U.S. Department of Energy (DOE) Hydrogen Carriers Workshop: Novel Pathways for Optimized Hydrogen Transport & Stationary Storage

November 13-14, 2019

Denver Marriott West
1717 Denver West Marriott Blvd.
Golden, CO 80401

WORKSHOP OBJECTIVES

- Enhance knowledge of and promote potential advantages hydrogen carriers
- Help shape DOE strategy for hydrogen carrier R&D
- Identify key gaps and barriers related to hydrogen carriers
- Prioritize R&D focuses and develop preliminary targets

Day 1

1:00–1:30 pm **Arrival / check-in**

1:30–1:45 pm **Introduction and Workshop Goals —** Ned Stetson, DOE

1:45–2:15 pm **Hydrogen Carrier Analysis** — Rajesh Ahluwalia, ANL

2:15–2:45 pm **Hydrogen Carrier Activities within HyMARC** — Tom Autrey, PNNL

2:45–3:00 pm **Breakout #1 Instructions**

3:00–3:15 pm *Coffee Break*

3:15–4:45 pm **Breakout #1** ***(Groups A, B, & C: What are hydrogen carriers and why use them?)***

- DOE currently uses a very broad definition of H_2 carriers. Beyond organic and inorganic liquid compounds (e.g.., methanol, ammonia), what materials might be used as a carrier?
- Should the definition of H_2 carriers be narrower? If so, what materials should and shouldn't be considered?
- Are there technical pathways (i.e., formation or dehydrogenation approaches) that are more advantageous than others?
- What advantages might H_2 carriers provide other than just higher hydrogen density and/or cost of delivered H_2?
- What role might H_2 carriers play in the emerging hydrogen infrastructure?

4:45pm **Adjourn**

Day 2

8:30–8:45 am **Arrival / Check-in**

8:45–9:00 am **Breakout #1 reports out**

9:00–9:30 am **Industry Perspectives** — Daisuke Kurosaki, Chiyoda

9:30–10:00 am **Industry Perspectives** — Rafael Schmidt, Hydrogenious

10:00–10:15 am *Coffee Break*

10:15–11:45 am **Expert Panel: Potential End Uses for Hydrogen Carriers**
Mike Perry, *United Technologies Research Center*; Guido Pez, *Air Products (retired), Lehigh University*; Genevieve Saur, *NREL;* Daisuke Kurosaki, *Chiyoda*; Rafael Schmidt, *Hydrogenious;* Bahman Habibzadeh, *DOE (moderator)*

11:45–12:00 pm **Breakout #2 and #3 Instructions**

12:00–1:00 pm *Lunch*

1:00–2:30 pm **Breakout #2** ***(Groups A, B, & C: Opportunities for hydrogen carriers)***

- Which application are ideal for H_2 carriers? Which aren't?
- What advantages do H_2 carriers provide for the ideal applications?
- What are key characteristics of H_2 carriers needed for the ideal applications?
- How would H_2 carriers help enable the application, either to be commercialized or for significant improvement?

2:30–2:45 pm *Coffee Break*

2:45–4:15 pm **Breakout #3**

Group A & B: Performance metrics and targets for hydrogen carriers

For the top 2-3 applications from breakout 2, consider:

- How do we develop targets for vastly different end uses?
- What are key performance attributes of H_2 carriers needed for success (e.g., cost, wt.%, H_2/vol, temp/pressure of operation)?
- How can those performance metrics be quantified (e.g., relative to conventional technology (X times), or specific values (X wt.%))?
- What is the current state-of-the-art for H_2 carrier performance, and what or how much improvements are needed?

Group C: R&D required for hydrogen carriers

For the potential H2 carriers identified for the top 2-3 applications from breakout 2, consider:

- In general what are the primary R&D needs to develop or demonstrate H_2 carriers?
- What R&D is needed to achieve and/or demonstrate H_2 carriers performance for the identified applications?
- What should be the government's primary role in H_2 carriers?

4:15–4:30 pm *Break/Group reconvenes*

4:30–5:30 pm **Breakout #2 and #3 reports out/Wrap-up/Discussion**