Hydrogen Production: Education & Research

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Hydrogen Production: Education & Research

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Past & Current Hydrogen Research: DRI, UNR & UNLV

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Clean Hydrogen Initiatives (Las Vegas)

- **Southwest Clean Hydrogen Innovation Network (SHINe)** submitted a proposal for the development of a desert Southwest clean hydrogen hub, was not funded.
- **Hydrogen Fuel Cell Electric Buses** with RTC Southern NV.
- **UNLV and Southwest Gas partnership** to develop a hydrogen-blending pilot program to study how hydrogen-blended natural gas can further reduce carbon emissions while still providing clean and reliable energy.
- **Air Liquide** opened its largest liquid hydrogen production facility in North Las Vegas, Nevada. The goal is to supply the growing needs for hydrogen mobility, and to provide hydrogen to a wide array of industries that can use it currently as other markets are developed.
  - Will produce 30 metric tons of liquid hydrogen/day, powered by fully renewable electricity.
  - Has the ability to provide enough renewable hydrogen for over 40,000 fuel cell vehicles in California, significantly improving the hydrogen supply for mobility.

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Hydrogen in Transportation

- **Challenges** include cost, hydrogen source, lack of stations, etc.
- Vehicle sales & leases in U.S. are **far behind** battery electric vehicles.
- Sufficient network of stations would be a **significant** investment & is required to support widespread vehicle adoption.
- **Research needs for Nevada**:
  - What would be sufficient for Nevadans?
  - Geographical location of stations throughout the state?
  - Commercial fleets and/or light-duty personal vehicles?
- **Key Barriers**:
  - Lack of a convenient network stations; reliability of existing stations in relatively sparse networks
  - Limited empirical research in Nevada: most of existing research is from elsewhere in the world, and for the U.S., in California.

Source for images: Kelley, S., Krafft, A., Kuby, M., Lopez, O., Stotts, R., & Liu, J. (2020). How early hydrogen fuel cell vehicle adopters geographically evaluate a network of refueling stations in California. *Journal of Transport Geography*, *89*, 102897.

Hydrogen Programs in Education

Recent, active research on hydrogen at **DRI, UNLV, and UNR.**

- Limited to individual NSHE faculty research programs and some of their graduate students.
- Not coordinated within or across NSHE institutions.
- No dedicated courses on hydrogen and hydrogen technologies are currently offered.
- Hydrogen is occasionally addressed in class assignments and individual lectures in undergraduate and graduate courses taught by individual faculty with active in research on hydrogen, but does not represent the central focus on any existing class.

What sorts of skills, training, and expertise would be required of students that NSHE institutions could help provide?

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Why Clean Hydrogen?

- **Environmental Benefits**
  - Zero emissions and renewable energy production.
- **Energy Efficiency**
  - High energy density combined with hydrogen fuel efficiency.
- **Versatility and Flexibility**
  - Wide range of applications.
  - Integration with existing infrastructure (such as natural gas).
- **Energy Security and Independence**
  - Diversity of hydrogen production from water, natural gas, biomass, and even waste.
  - Domestic hydrogen production enhances energy security.
- **Technological Advancements and Economic Opportunities**
  - Innovative technologies: advances in hydrogen production, storage, and fuel cell technologies.
  - Create new industries and job opportunities.

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Why **Not** Hydrogen?

- **High Production Costs and Energy Intensity**
  - Energy-intensive cost.
- **Infrastructure Challenges**
  - Infrastructure, transportation, storage: hydrogen infrastructure (production facilities, storage systems, pipelines, and refueling stations) is lacking or not easily converted.
  - Transport and storage issues: hydrogen requires high-pressure storage or liquefaction.
- **Safety Concerns**
  - Flammability, explosiveness and handling and storage risks.
- **Environmental and Resource Concerns**
  - Blue Hydrogen: hydrogen production can rely on natural gas which emits C.
  - Hydrogen via electrolysis requires a significant amount of water.
- **Technological and Economic Viability**
  - Competition with other technologies and slow market adoption.

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Green Hydrogen for Nevada

Water

Renewable Electricity

Point-of-use

Key Questions:

- **Where are these components located in Nevada?**
- **What are the current and potential scale of these components across Nevada?**
- **What investment is needed where to realize that potential?**
  Education, Workforce, Industry, Communities
- **What current efforts can be leveraged?**
  Nevada Water Initiative, Southwest Sustainability Innovation Engine

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Questions?

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Thank you

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