Energy Materials Network
U.S. Department of Energy

HydroGEN
Advanced Water Splitting Materials

HydroGEN:
A Consortium on Advanced Water Splitting Materials

Huyen Dinh, Director of HydroGEN, NREL

8/21/2023

HydroGEN STCH & PEC Project Kickoff Meeting

NREL Transforming ENERGY
BERKELEY LAB Bringing Science Solutions to the World
Sandia National Laboratories
INL Idaho National Laboratory
Lawrence Livermore National Laboratory

Objectives

- Lab experts learn about the new projects
- Project team members understand the HydroGEN resources available to them
  - Lab capabilities and expertise for collaboration and project success
  - Teams / SharePoint site for collaboration
  - Data Hub for data sharing
  - Technology transfer agreements (TTA) for streamlined access
- Meet and build an integrated team / community
  - Accelerate PEC & STCH technologies

Energy Materials Network (EMN) Core Pillars

1. ***WORLD CLASS MATERIALS CAPABILITY NETWORK:*** Create and manage a **unique, accessible set of capabilities** within the DOE National Laboratory system
2. ***CLEAR POINT OF ENGAGEMENT:*** Provide a **single point-of-contact** and concierge to direct interested users (e.g., industry research teams) to the appropriate laboratory capabilities, and to **facilitate efficient access**.
3. ***DATA AND TOOL COLLABORATION FRAMEWORK:*** **Capture data, tools, and expertise** developed at each node such that they can be **shared and leveraged** throughout the EMN and **in future programs**. Establish data repositories and, where appropriate, **distribute data to the scientific community and public**. Accelerate learning and development through data analysis using advanced informatics tools.
4. ***STREAMLINED ACCESS:*** Facilitate **rapid completion of agreements** for external partners, and aggressively pursue approaches to reduce non-technical burden on organizations seeking to leverage the EMN for accelerated materials development and deployment.

HydroGEN Overview

Website: https://www.h2awsm.org/

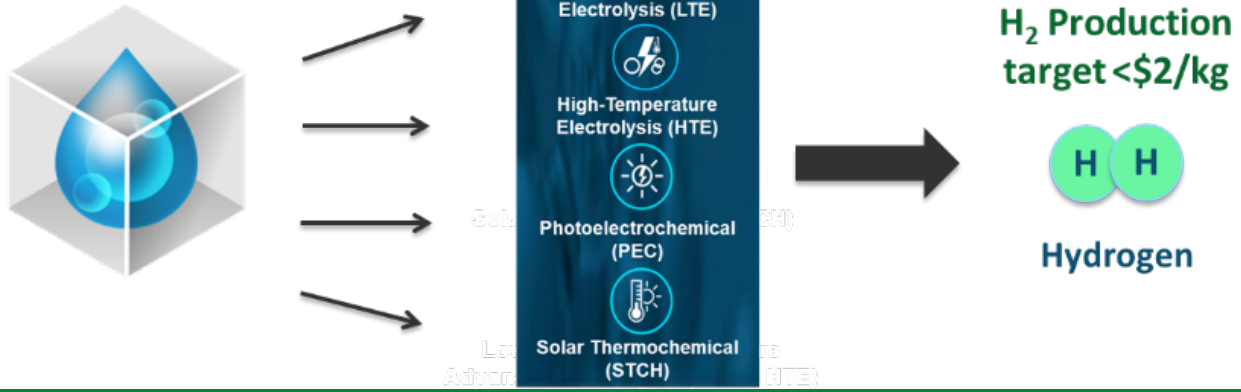
Goal: Accelerating R&D of innovative advance water splitting (AWS) materials and technologies for clean, sustainable and low-cost hydrogen production.

Barriers

- Cost
- Efficiency
- Durability

National Lab Consortium Team

NREL – National Renewable Energy Laboratory
Berkeley Lab
Idaho National Laboratory
Sandia National Laboratories
Lawrence Livermore National Laboratory



HydroGEN is advancing Hydrogen Shot goals by fostering cross-cutting innovation using theory-guided applied materials R&D to advance all emerging water-splitting pathways for hydrogen production

HydroGEN Energy Materials Network

Collaboration, Streamline Access

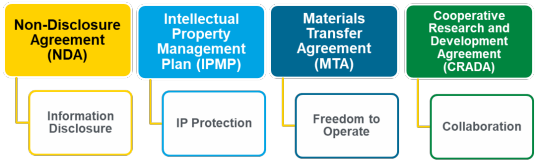
HydroGEN is vastly collaborative, has produced many high value products, and is disseminating them to the R&D community.

2 R&D 100 Awards

118 Publications, Impact factor* = 2.20
2,783 citations, 436 authors

4 community benchmarking workshops

STEM Work Force Development



https://www.h2awsm.org/working-with-hydrogen

*Field-weighted citation impact (FWCI) indicates how the number of citations received by the Publication Set's publications compares with the average number of citations received by all other similar publications in Scopus.

HydroGEN Leadership

Director
Huyen Dinh
(NREL)

Cross-Cutting Activities

- **Data Hub**
- **Technology Transfer**
- **Website, SharePoint Site, Zotero Library**

Research

LTE Technology Lead	HTE Technology Lead	PEC Technology Lead	STCH Technology Lead	Cross-Cutting Modeling Lead
Shaun Alia/ Bryan Pivovar (NREL)	Dong Ding/ Qian Zhang Qian Zhang (INL)	Adam Weber/ Joel Ager (LBNL)	Tony McDaniel/ Sean Bishop (SNL)	Tadashi Ogitsu/ Brandon Wood (LLNL)

NREL Transforming ENERGY · INL Idaho National Laboratory · BERKELEY LAB · Sandia National Laboratories · Lawrence Livermore National Laboratory

Community Approach to Benchmarking and Protocol Development for AWS Technologies

Goal: ***Develop best practices in materials characterization and benchmarking: Critical to accelerate materials discovery and development***

Best Practices in Materials Characterization

Kathy Ayers, Nel Hydrogen (LTE)
Ellen B. Stechel, ASU (STCH)
Olga Marina, PNNL (HTE)
CX Xiang, Caltech (PEC)
Consultant: Karl Gross, George Roberts

- Strong community engagement and participation, nationally and internationally
  - Participation from both HydroGEN and H2NEW consortia
- Disseminated information to AWS community via HydroGEN Data Hub, website, SharePoint site, email, quarterly newsletters, workshops

Accomplishments:

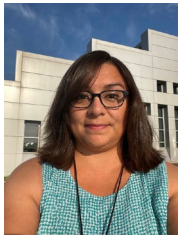
- **19 standardized measurement protocols and benchmarks published in open-access journal Frontiers in Energy Research special issue:** free to download: https://www.frontiersin.org/research-topics/16823/advanced-water-splitting-technologies-development-best-practices-and-protocols#articles
  - 7 LTE, 4 HTE, 5 PEC, 3 STCH
  - 4,912 total downloads and 36,000 views
- **4 Annual AWS community-wide benchmarking workshop**
- **Developed high-level roadmaps by AWS technology**

Date: Thursday September 21 - Friday September 22, 2023
Location*: Sky Song: The ASU Scottsdale Innovation Center- Scottsdale, AZ USA
**In-Person attendance is highly encouraged!*

Pre-Registration is now open: Link to Pre-Registration Site

Introducing the Teams

- **Website / Communications / Zotero team**
  - Sara Havig and Natasha Headland / Jason Youngstrom
- **Teams / SharePoint** point of contact
  - Christina Vader
- **Data Hub Team**
  - Rachel Hurst, Emily Harrell, Christina Vader
- **Technology Transfer Agreement Team**
  - Angel Medina-Drago (NDA)
  - Megan Grimes (CRADA)
  - Eric Payne (IP management plan)



Important items and links

- For publications, please see DOE's guidance on acknowledgement and disclaimer.
- Please add the bibliography of your HydroGEN publications & presentations to the H2AWSM Zotero Site. There's a Zotero tutorial on the SharePoint site to help you use this tool.
- When you publish a paper as part of HydroGEN work, please prepare a technical highlight using the template and add it to the SharePoint site, choosing "Highlights" as the Document type and the appropriate fiscal year (e.g., FY2020) for the Fiscal Year.
- When preparing HydroGEN project presentations, please use the HydroGEN powerpoint template-16x9 or template-4x3.

Teams Site for Collaboration

- HydroGEN – AWSM main site
  - General
  - Benchmarking
  - HydroGEN Seedling Projects
    - More open than individual project sites
- Share files (quarterly reports, PowerPoint presentations, meeting minutes, contact info, pictures, etc.)

Agenda: Day 1

Time	Topic	Lead
1:00 pm	DOE Welcome Introductions and Day's Objectives HydroGEN Director's address	James Vickers and Dave Peterson Huyen Dinh
1:30 pm	Data Hub (10 min talk + 5 min Q&A) Technology Transfer Agreements (10 min talk + 5 min Q&A)	Rachel Hurst Angel Medina-Drago and Megan Grimes
2:00 pm	**Break**	

Agenda: Day 1 (Continued): STCH Project Presentations

2:15 pm	**New Project Overviews (10 min talk + 5 min Q&A): STCH** 1. University of Colorado Boulder 2. Arizona State University 3.Washington University in St. Louis 4. University of Colorado Boulder 5. Saint-Gobain	1. Al Weimer 2. Chris Muhich 3. Robert Wexler 4. Charles Musgrave 5. Xin Qian
3:30 pm	**Break & Group picture**	

Agenda: Day 1 (Continued): PEC Project Presentations

4:00 pm	**New Project Overviews (10 min talk + 5 min Q&A): PEC** 1. Rice University 2. University of Toledo 3. University of Michigan 4. University of Hawaii Manoa 5. California Institute of Technology 6. Yale University	1. Aditya Mohite 2. Yanfa Yan 3. Zetian Mi 4. Nico Gaillard 5. Joel Haber 6. Shu Hu
5:30 pm	**Notes for tomorrow**	
5:45 pm	**Adjourn / Shuttle back to Marriott Denver West**	
6:30 pm – 9 pm	**No Host Dinner at Guapo Taco (14500 W Colfax Ave Suite 343, Lakewood, CO 80401)** guapotacocolorado.com; (720) 835-2068; Reservation is under HydroGEN. Carpool encouraged.	

Agenda: Day 2

Time	Topic	Lead
9:00 am	Introductions and Day's Objectives	Huyen Dinh James Vickers
9:15 am	**Successful Examples of Project - HydroGEN PEC Nodes Interactions** (10 min talk + 5 min Q&A)	Joel Ager
9:30 am	**Successful Examples of Project - HydroGEN STCH Nodes Interactions** (10 min talk + 5 min Q&A)	Tony McDaniel
9:45 am	**Break** **Ice breaker game: body bingo game**	Christina Vader

Agenda: Day 2: PI/Node Interaction & Optional Lab Tour

10:10 am	**PI/Node interaction** "Simple Node Poster" Data hub booth for access sign up
12:00 pm	Adjourn / Lunch
1 – 3:15 pm	**Optional Lab Tour (Shuttle to different buildings)** - Pick up your safety glasses here - Shuttle pickup is 12:45 pm
3:15 pm	**Shuttle back to Marriott** - Pick up people at IBRF first at 3 pm, - then pick up lab tour people at ESIF

Lab Tour

- 1 pm: **Keenan**: PEC testing capability
  - SERF E216: 15 minutes
- 1:15 pm: **Michael Dzara**: STCH capability
  - SERF E135 & SERF W213: 15 minutes
- **Kai**: Perovskite capabilities:
  - 1:30 pm: SERF.W129: general perovskite film fabrication, thermal evaporator to complete device fabrication, stability setup
  - 1:45 pm:SERF.C215: cell performance measurement, more stability setup
  - 2pm: PDIL in S&TF: scalable deposition system, large area module fabrication
- 2:15 pm: **Glenn Teeter**:
  - STF 140: NAP-XPS characterization capability
- 2:30 – 3 pm: **Chai Engtrakul & Fry Intia**
  - ESIF C323, C321, C330, C331
- **Judy Netter**: High Flux Solar Furnace
  - 3:30? – carpool?

Acknowledgements

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James Vickers

William Gibbons

Rachel Mow

David Peterson

Katie Randolph

Ned Stetson

Eric Miller