

# Validating an electrolysis system with high output pressure

Danny Terlip, Presenter  
National Renewable Energy Laboratory  
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DOE Hydrogen and Fuel Cells Program  
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Project ID H2036

# Overview

## Timeline and Budget

- Project start date: 8/1/2018 (estimated)
- Project end date: 8/1/2019 (estimated)
- Total project budget: \$224k
  - Total recipient share: \$124k
  - Total federal share: \$100k
  - Total DOE funds spent\*: \$0

\* As of 4/17/18

## Barriers

- Reliability and Costs of Hydrogen Compression (Delivery B)
- Other Fueling Site/Terminal Operations (Delivery I)
- Hydrogen from Renewable Resources (TV G)

## Partners

- Honda R&D Americas, Inc.
- Danny Terlip, NREL, PI

# Relevance

State of the art  
electrolysis outlet

30b



PRESSURE GAP

Light duty fuel cell  
electric vehicle market

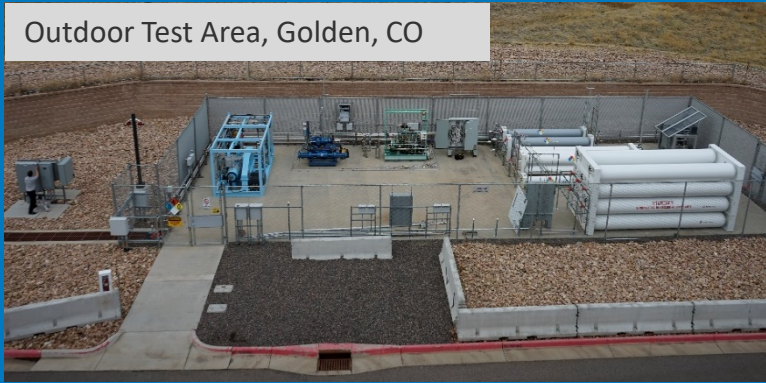
700b

PRESSURE GAP necessitates additional, costly mechanical compression

# Approach - 3<sup>rd</sup> party benchmarking and validation of Honda system

Integrate and test Honda electrochemical hydrogen compressor in NREL's Hydrogen Infrastructure Testing and Research Facility (HITRF)

Outdoor Test Area, Golden, CO



Stack Test Bed, Golden, CO



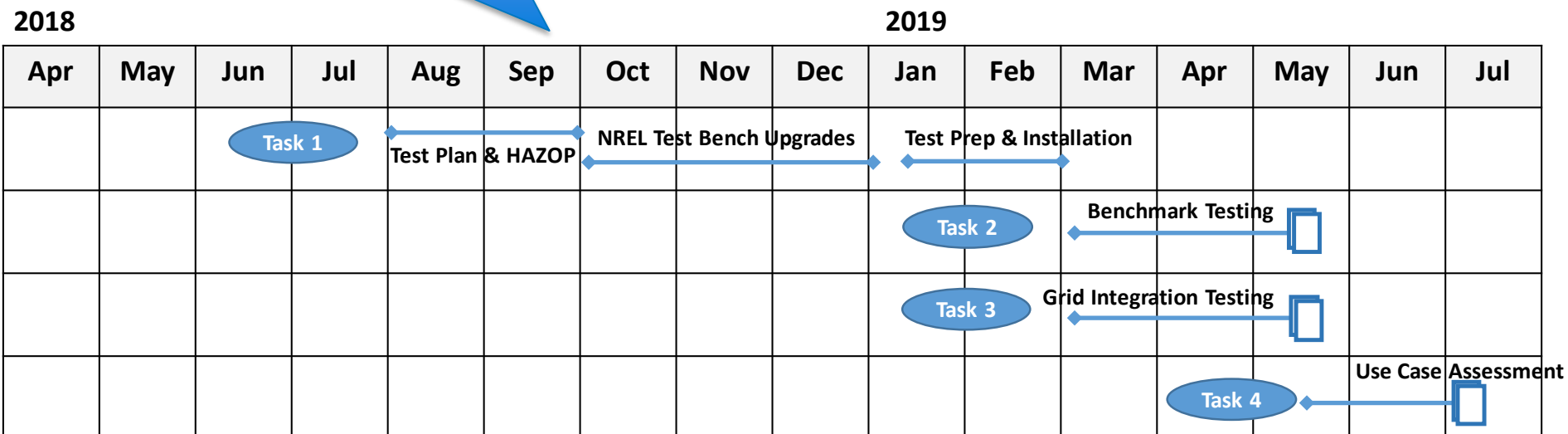
## HITRF Major System Components

Low Pressure Storage	200b, 189 kg	5 banks	Type 1 ground storage
Med Pressure Storage	400b, 103 kg	3 banks	Type 1 ground storage
High Pressure Storage	875b, 62 kg	4 banks	Type 2 ground storage
Power supply	4000A DC, 250V DC	4 units	Controlled remotely, high slew
Mechanical compression	400b, 900b	3 units	Up to 1 kg/min

# Approach – Timeline

- In development of the task schedule and deliverables
- In development of the method for measuring impact and integration of research reporting

This is the timeline we have developed so far



# Approach – Task 1

## Site Preparation and Test Plan Development

- Honda will provide self-developed PEM stack to NREL
- NREL will perform testing at the Energy Systems Integration Facility (ESIF) in Golden, CO

**HITRF system must be upgraded for 700b stack**

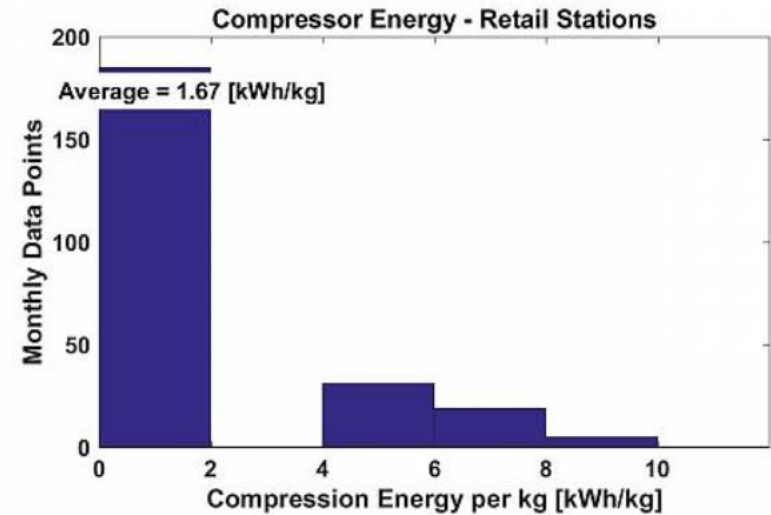
- Team will define widely accepted metrics for benchmarking and design test protocols accordingly

Energy efficiency	Mean time between failure	Product quality
Production rate	Failure modes	Operating temperature
Water flow rate	Output pressure	Response to change

# Approach – Task 2

## Stack and System Benchmarking

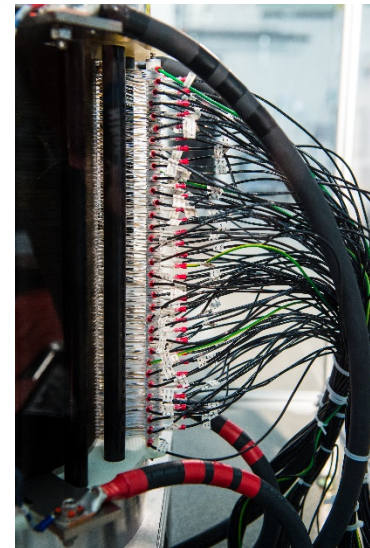
- NREL will operate the stack at various power, pressure and temperature levels to create an efficiency map for comparison with conventional electrolysis + mechanical compression technologies



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- NREL will leverage in-house developed cell voltage monitoring capabilities

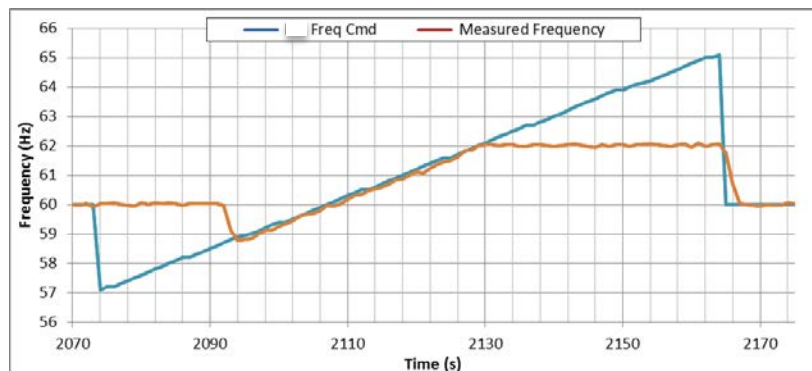
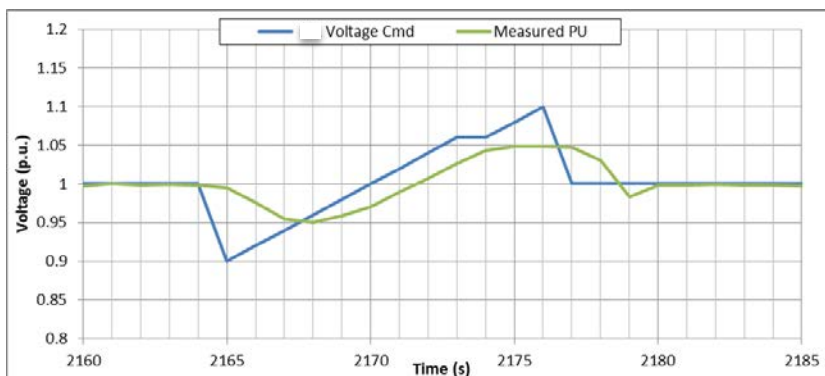
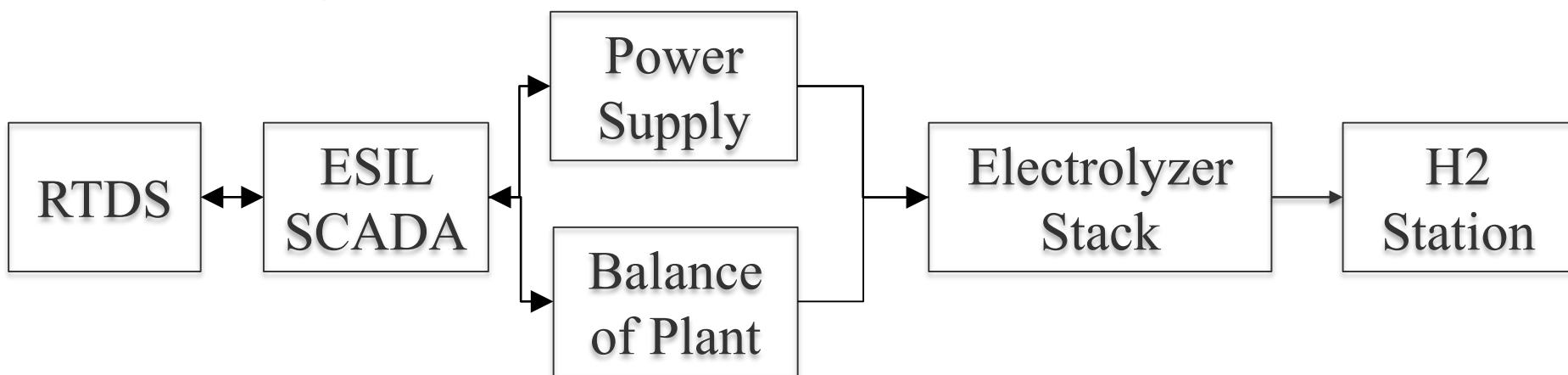




# Approach – Task 3

## Renewable Source and Grid Integration Testing

- NREL will use its controllable AC/DC power supplies to simulate different renewable or regulation profiles for regions identified as potential deployment sites for this electrolyzer





# Accomplishments and Progress

- Finalizing details of agreement

# Collaboration and Coordination

NREL and Honda R&D Americas, Inc. have a good working relationship

- Honda needs a third party validation site with 700b hydrogen capabilities
- NREL will test and provide data to Honda about its product and how it compares with more conventional products
- This may enable improvements in future models and may provide insight into other applications for this technology

# Remaining Challenges and Barriers

- NREL must upgrade its Stack Test Bed to accommodate 700 bar hydrogen
- NREL and Honda must negotiate the test plan and timeline.

# Proposed Future Work

- Begin tasks

# Summary

- The project has not started yet
- NREL will test Honda electrolyzer/compressor system
- NREL will measure metrics to compare with conventional electrolyzer + compression technology (i.e. mechanical)
- NREL will subject the stack to varying input power, that follows renewable energy profiles, while measuring performance.

# Thank You

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Publication Number

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