

Multi-physics Modeling of Hydrogen Fueling Methods

Paul Sorensen - Shell
Mike Peters, Dani Murphy, Taichi Kuroki - NREL

September 11, 2018
International Hydrogen Infrastructure Workshop
Boston, MA

Project Snapshot

Identify, modify, and validate a hydrogen station and fuel cell electric vehicle fueling model. The model will be free to use and will be made available to the public

Project Participants

- Leads: NREL and Frontier Energy
- Industry: Ford, GM, Honda, Hyundai, IVYS, Shell, Toyota
- National Labs: ANL and SNL

Timeline and Budget

- Project start date: 8/14/2018
- Project expected end date: 8/13/2019
- Total budget: \$370k



HONDA



HYUNDAI



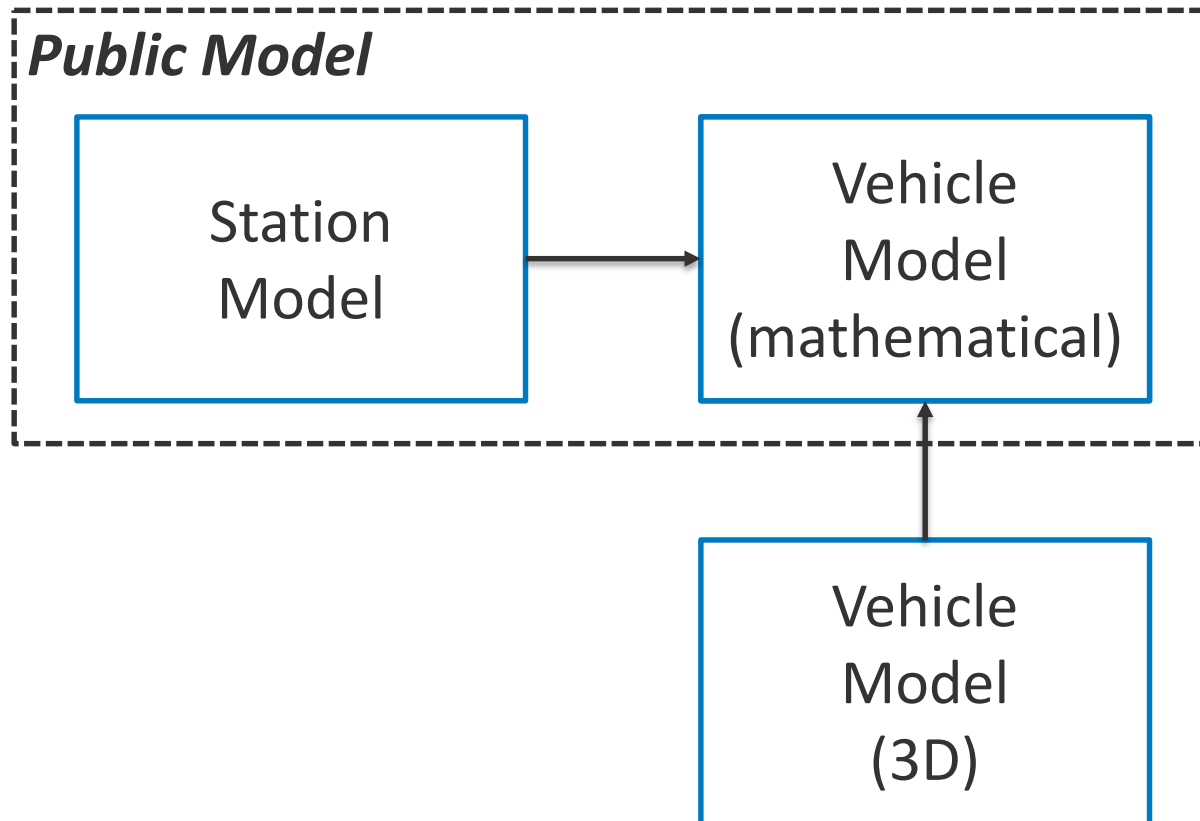
TOYOTA



Shell

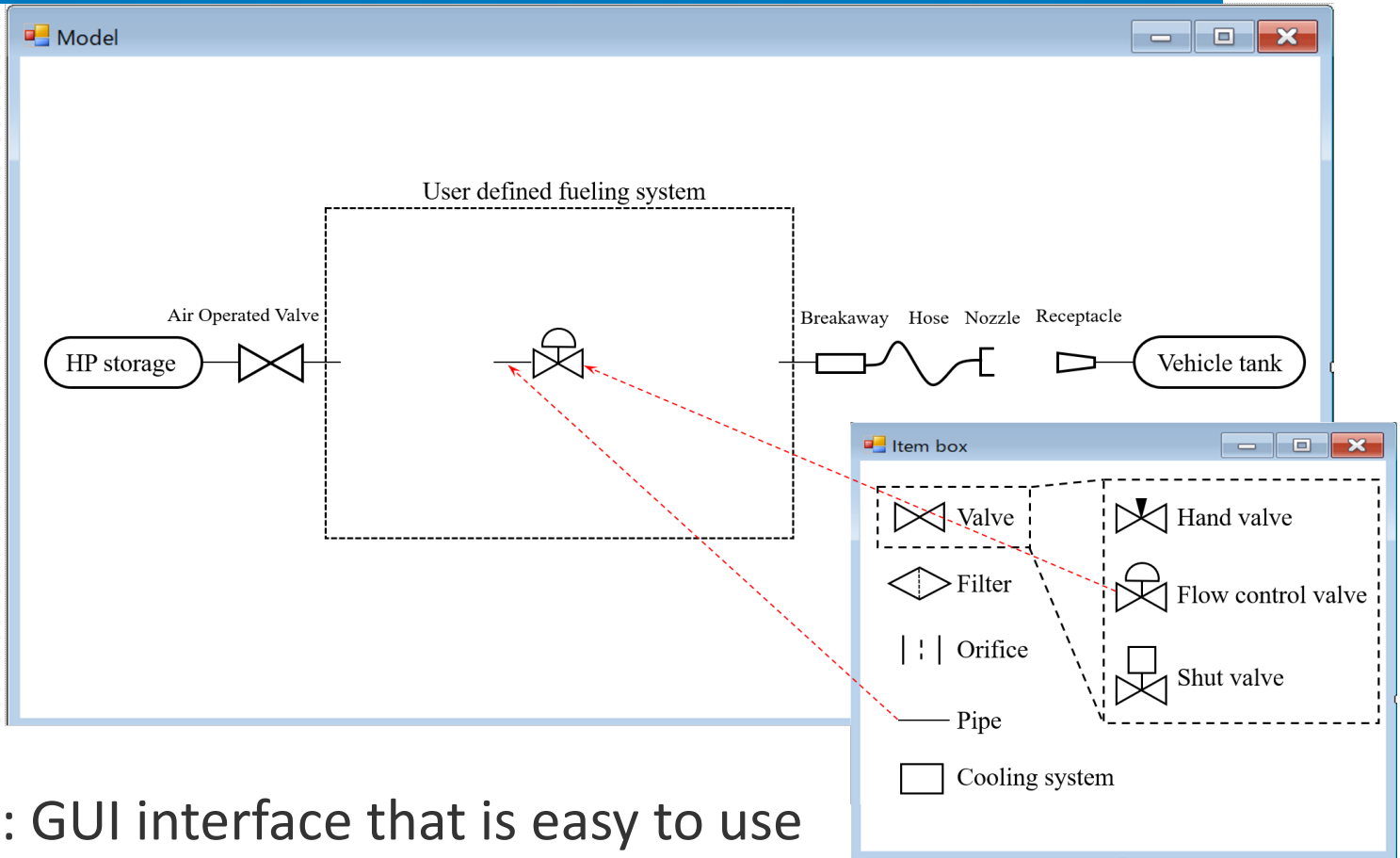


Flow Diagram



Mathematical – Can be operated with a typical computer
3D – Needs specialized software and more computing power/time

User Focused



- **Visual:** GUI interface that is easy to use
- **Accurate:** Clearly defined boundaries of validated versus extrapolated results
- **Flexible:** User defines line lengths, sequencing of components, component characteristics

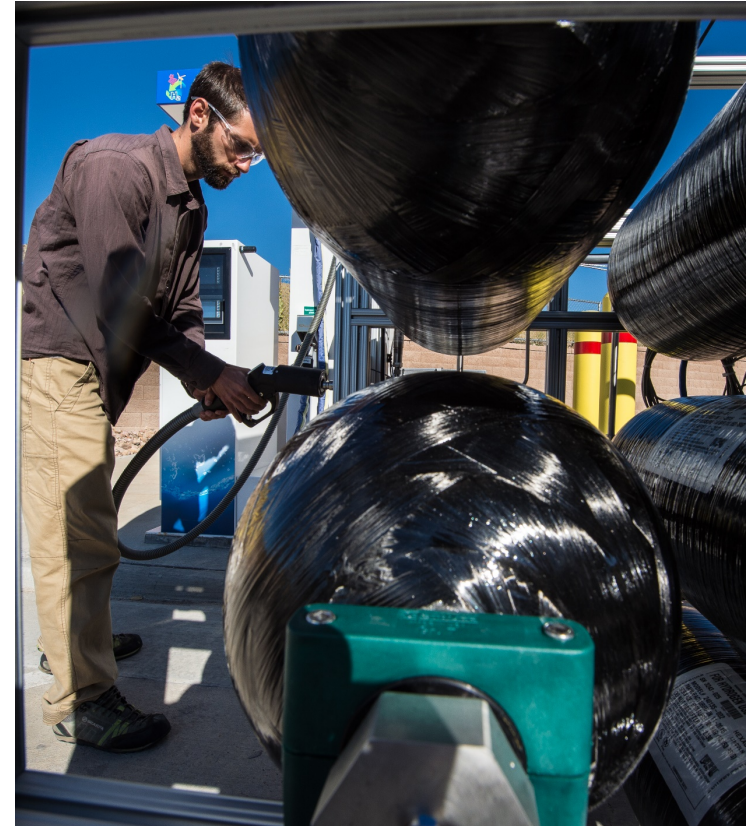
Main Goals

- Explore the interaction between station and vehicle
- Optimize station designs through a better understanding of hydrogen components
- Build upon previous work carried out on the tank vehicle system
 - Utilize validated 3D CFD model to set the accuracy range for the mathematical tank model



Additional Impact

- Project could give more insight into medium- and heavy-duty fueling
- Ambient or slow fueling could also be explored
- Free to use model could assist the codes and standards community as they look towards new protocols



Timeline and Expected Outcomes

- Project is expected to take ~1 year but could be extended with additional funding/scope
- Station and vehicle model drafts within 9 months
- Final 3 months: Validation, troubleshooting, and GUI modifications
- Expect to release the model for public use at the end of the project



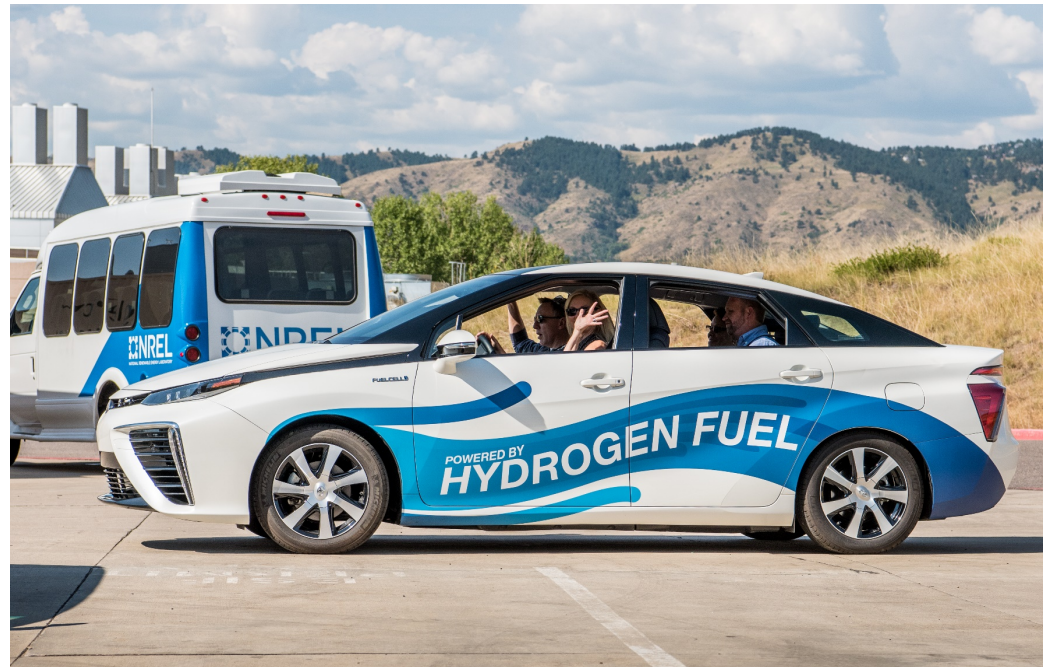
Potential for Future Work

- Make the model capable of handling multiple dispensers
 - Medium pressure storage, compressors, etc.
- Integrate additional hydrogen stations components
 - Medium pressure storage, compressors, etc.
- Expand upon validation work to include other fueling categories and previously out-of-bounds scenarios



Summary

- NREL is leading a joint laboratory and industry project exploring the thermodynamic characteristics of the hydrogen fueling process
- The final model will be released to the public and will be free to use
- The timeline for the project is 1 year



Thank You

Contact Information

Project Lead - NREL

Mike Peters – Michael.Peters@nrel.gov

Dani Murphy – Dani.Murphy@nrel.gov

Taichi Kuroki – Taichi.Kuroki@nrel.gov

A special thanks to Paul Sorensen from Shell for agreeing to present alongside NREL today.