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ARIES: NREL Off-Road Decarbonization and Energy Systems Integration Workshop - Challenges and Opportunities

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About Advanced Research on Integrated Energy Systems (ARIES)

- ARIES is a research platform developed by the National Renewable Energy Laboratory and DOE's Office of Energy Efficiency and Renewable Energy.
- It was designed to fill a significant gap: there is no research platform that can support the nation's transition to a decarbonized energy system.
- Without a safe environment to prove things out, we could be introducing significant risk, vulnerability, and expense to the electric grid and customers.

ARIES Research Platform Cornerstones at NREL

Energy Systems Integration Facility (ESIF)

Flatirons Campus

A research platform to accelerate the transition to a modern energy system

- Identify the best path to reach local and national **decarbonization goals**
- Look at **system-wide resilience** to pinpoint weaknesses and solutions
- **Troubleshoot and de-risk new technologies** before they are connected to the electric grid
- **Embed cybersecurity** as a fundamental layer to all research
- **Accelerate deployment** by providing a research platform that can replicate the real-world

ARIES Research Goals & Capabilities

ARIES is Addressing 3 Energy System Technical Challenges

1

Variability in the **physical size** of new energy technologies being added to energy system

2

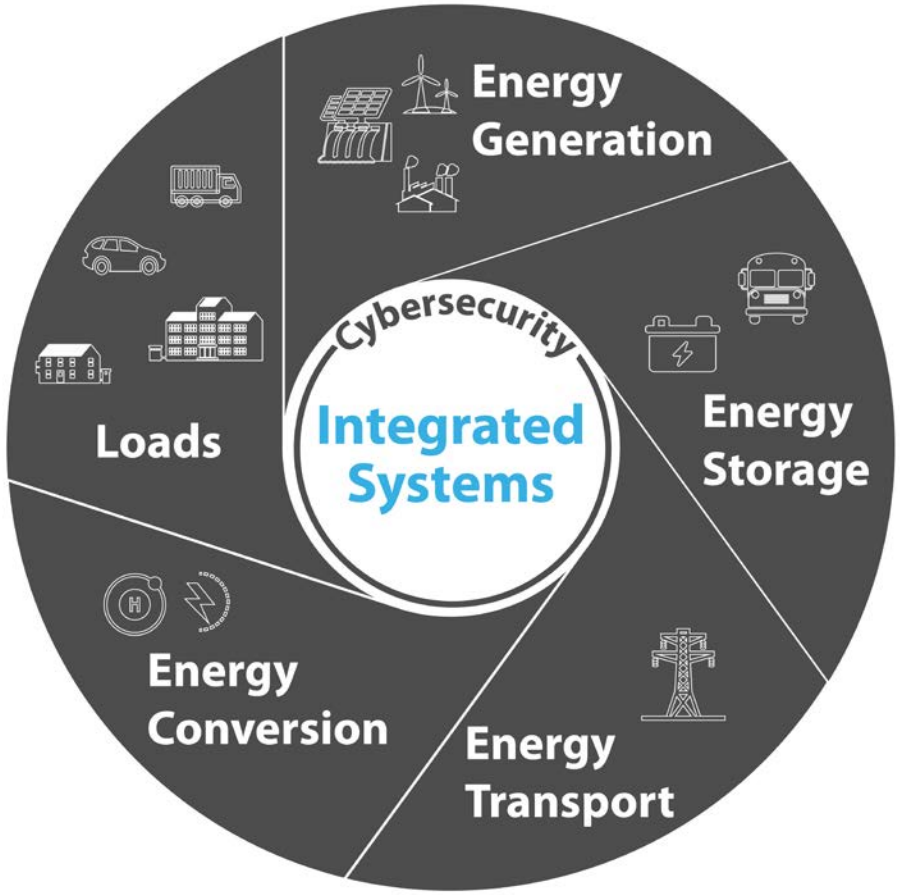
Securely controlling **large numbers** (millions to tens of millions) of interconnected devices

3

Integrating **multiple diverse technologies** that have not previously worked together

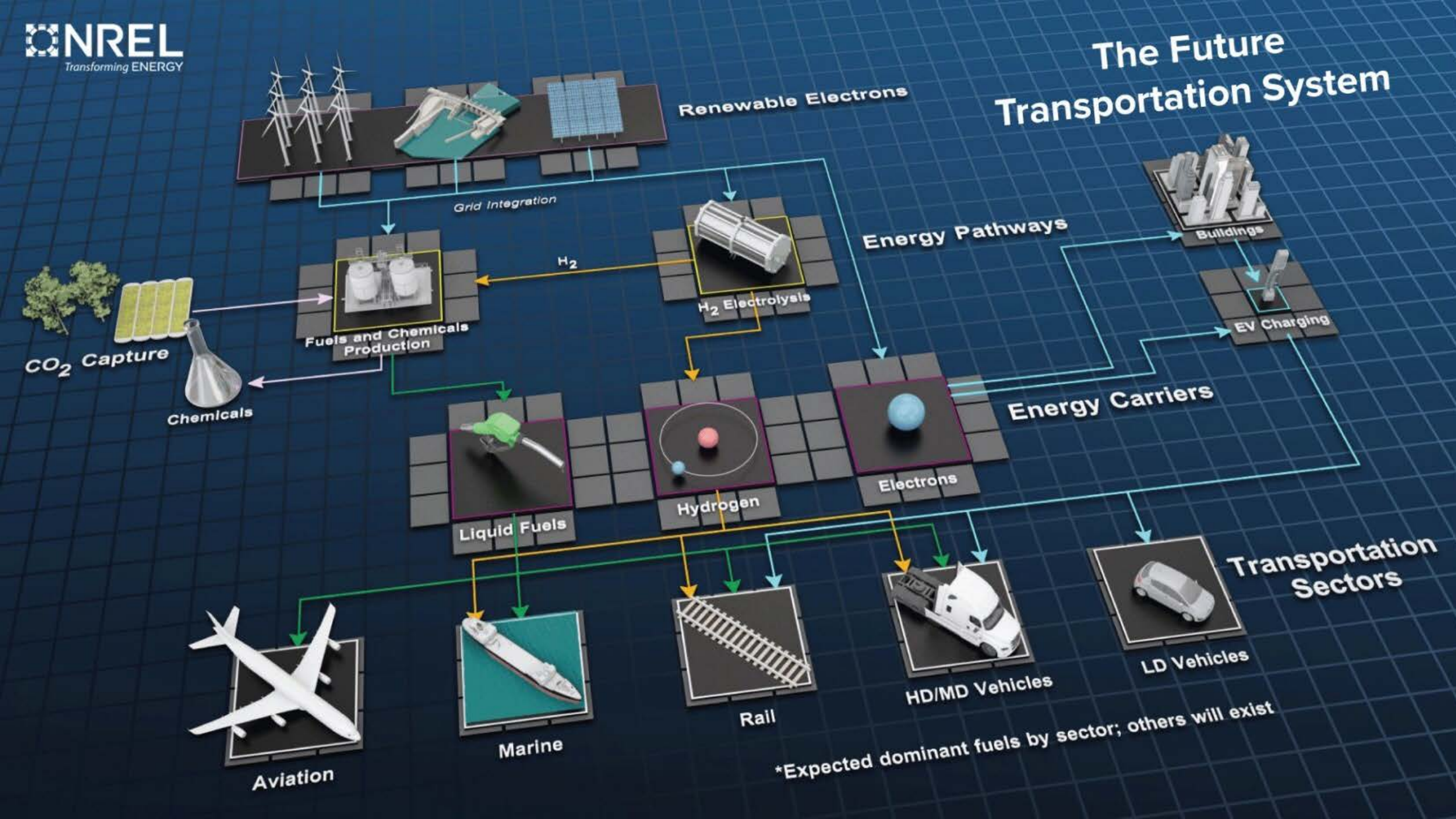
- **Primary Goal**: Use ARIES to demonstrate and de-risk a future energy system with more than 50% renewable generation by 2030, that is just, affordable, flexible, clean, secure, resilient, and reliable.

ARIES Research Platform Includes Different Technologies and Sectors



NREL's Integrated Energy Systems at Scale Lab at Flatirons Campus

How the ARIES Platform Can Support Decarbonization in the Off-Road Sector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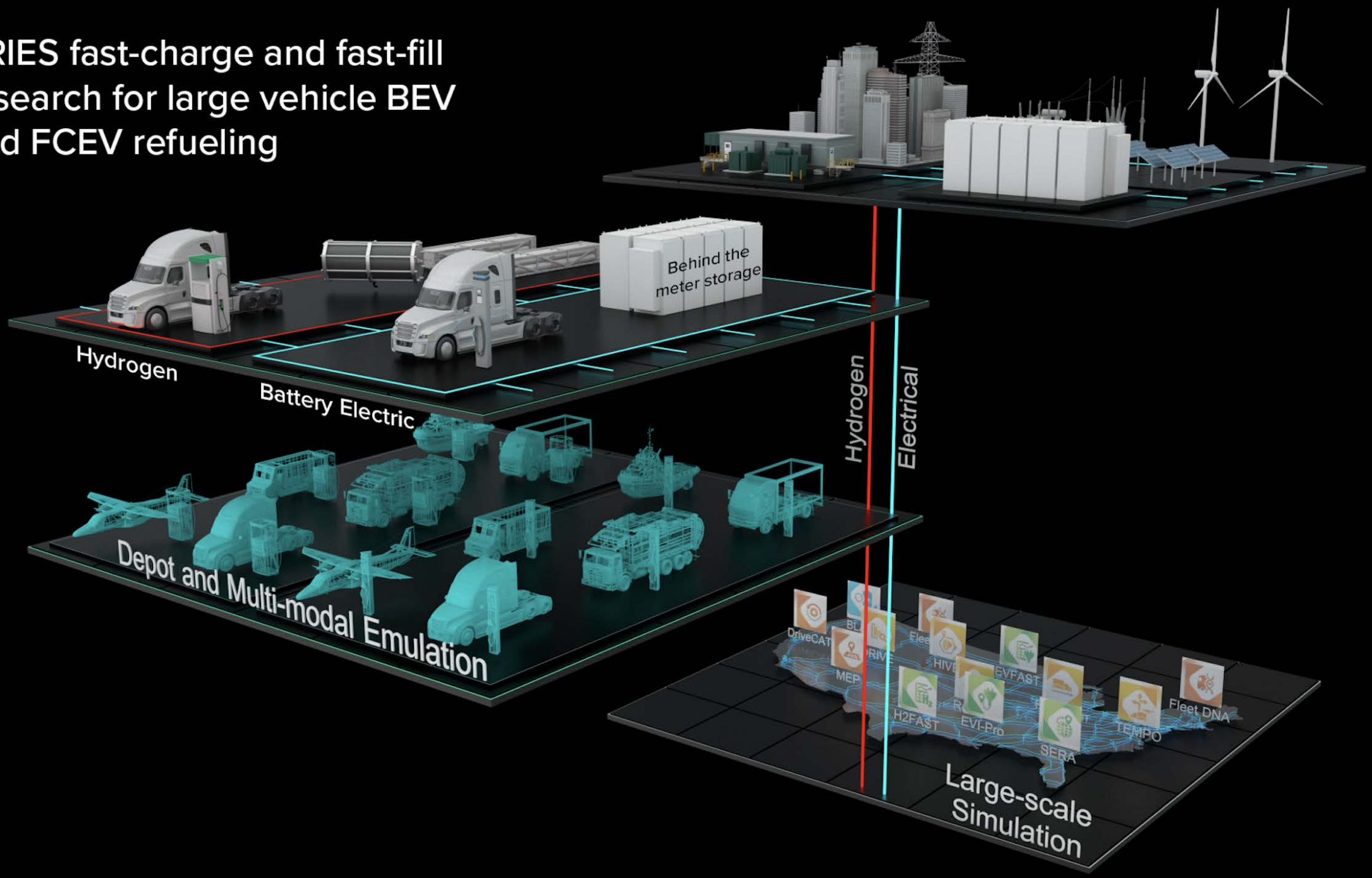
The Future Transportation System
Renewable Electrons
Grid Integration
Energy Pathways
Buildings
H_2
H_2 Electrolysis
Fuels and Chemicals Production
EV Charging
CO_2 Capture
Chemicals
Energy Carriers
Liquid Fuels
Hydrogen
Electrons
Transportation Sectors
Aviation
Marine
Rail
HD/MD Vehicles
LD Vehicles
*Expected dominant fuels by sector; others will exist

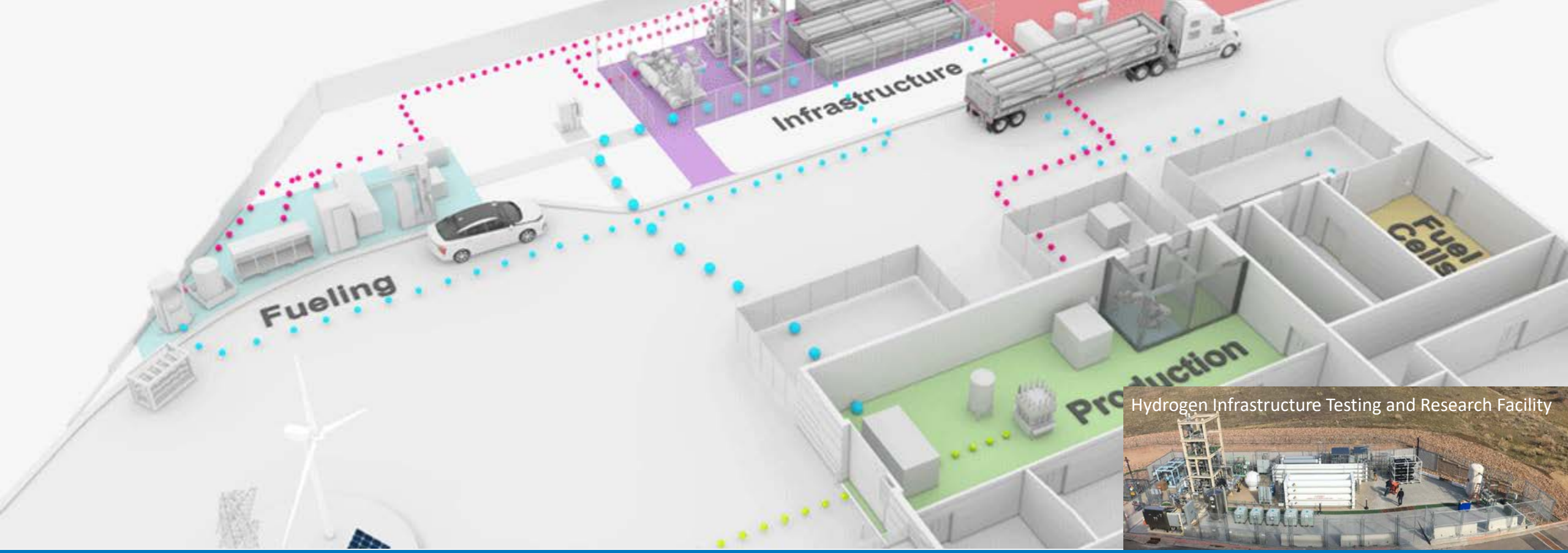
ARIES fast-charge and fast-fill research for large vehicle BEV and FCEV refueling



Behind the Meter Storage

Integrated energy technologies:

- decarbonized buildings
- vehicle charging
- thermal emulator
- building emulator



Hydrogen Infrastructure Testing and Research Facility

Hydrogen Fueling

Accelerate and de-risk the deployment of hydrogen fuel cell transportation technologies

-Station-side infrastructure

-Vehicle-side infrastructure

Flatirons Campus

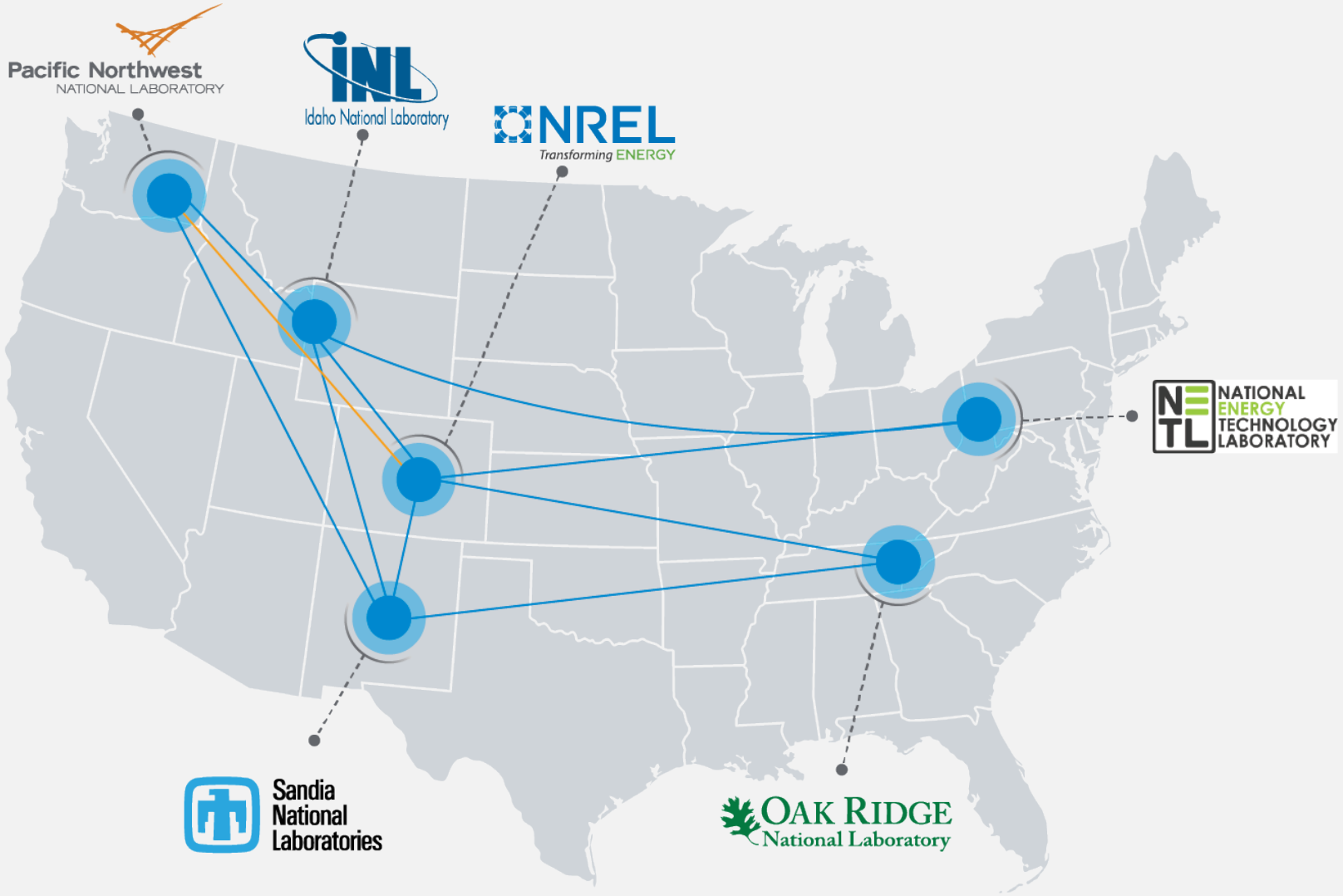
De-risking future transportation systems

Scaling up the ARIES transportation & infrastructure systems integration with:

- High Power EV Charging up to 7MW
- Hydrogen production, fuel cell power, and storage
- Controllable grid interface, microgrids, and renewable generation

ARIES Partnerships

ARIES is Connecting with Research Across the DOE Lab Complex



Key:

: Strategic National Labs ARIES alignment

: ESnet OSCARS Connection with PNNL (Est. FY21)

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Thank you

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NREL/PR-5700-82548

This work was authored by the National Renewable Energy Laboratory, operated by Alliance for Sustainable Energy, LLC, for the U.S. Department of Energy (DOE) under Contract No. DE-AC36-08GO28308. Funding provided by U.S. Department of Energy Office of Energy Efficiency and Renewable Energy. The views expressed in the article do not necessarily represent the views of the DOE or the U.S. Government. The U.S. Government retains and the publisher, by accepting the article for publication, acknowledges that the U.S. Government retains a nonexclusive, paid-up, irrevocable, worldwide license to publish or reproduce the published form of this work, or allow others to do so, for U.S. Government purposes.

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