High-density hydrogen for heavy-duty trucking

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40% of heavy duty trucks are
long-haul or weight limited

Compressed H_2 storage is available today and has enabled early deployments

Kenworth Toyota in LA

- **300-mile** range and 60 kg of H_2
- 700 bar storage and refueling
- 10 trucks

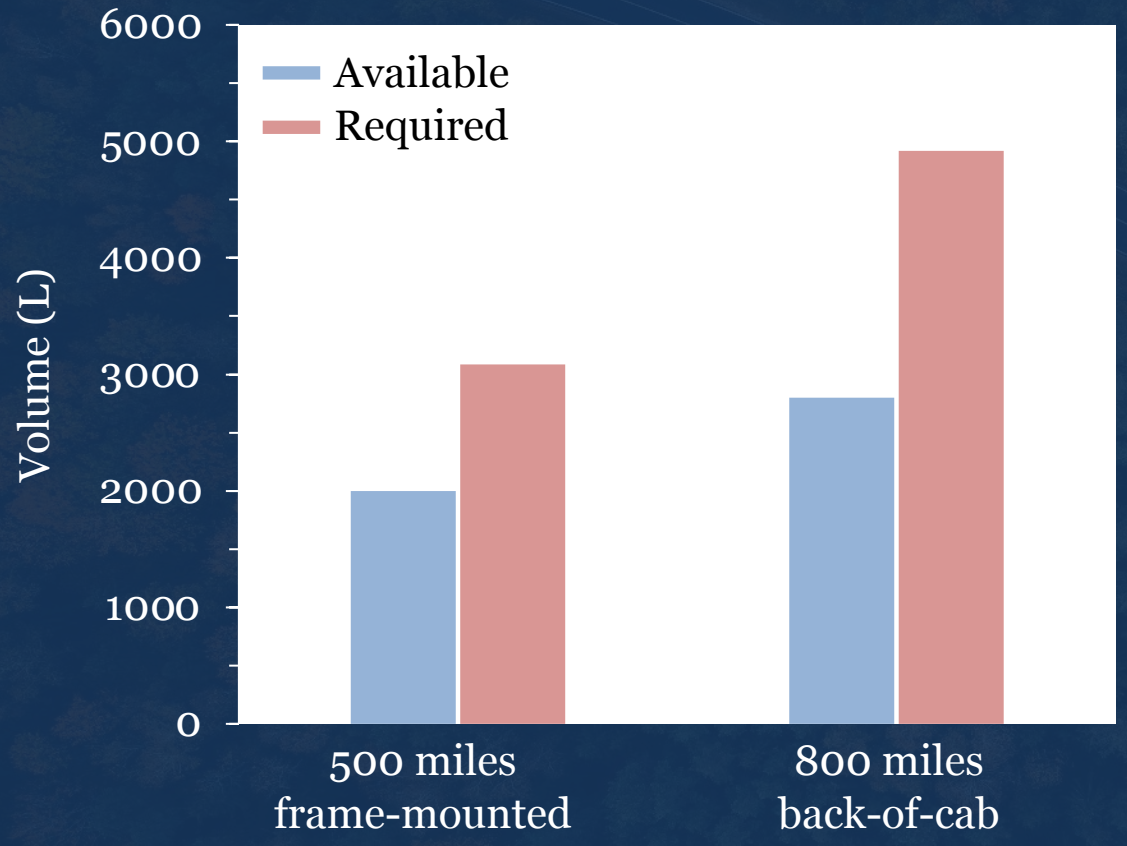
Hyundai in Switzerland

- **250-mile** range and 31 kg of H_2
- 350 bar storage and refueling
- 50 trucks

Early demonstrations have not met long-haul needs

700 bar storage does not meet volumetric requirements for long-haul

Volume available and required with 700 bar storage



Back-of-cab 700 bar storage system

Low volumetric density of 700 bar limits range for two Class 8 truck configurations

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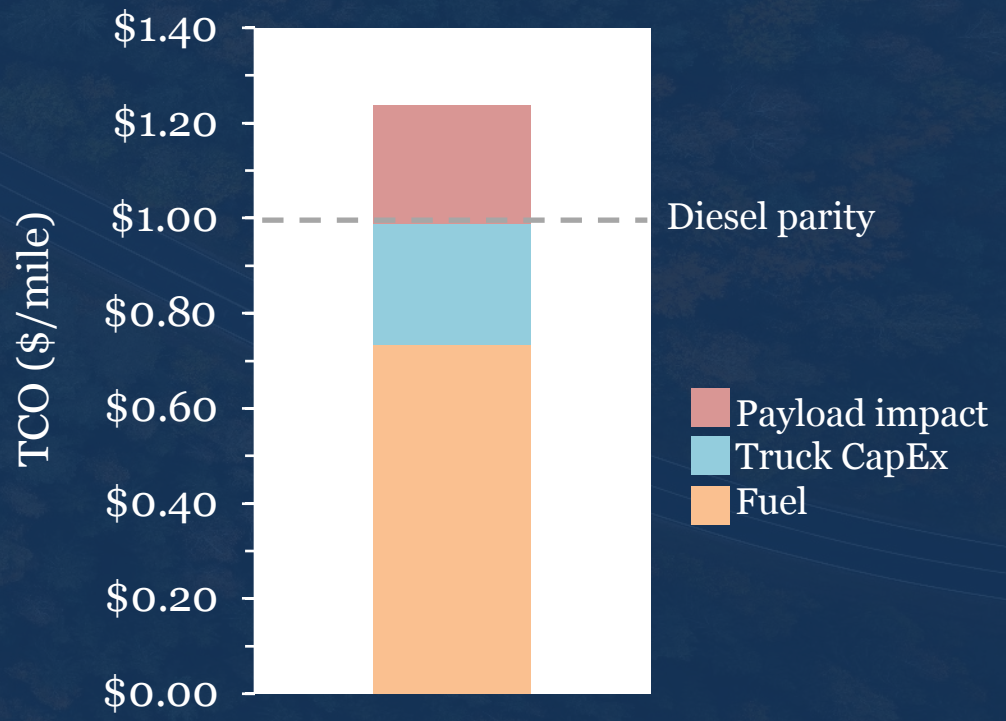
Low gravimetric density has high impact on total cost of ownership

Maxing out back-of-cab volume with 700 bar enables 450 miles of range

Main contributors to total cost of ownership for 450-mile range truck



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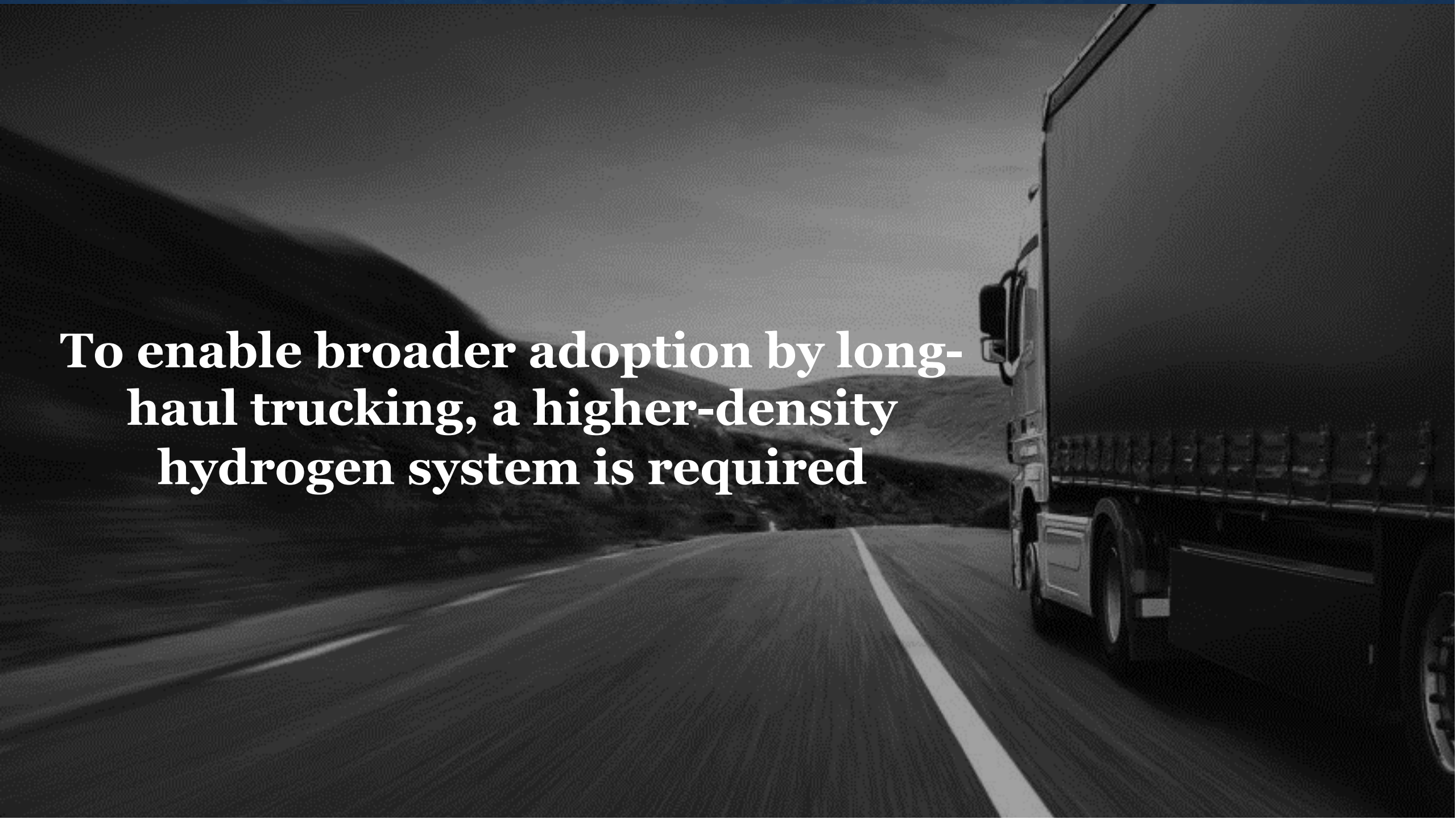
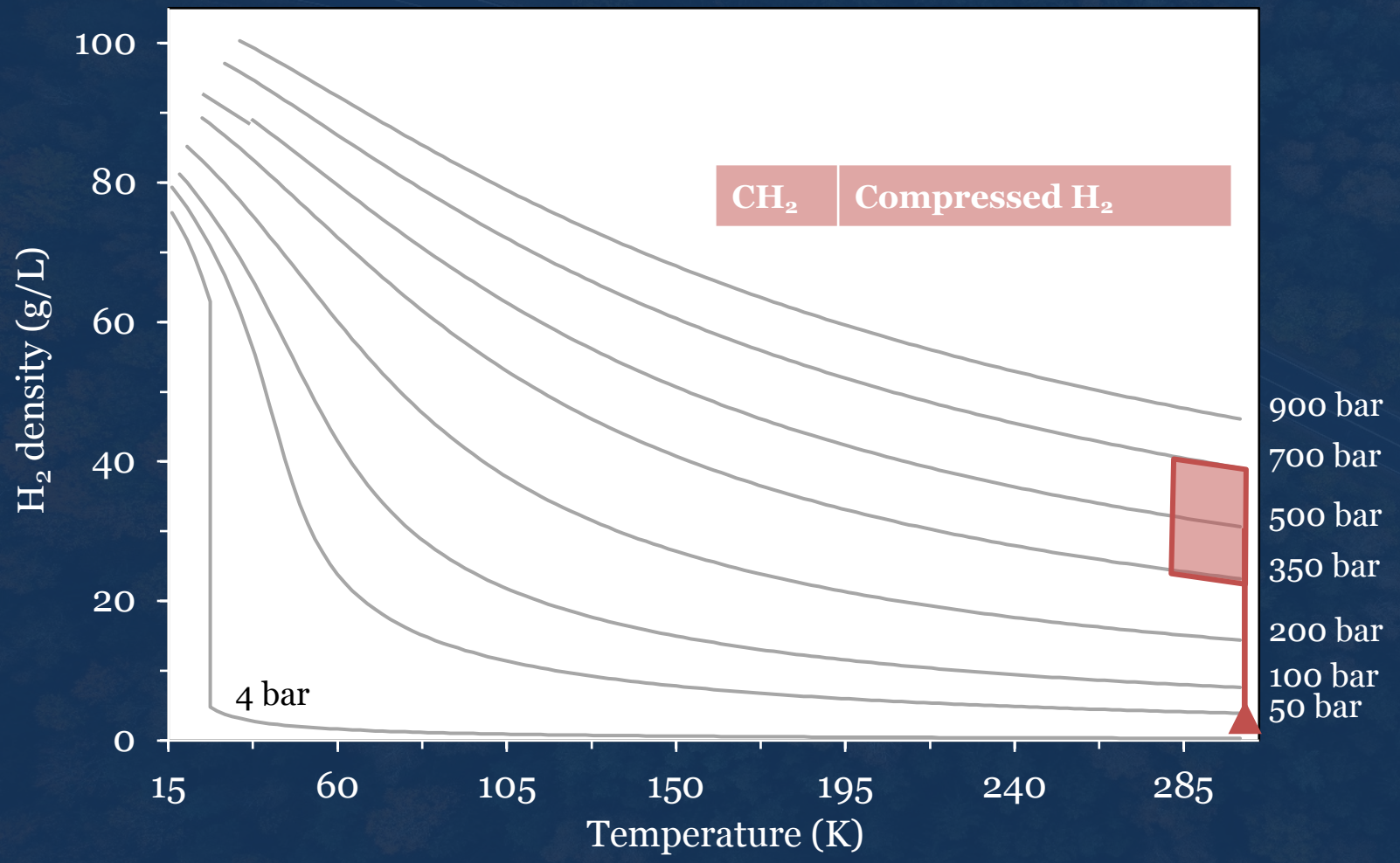
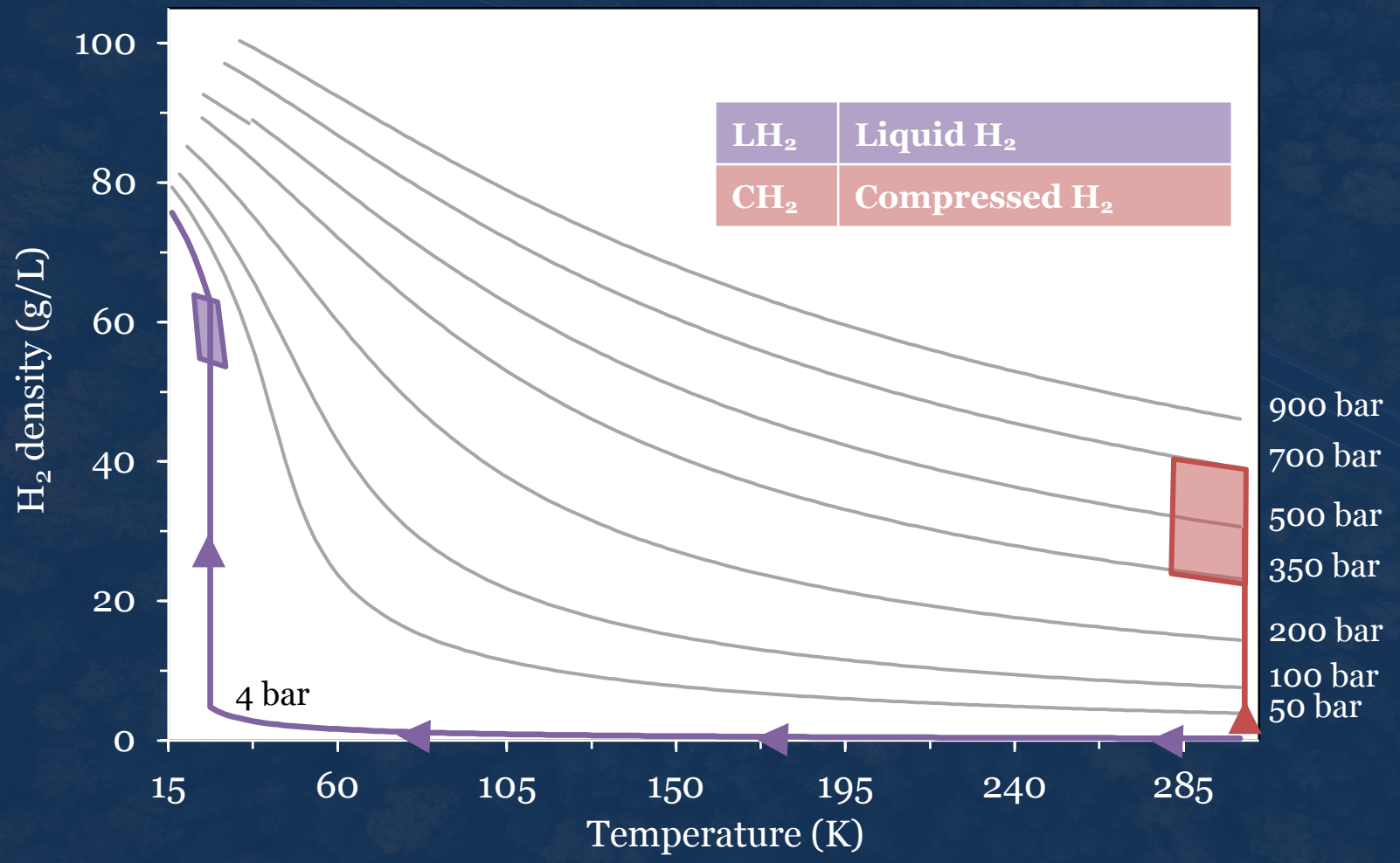

To enable broader adoption by long-haul trucking, a higher-density hydrogen system is required

Compressed hydrogen covers one narrow space of the hydrogen phase diagram



Liquid hydrogen enables higher densities than 700 bar



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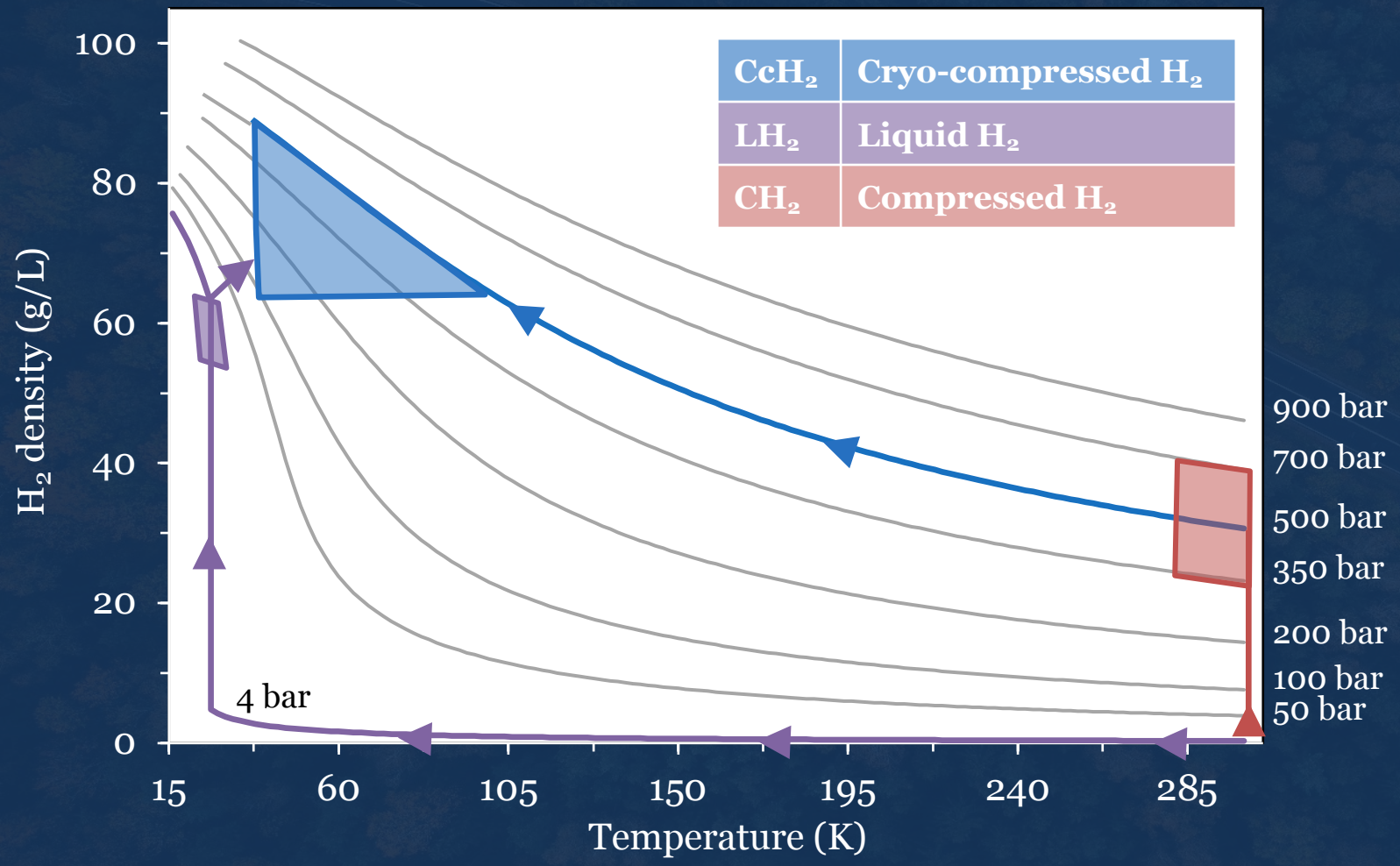
Cryo-compressed hydrogen enables the highest density solution with supply flexibility



Two routes to reach the CcH_2 state:

1. **From a liquid, using a cryo-pump (purple path)**
2. **Compressing and cooling a gas, using a cryo-compressor (blue path)**

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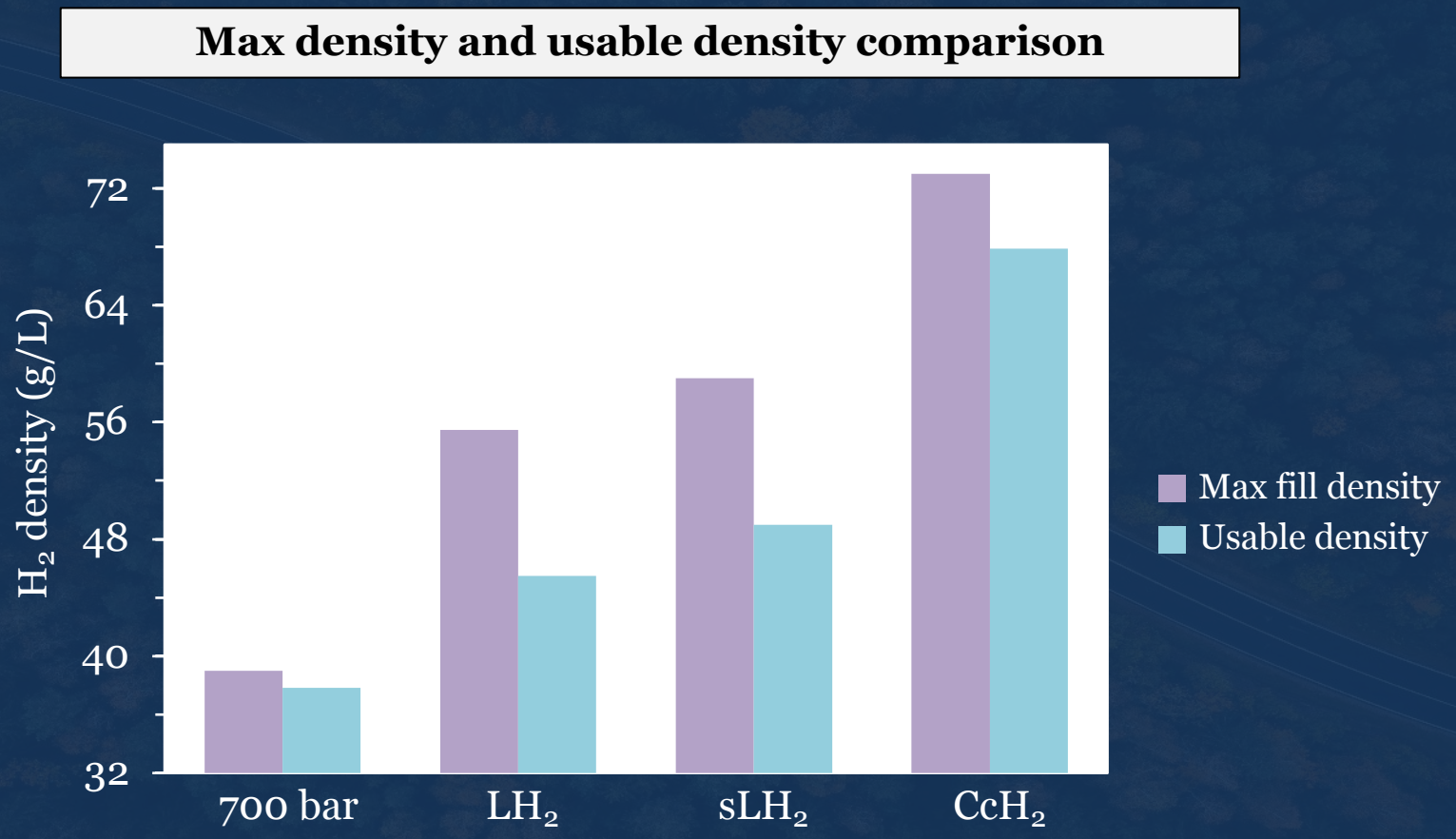
Verne develops cryo-compressed hydrogen storage and refueling solutions

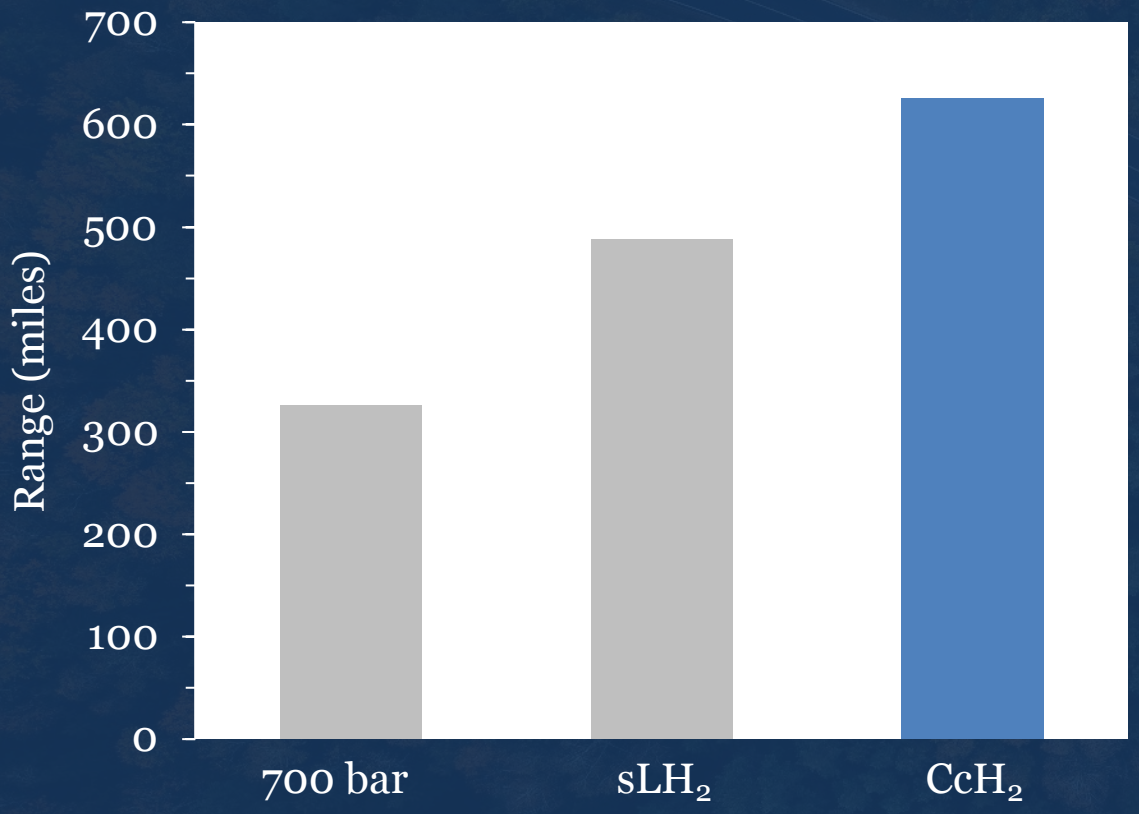
CcH_2 exhibits 40% greater usable densities than sLH_2



- CcH_2 exhibits 80% higher usable density relative to 700 bar
- CcH_2 exhibits 50%, and 40% higher usable densities relative to LH_2 and sLH_2, respectively

Given the same frame volume, CcH_2 system reaches 600+ miles

Range for frame-mounted systems



Frame-mounted CcH_2 system

Long-haul range and frame-mounted system is possible with CcH_2

Various options to take advantage of high-density

Current hydrogen

6 tanks: back-of-cab

450 mi

Diesel-equivalent weight

Verne: ultra-light

2 tanks: saddle mount

450+ mi

1,250+ lbs lighter

Double Profit Margins

Verne: long-range

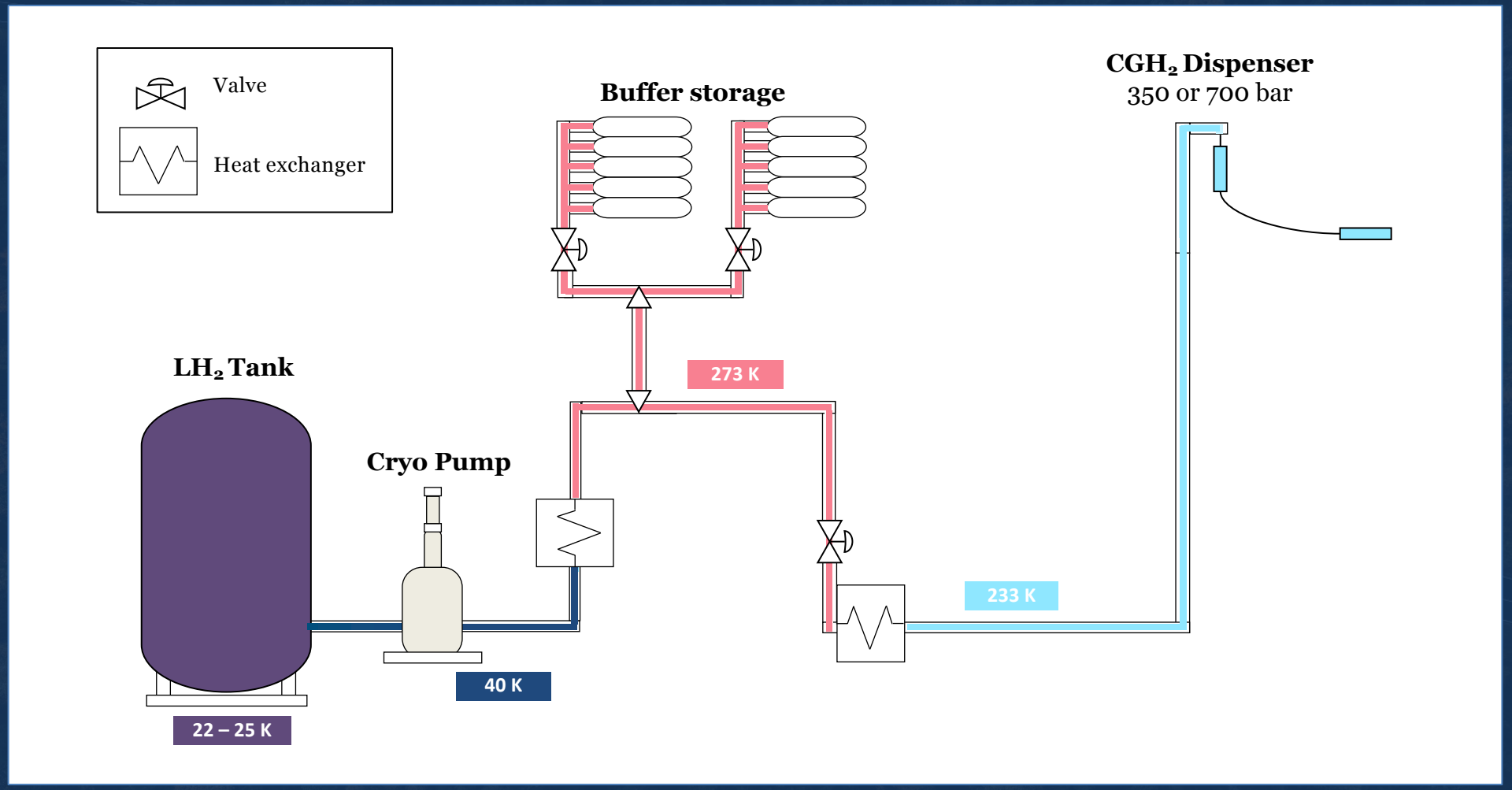
4 tanks: back-of-cab

900+ mi

Diesel-equivalent weight

Travel Full Routes and Half Infrastructure

CcH_2 refueling from LH_2 requires minimal modification



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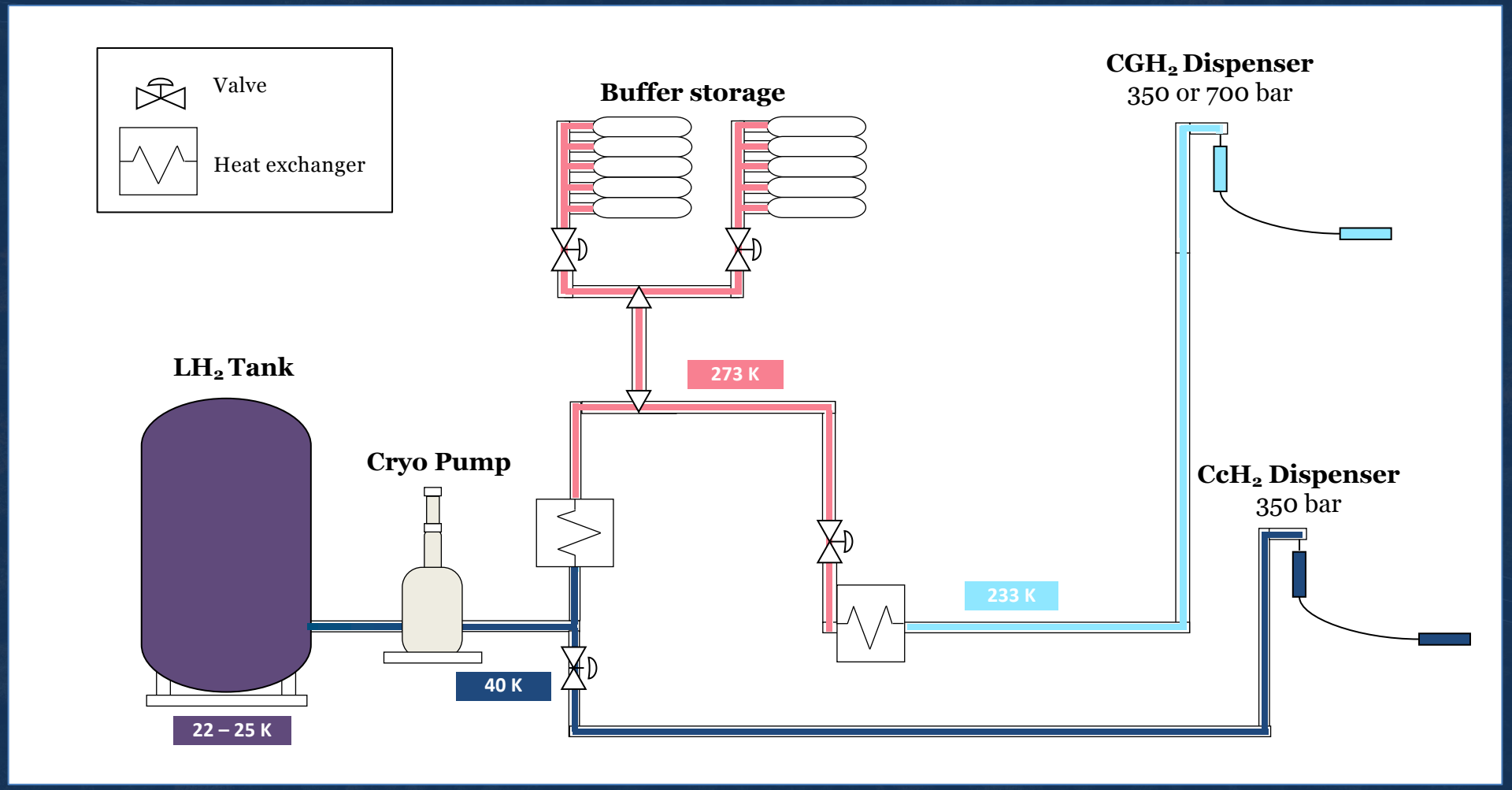
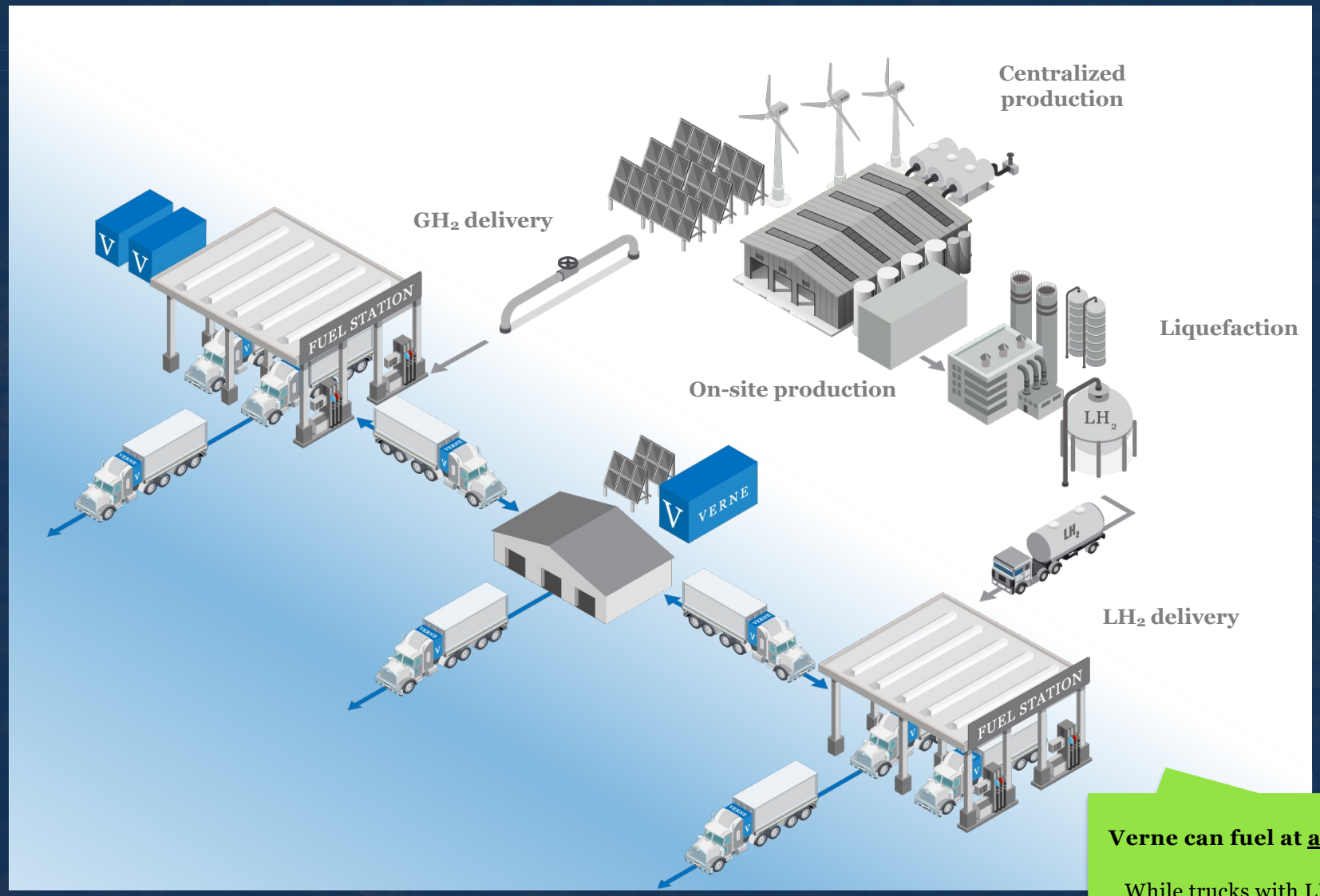


High-density with supply flexibility



Performance
Range and payload

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Supply optionality
no liquefaction cost

Verne can fuel at <u>any</u> H_2 station.

While trucks with LH_2 storage can only fuel at stations with LH_2 delivery

Commercialization and development progress

10 kg system demonstrated

Full-scale storage systems built and testing

Lawrence Livermore National Laboratory

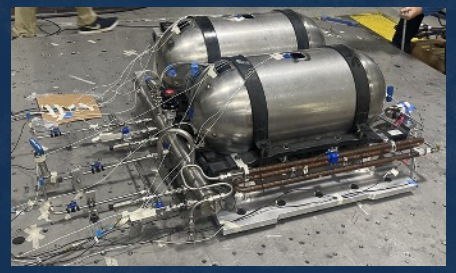
Initial Class 8 truck testing with fleet and OEMs

2022

- Closed Seed Round
  - amazon
  - CATERPILLAR
- DOE Project started
  - arpa·e U.S. DEPARTMENT OF ENERGY

2023

- Multi-tank system tested for durability



- Fleet LOI 's for >150 trucks with Verne storage systems
  - Multiple Class 8 Truck Fleets

2024

- Refueling demonstrations

NREL NATIONAL RENEWABLE ENERGY LABORATORY

- Mobile refueler commissioning

We have built a team of global experts

Leadership

Ted McKlveen
CEO

David Jaramillo
CTO

Bav Roy
COO

Kaushik Mallick
Head of H_2 Storage

Vincent Heloin
Head of H_2 Engineering

Advisory Board

Tom Linebarger
Ex-CEO Cummins

Salvador Aceves
Cryo-compression

Bob Boyd
Safety & Standards

Ryan Kemmet
Truck Fuels

John Formisano
HD Truck Fleet

Dolly Singh
Talent

Technical Consultants

Rob Pahl
Metals R&D

Markus Kampitsch
Hydrogen Vehicles

Funding

Grants

Breakthrough Energy

arpa·e U.S. DEPARTMENT OF ENERGY

Private

amazon

CATERPILLAR

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A diesel-free future. Powered by Verne.

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