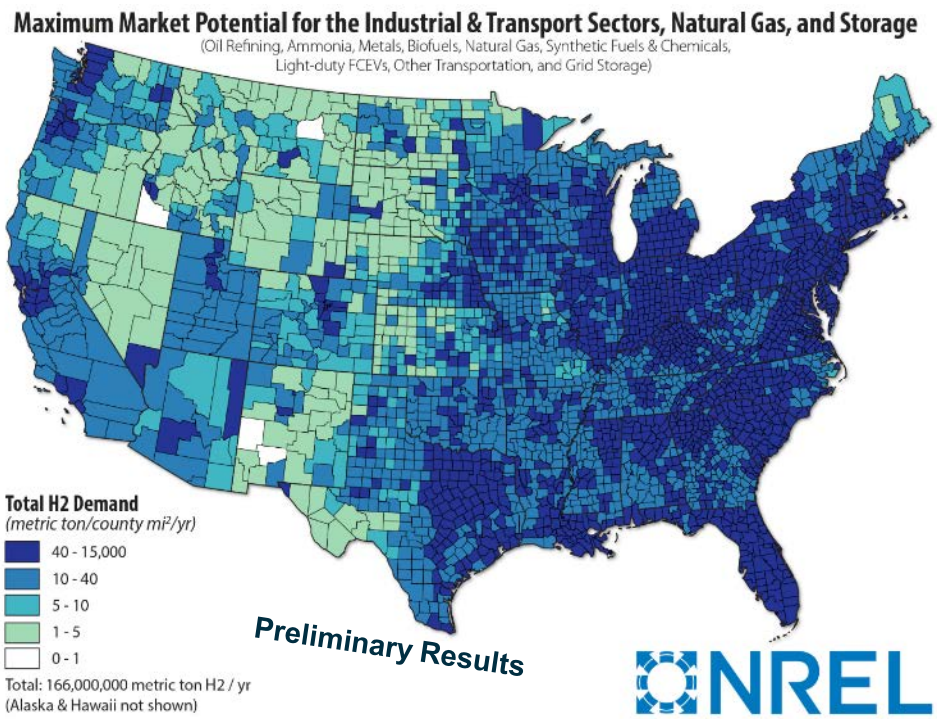
Source: "Evaluation of Non-electric Market Options for a Light-water Reactor in the Midwest", INL/EXT-19-55090, U.S. DOE Office of Nuclear Energy
https://inldigitallibrary.inl.gov/sites/sti/sti/Sort_19807.pdf

# Delivery Cost Reduction Through Co-Location

## Where hydrogen is available

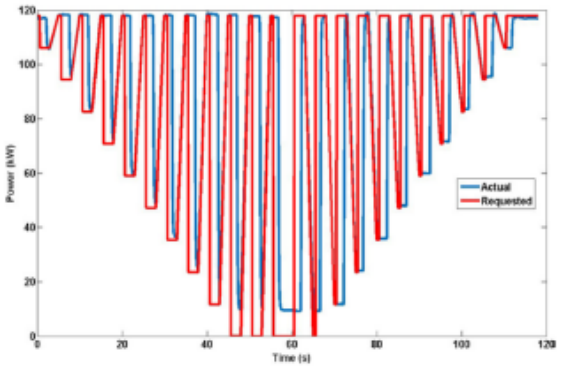



## Where potential hydrogen users are



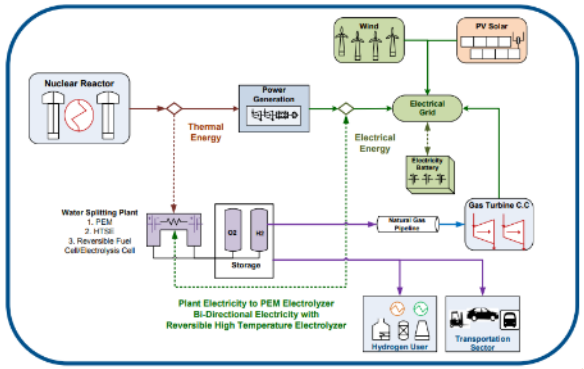
# H2 + Nuclear Work to Date

- Dynamic Modeling and Validation of Electrolyzers in Real Time Grid Simulation
  - INL, NREL, and SNL, collaborating with utilities and universities
  - Validating benefits of electrolyzers for grid services and offsite hydrogen sale




*Dynamic electrolyzer response – INL & NREL*

- Analysis of Hydrogen Production and Markets
  - INL, NREL, ANL and CRADA partners
  - Evaluating technical and economic potential for hydrogen production at nuclear reactor sites
  - Analyzing regional market opportunities and industrial demands



# DOE-Supported Electrolysis Development

- High Temperature Electrolysis Test Stand
  - INL, PNNL (HTE stack design and fabrication)
  - Advancing state-of-the-art of high temperature electrolysis and demonstrating dynamic grid and thermal energy integration
  - 25 kW facility commissioned, 250 kW being developed, along with thermal energy distribution system

*25 kW high-temperature electrolysis @ INL Energy Systems Laboratory*

- HydroGEN
  - www.h2awsm.org
  - 6-lab consortium (NREL, LBNL, SNL, INL, LLNL, SRNL), part of Energy Materials Network
  - Low- and high-T electrolysis, as well as

HydroGEN
Advanced Water Splitting Materials

# Recently Funded Demonstrations

- **EERE-led:** Exelon and partners
  - $7.2M project announced in August 2019
  - 1MW proton exchange membrane electrolyzer, storage, controls @ Midwest site to be determined
  - Supplying onsite needs for now, evaluating offsite markets
- **NE-led:** FirstEnergy and partners
  - $11.5M project announced in September 2019
  - Electrolysis unit at Davis-Besse NPP in Ohio
  - Onsite and offsite uses planned


*Recently announced demonstrations*

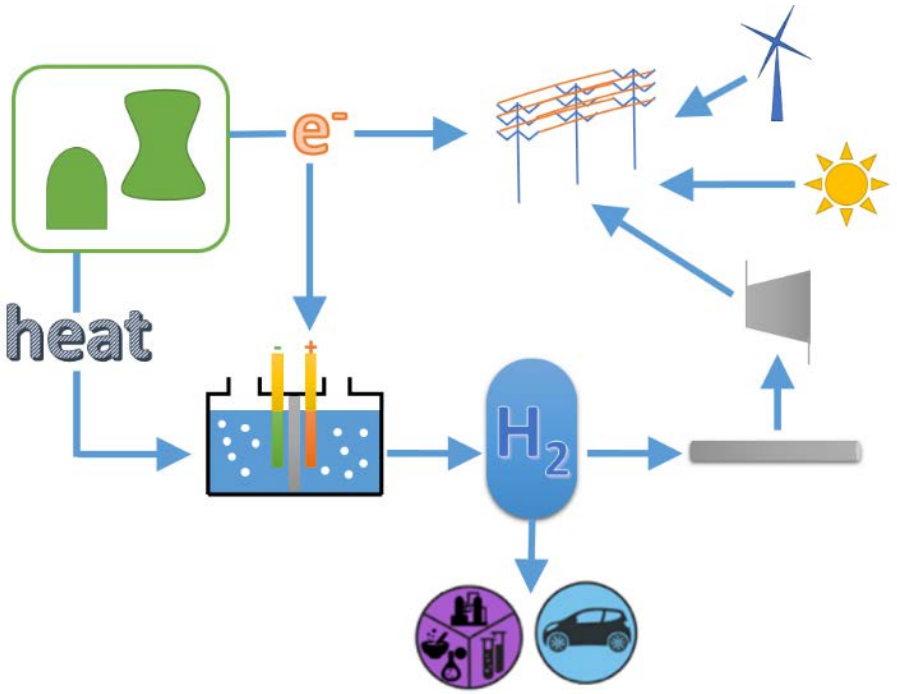
# FY 2020 Appropriation Planning

- Continuing resolution in effect.
- One data point—FY20 House Energy and Water Development appropriations report includes:
  - [NE]
    - Nuclear Energy Enabling Technologies.--Within available funds, … $10,000,000 is for hybrid integrated energy systems;
    - Reactor Concepts Research, Development, and Demonstration.--In support of the current fleet of reactors to ensure safe and reliable operations, the Committee includes $55,000,000 for the Light Water Reactor Sustainability program, of which $11,000,000 is for a for a hydrogen production demonstration.
  - [EERE] Hydrogen and Fuel Cell Technologies.-- …Within available funds, $7,000,000 is to enable integrated energy systems using high and low temperature electrolyzers with the intent of advancing the H2@Scale concept and $10,000,000 to cost share the Office of Nuclear Energy hydrogen demonstration project.

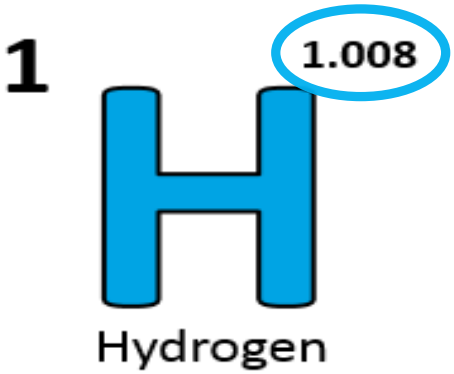
*https://www.congress.gov/congressional-report/116th-congress/house-report/83/1?overview=closed*

# Future Demonstrations: Larger Scale, More Integrated

- Possible areas of work:
  - Larger scale—20 MW up to full reactor output (including low-T)
  - Use of electricity and heat (higher efficiency) in high-T electrolysis
  - Integration of renewable resources and grid services
  - Regional market transformation
- Complexity means more attention to:
  - System design and cost analysis
  - Safety and risk assessment
  - Integration with reactor operations
  - Cybersecurity
  - Regulatory engagement
  - Qualification of electrolyzers



# Learn More about Hydrogen




**Celebrate Hydrogen & Fuel Cell Day**
October 8 or 10.08

INCREASE YOUR $H_2IQ$

http://www.H2Tools.org

https://www.energy.gov/eere/fuelcells/increase-your-h2iq

**2020**
**Annual Merit Review**
May 19-21
Crystal City, VA

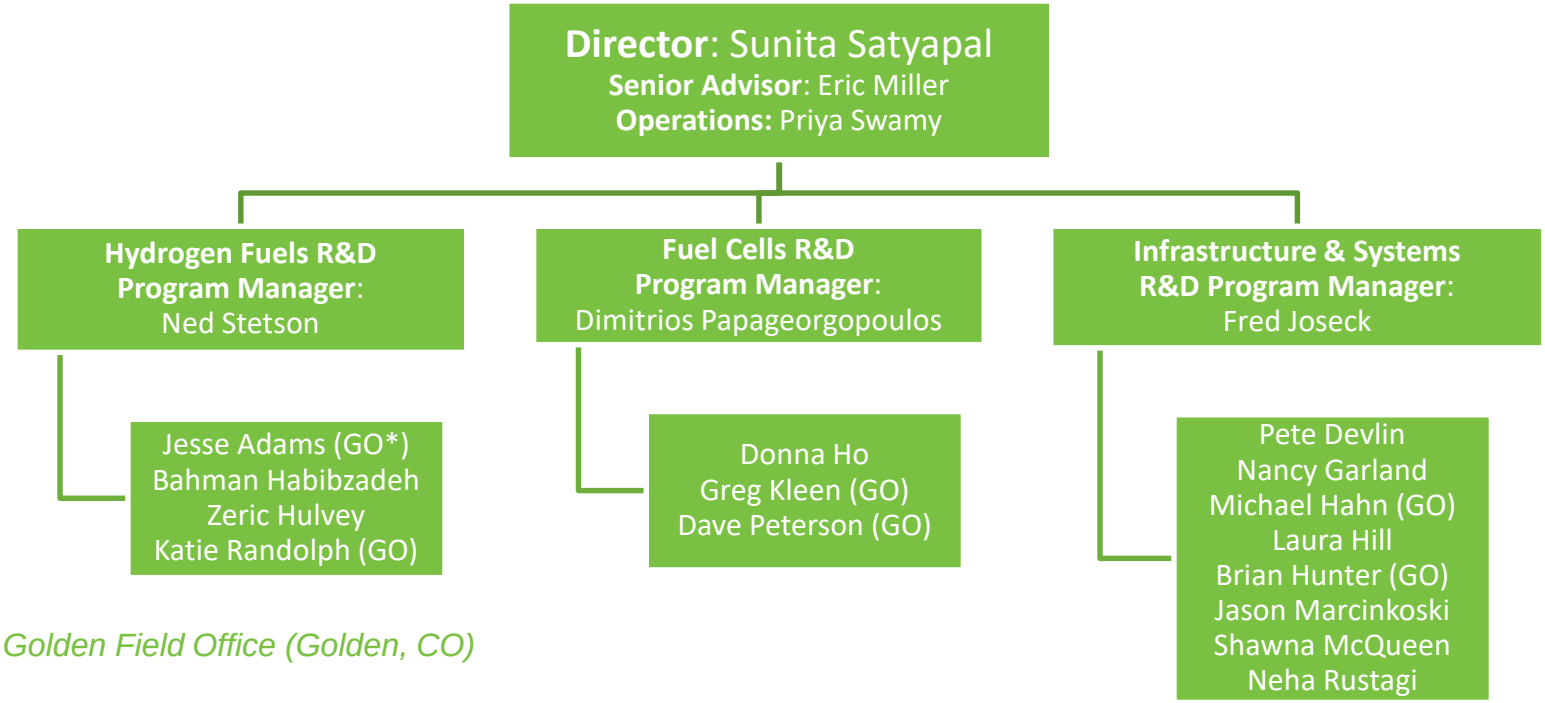
https://www.annualmeritreview.energy.gov/

**Jason Marcinkoski**
Fuel Cell Technologies Office
Jason.Marcinkoski@ee.doe.gov

**energy.gov/eere/fuelcells**

**hydrogen.energy.gov**

# FCTO Organization (Federal)




** Golden Field Office (Golden, CO)*

# Hydrogen and Fuel Cells Funding Across DOE

## EERE – Fuel Cell Technologies Office (FCTO)

| Key Activity | FY 2017 | FY 2018 | FY 2019 |
|---|---|---|---|
| | ($ in thousands) | | |
| Fuel Cell R&D | 32,000 | 32,000 | 30,000 |
| Hydrogen Fuel R&D | 41,000 | 54,000 | 39,000 |
| Hydrogen Infrastructure R&D | - | - | 21,000 |
| Systems Analysis | 3,000 | 3,000 | 2,000 |
| Technology Acceleration | 18,000 | 19,000 | 21,000 |
| Safety, Codes and Standards | 7,000 | 7,000 | 7,000 |
| **Total** | **101,000** | **115,000** | **120,000** |

EERE: Office of Energy Efficiency and Renewable Energy

## DOE-wide Hydrogen and Fuel Cells Funding

| Office | FY 2018 ($ in thousands) |
|---|---|
| EERE (FCTO) | 115,000 |
| Science (Basic/xcut) | 19,000 |
| Fossil Energy (SOFC) | 30,000 |
| Nuclear Energy ($H_2$/hybrid specific) | 2,000 |
| **Total** | **~166,000** |

**Note: ARPA-E funding dependent on program selected each fiscal year**

Approx.
**$12M**
in the past 3 years

**Savings from Active Project Management Go/No Go Decision**

# Fuel Cells: Real-World Uses

Photo Credit: UPS

Parcel trucks in CA & NY

Photo Credit: FedEx

Airport tow trucks in Memphis

Power for ports in Hawaii

Photo Credit: Sandia National Laboratories

Army/GM truck collaboration


Photo Credit: General Motors

Stationary power in >40 states

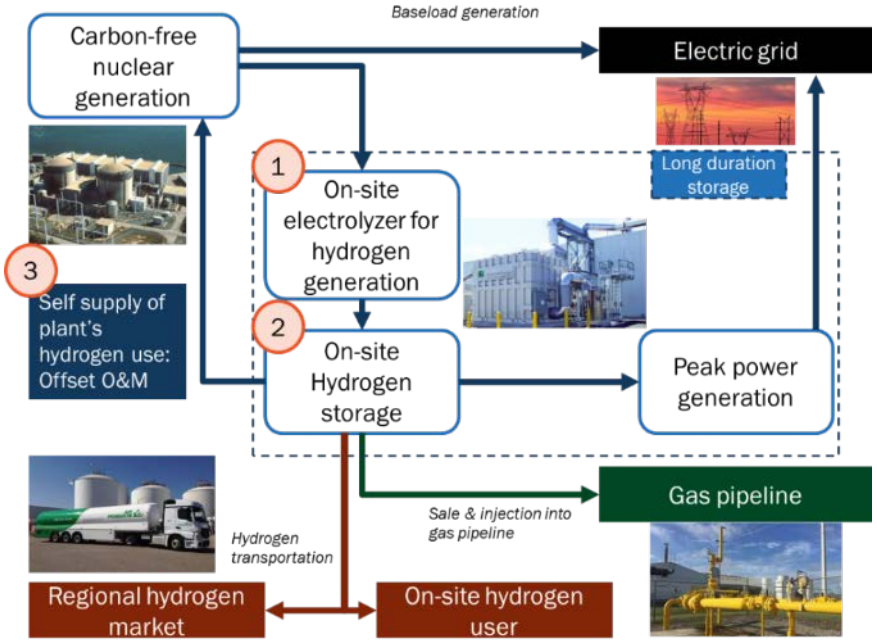

Photo Credit: Fukuoka Pref.

# Electrolyzer Operation at Nuclear Plant and In-House Hydrogen Supply

**Clean H2 production enabling dispatchable, carbon-free power**

## Objectives

- Develop an integrated hydrogen production, storage, and utilization facility at a nuclear plant site, based on a PEM electrolyzer
- Demonstration of economic supply of carbon-free hydrogen for internal nuclear site use.
- Dynamic control of the electrolyzer




## Program Summary

**Partners**: Exelon & Nel Hydrogen, INL, NREL, ANL
**Period**: 36 months
**Total budget**: $7,238,122

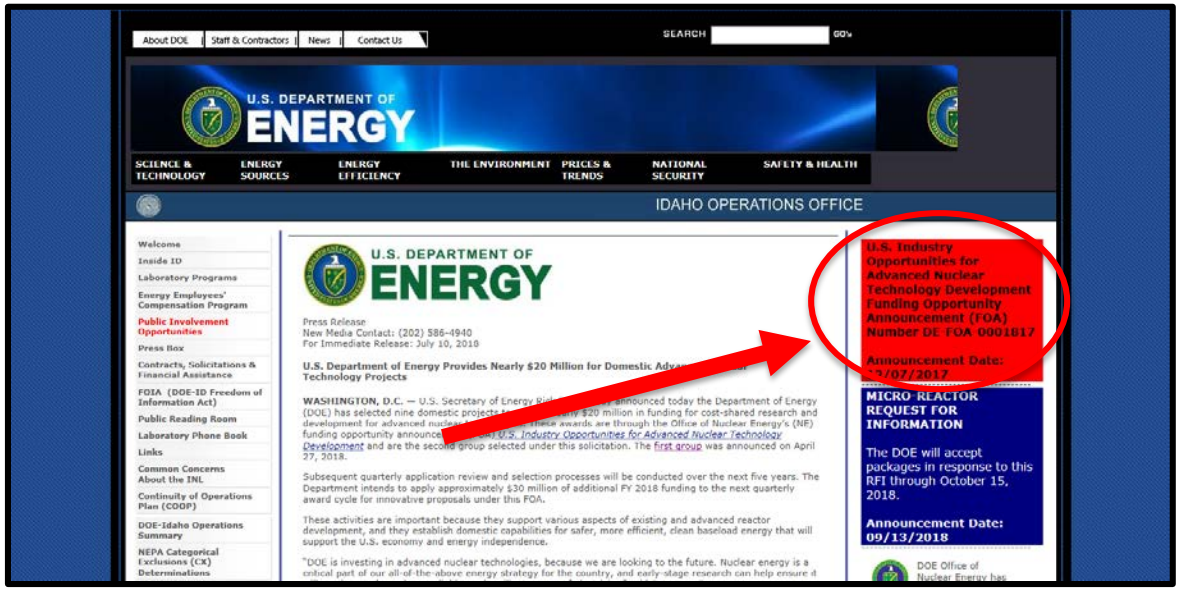
| | Key Milestones & Deliverables |
|---|---|
| Year 1 | • Site selection, 30% engineering design<br>• Simulation using prototype electrolyzer |
| Year 2 | • 100% engineering design, decision to install<br>• Complete manufacture, test of electrolyzer. |
| Year 3 | • Start of steady state operation of electrolyzer<br>• Simulation of scale-up electrolyzer operation<br>• Demonstration of dynamic operation on site |

## Expected Outcomes

- Scaled-up hydrogen production in the U.S. power sector through a dynamically operable hydrogen production facility at a nuclear plant enabling nuclear units to be dispatchable.
- Demonstrated mechanism for hydrogen-based energy storage systems to improve nuclear plant participation in organized power markets.

# Industry FOA

- Where to find more: https://www.id.energy.gov/
  - FOA
  - Questions & Responses
  - Begin Application Process
  - Webinar Video



# Industry FOA - Statistics

- Completed six rounds of reviews/selections since inception, currently undergoing a 4th round of reviews for Cycle 2019

- To Date:
  - ~ 70 applications submitted
  - ~ 50 separate entities applied
  - 30 applications selected for negotiations for award
  - More than $195M committed to awards
  - ~ 45% success rate of being selected for award

# Industry FOA – Funding Availability

- Funding for awards must align with Congressional Appropriations
- Project Topics:
  - Based on remaining FY 2019 funds plus projected FY 2020 funding
  - Modeling and Simulation Projects
  - Projects that integrate nuclear energy into micro-grid, non-electric, and/or hybrid applications
  - Cross-cutting Projects
  - Dynamic Convection Projects
  - Projects that assist the current fleet of light water reactors
  - Advanced small modular reactor projects
  - Projects that address regulatory and licensing issues with the NRC

# Industry FOA – Funding History and FY 2020 (Worley Projection)

| | Hub/NEAMS | CTD | LWRS | Adv SMR | ART | Licensing | Dynamic Convection | Fuel Cycle |
|---|---|---|---|---|---|---|---|---|
| **FY 17-19** | 13.9 | 24.7 | 25.5 | 64.1 | 61.0 | 3.1 | 3.0 | - |
| **FY 2020 Personal Projection** | 3-5 | 10-15 | 10-12 | 80-85 | 0-5 | 2-3 | 3.0 | TBD |

# Industry FOA:
# From Selection to Finalization of Award

- What happens after you are selected for negotiations?
  - Assignment made to Contract Specialist
  - Applicant provides required information
  - Technical evaluation of application/budget
  - Budget analysis
  - NEPA determination
  - Negotiation of award with applicant
  - Final budget established
  - Award package routed for approval
  - Applicant is notified of award

# Lessons Learned and Feedback - Negotiation Process

- Improved Communications
  - DOE-ID issues a welcome letter to the PI and Business Manager listed in the application and provides the following information:
    - Contact information for the assigned Contract Specialist and the Contracting Officer is provided to applicant to support future communications.
    - A list of policies and procedures the applicant is required to submit.
    - A website providing guidance on preparing the required information.
  - DOE-NE Performance Information Collection System (PICS) requirement.

# Lessons Learned and Feedback - Award Process

## Please Note:

If Applicants do not provide the documents required for award, the award cannot be made.

# Lessons Learned and Feedback - Award Process

## Industry FOA Section IV, K “Pre-Award Costs”

- Recipients may request that pre-award costs be allowed.
- Recipient must receive a letter from the CO providing written approval prior to incurring any reimbursable pre-award costs. This applies to costs incurred prior to the effective date of the Federal award.
- These costs are typically approved for the ninety (90) calendar day period immediately preceding the effective date of the award. Pre-award costs greater than 90 calendar days may also be considered, but must also be approved in writing by the CO.
- Pre-award costs must be considered necessary for efficient and timely performance of the scope of work.
- Costs must be allowable in accordance with the applicable Federal cost principles referenced in 2 CFR Part 200 as amended by 2 CFR Part 910.
- **Pre-award costs are incurred at the applicant's risk.** DOE is under no obligation to reimburse such costs to an applicant who, for any reason, does not receive an award or receives an award for a lesser amount than the applicant expected.

# Overview of Amendment No. 007 Changes

Amendment 007 to the FOA is excepted to be issued November, 2019.

- Overview of changes:
  - Multi-award periods established, February, June, & October.
  - Foreign government ownership/interests disclosure and template updated.
  - Fusion energy added to the list of “Applications Specifically Not of Interest”.
  - Budget Periods are to be written so that tasks are completed within each proposed Budget Period.
    - When the Department is under constrained funding, applicants budget period breakdowns can be very helpful if we can award a specific BP rather than the entire proposal,
    - When application can point to a milestone event at the end of the BP that shows a meaningful outcome that will add further evidence to award. Not a guarantee but it is helpful.

# Overview of Amendment No. 007 Changes

Changes cont'd:

- If only a portion of the application is selected for negotiations, a new application is required to be submitted for the portion not selected.
- Federal Ceiling Amount for Advanced Reactor Development Projects increased from $10M to $20M.
- Prime expected to perform a minimum of 35% of the total work effort.
- Additional information provided on the submittal of continuation applications.

# Overview of Amendment No. 007 Changes

Changes cont'd:

- Prime recipient is allowed up to three active awards if one or more of the awards is a Pathway 3 (Regulatory Grant) award.
- Definition of Collaborator provided.

- Does Industry have any proposed changes?

# Lessons Learned and Feedback - Application Review

- Industry FOA Section IV. D. 5. “Project Narrative File”
  - The Project Narrative should be formatted to address each of the merit review criterion listed in Section V.C.2. Provide sufficient information so that reviewers will be able to evaluate the application in accordance with these merit review criteria (cross reference in your discussion which criteria is being addressed). **DOE has the right to evaluate and consider only those applications that separately address each of the merit review criteria.**
    - FOAK Nuclear Demonstration Readiness Projects
    - Advanced Reactor Development Projects

# Lessons Learned and Feedback - Application Review

- Industry FOA Section IV. D. 23. “Past Performance”/ Industry FOA Section IV. F. 14. “Past Performance”
  - Applicants must submit data on past performance that demonstrates the applicant team (not required for FFRDC/NL) has demonstrated successful experience/past performance, knowledge and understanding of the business and regulatory requirements for projects of similar size, scope and complexity in achieving project technical success within budget and on time with no significant safety and quality issues.

- Past Performance ≠ Experience
  - Discuss performance of prior work (e.g. Budget and Schedule)

# Lessons Learned and Feedback - Application Review and Project Oversight

- If possible, proposing project in multiple budget periods, each with well-defined, meaningful outcomes is beneficial to DOE
- DOE needs to fully understand the role of partners with respect to assigned scope and funding
- Define the long-term outcomes for the project. Present the overall development/commercialization strategy
- Fully identify risks and valid management strategy
- Oversight of awarded projects via PICS:NE system. Please support. DOE will assist

# US Industry Feedback and Lessons Learned

Starting the dialogue…

- What can be improved?
- What is working?
- What can be expanded upon?

A complete Set of Q&As, as well as the webinar video will be posted to [https://www.id.energy.gov/](https://www.id.energy.gov/)

# Questions?

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