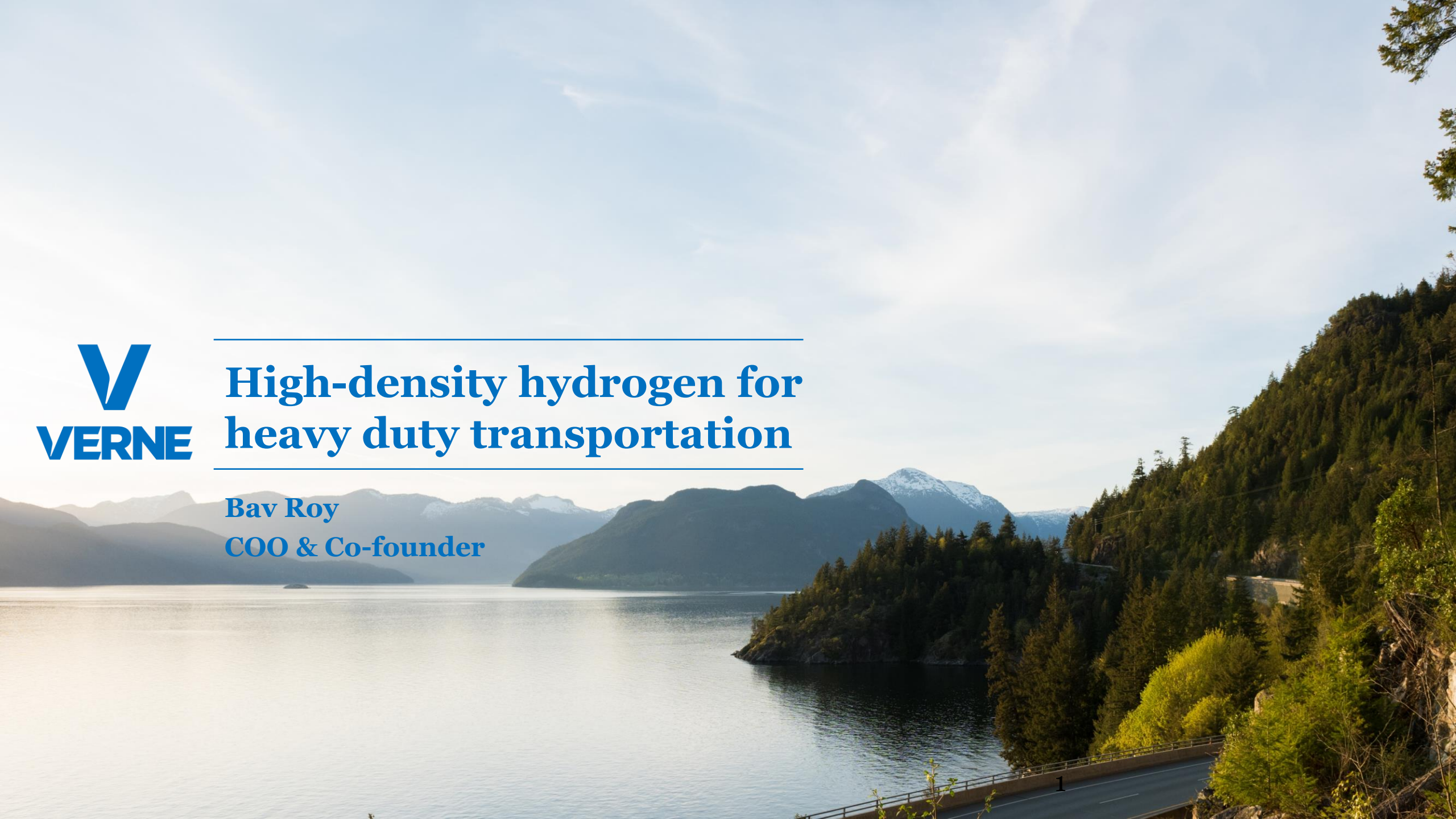
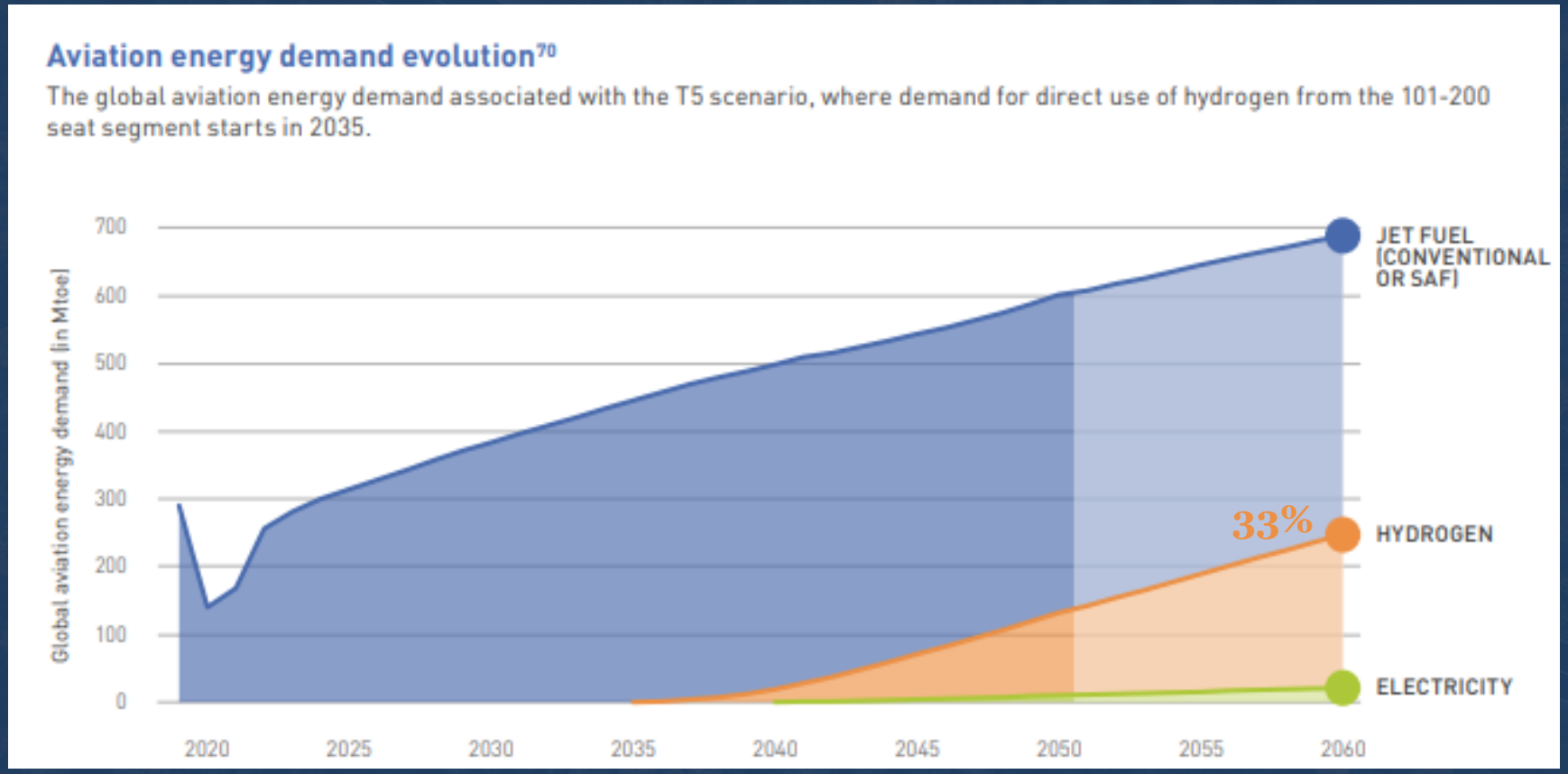


High-density hydrogen for heavy duty transportation

Bav Roy
COO & Co-founder

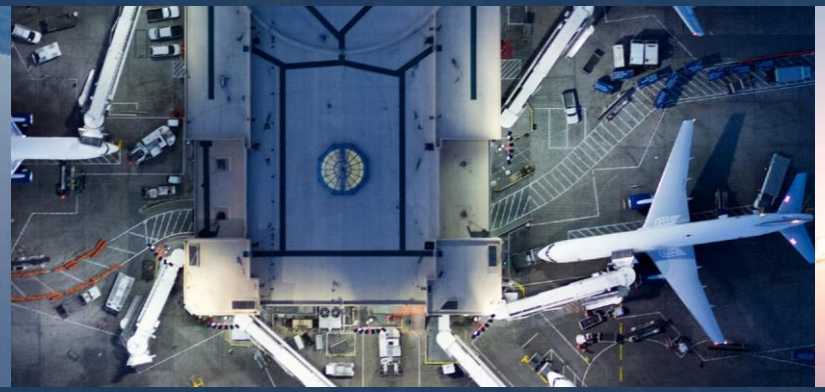
Hydrogen is expected to make up 33% of aviation energy demand by 2060



Source: European Federation for Transport and Environment (May, 2023) – Low traffic Scenario & Verne analysis

Proprietary & Confidential

$50b+ will be needed for a massive transformation across aircraft, infrastructure and fuel delivery



Aircraft development

$10b+

Airport infrastructure

$30b+

Hydrogen fuel delivery

$10b+

Source: European Federation for Transport and Environment (May, 2023) – Low traffic Scenario & Verne analysis

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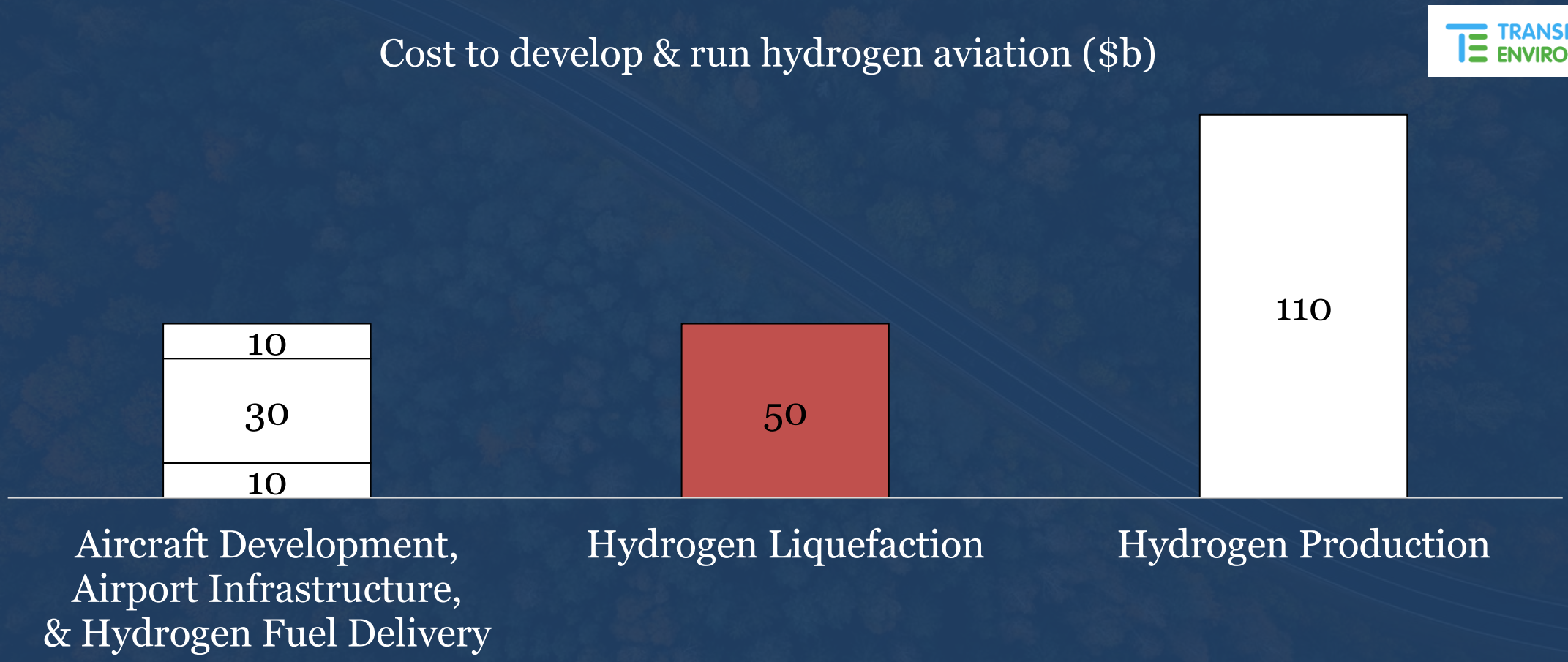
But $50b will also be needed for H_2 liquefaction alone



Note: Costs based on Europe market transition from 2025 – 2050 (Low Traffic Scenario)
Source: European Federation for Transport and Environment (May 2023)

VERNE

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Hydrogen liquefaction is incredibly energy intensive

12 kWh
required to liquefy a source of H_2 gas down to -253 °C

1 kg
of LH_2

15 kWh
of useable energy onboard for engine or fuel cell

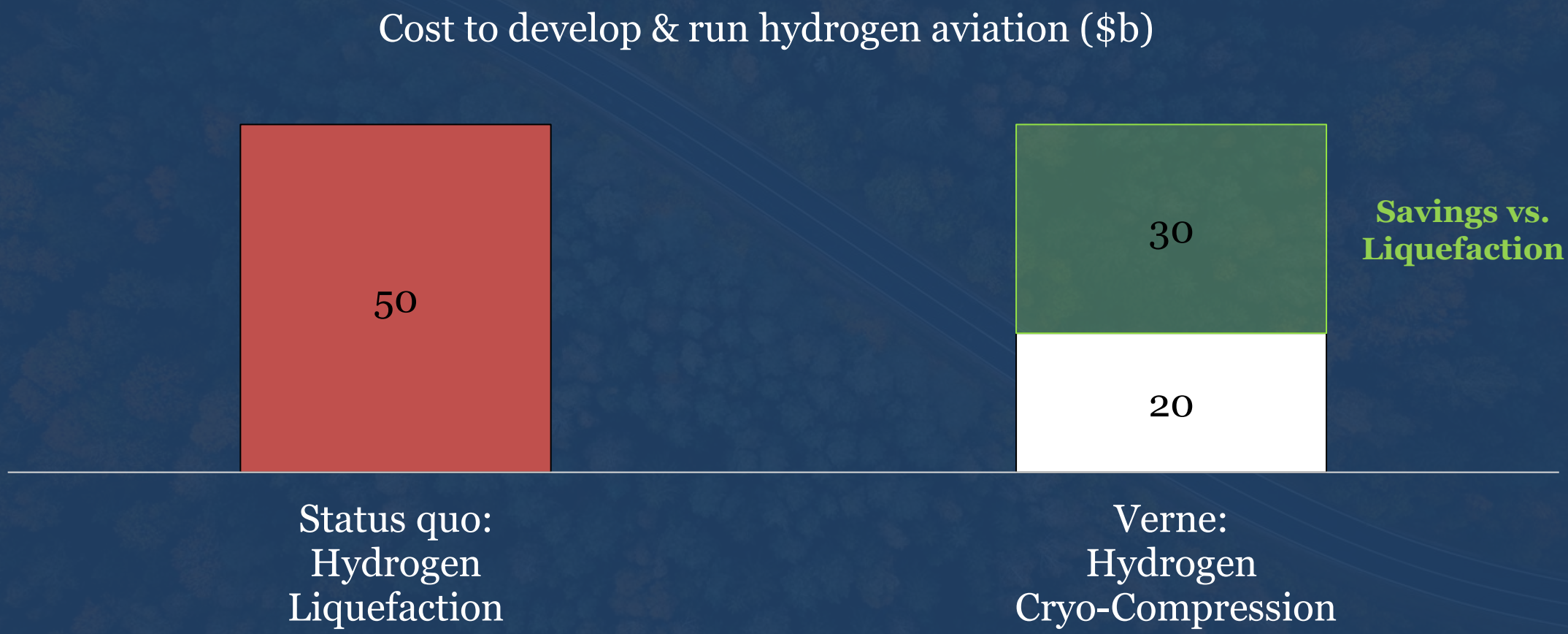
Proprietary & Confidential

Each liquefaction plant is a major investment

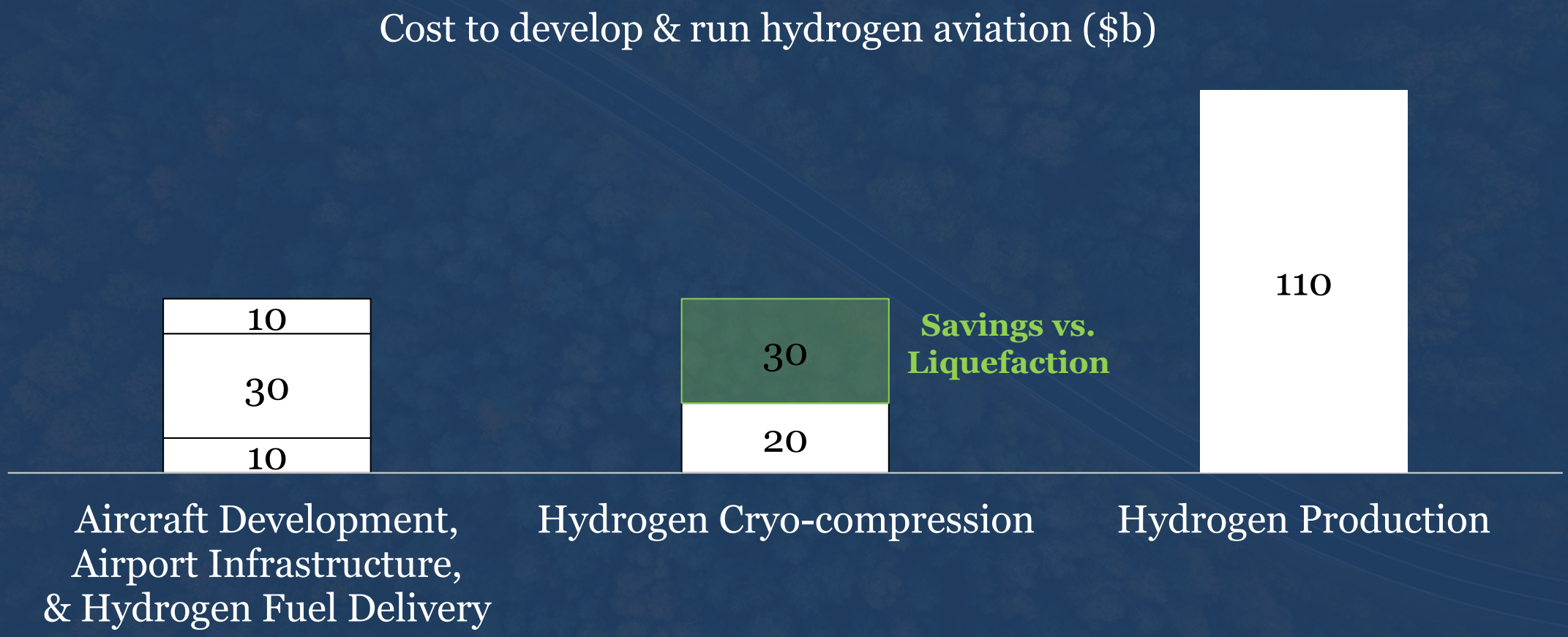
Liquefaction plant: 30 tonnes / day

$250m & 4 years to complete facility

Verne's solves the $50b hydrogen liquefaction problem



But $50b will also be needed for H_2 liquefaction alone



Note: Costs based on Europe market transition from 2025 – 2050 (Low Traffic Scenario)
Source: European Federation for Transport and Environment (May 2023)

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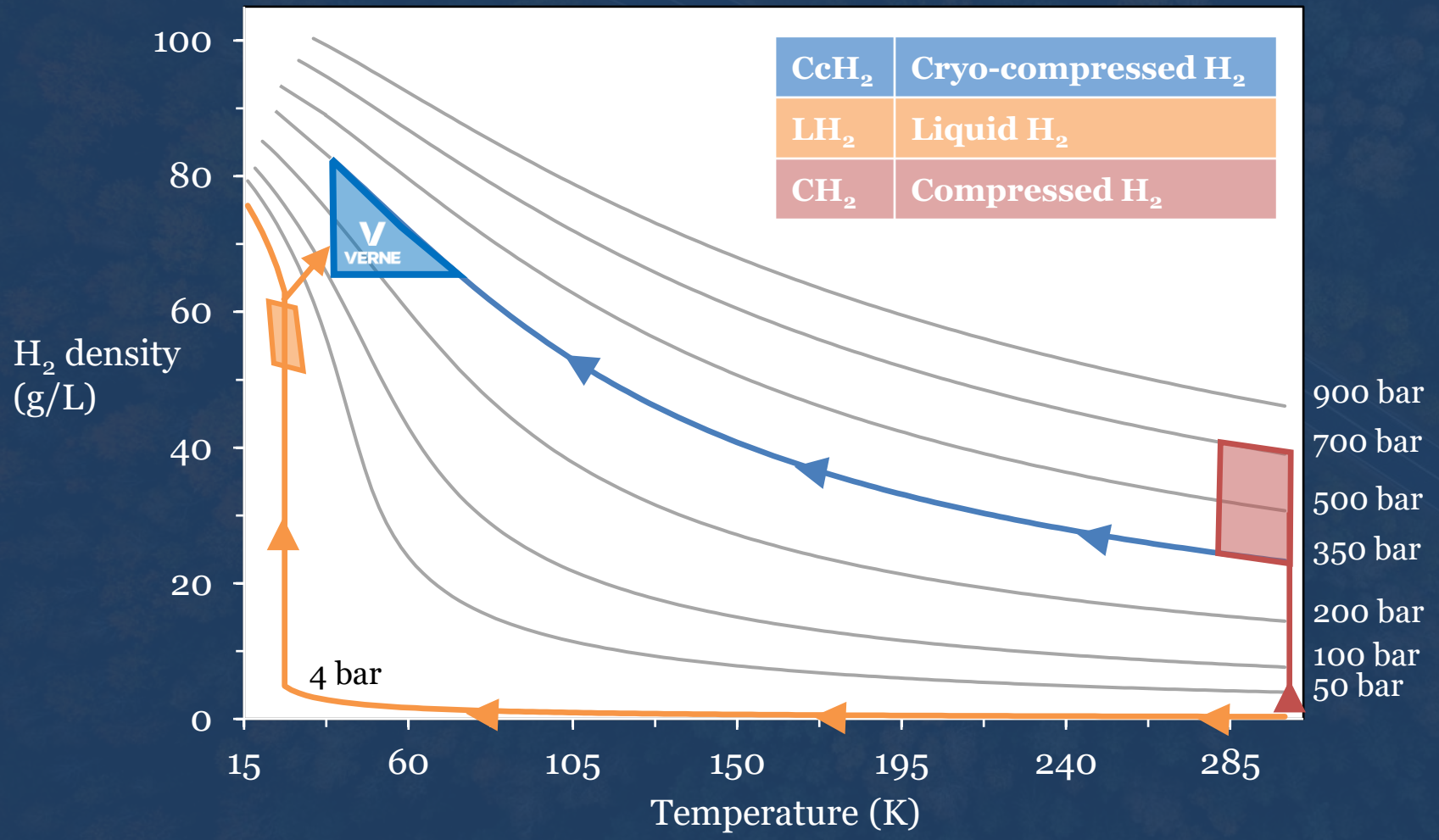
Cryo-compressed hydrogen: the highest-density state, accessible from two densification paths



1. **Higher than LH_2 density**
2. **Accessible from LH_2 or GH_2 source:**
   - From liquid hydrogen, using a cryo-pump (orange path)
   - From gaseous hydrogen, compressing and cooling a gas using Verne's cryo-compressor (blue path)

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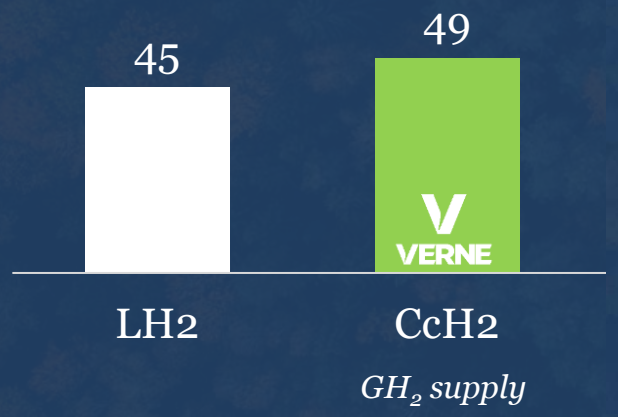
Verne provides high fuel density at half the cost of liquefaction

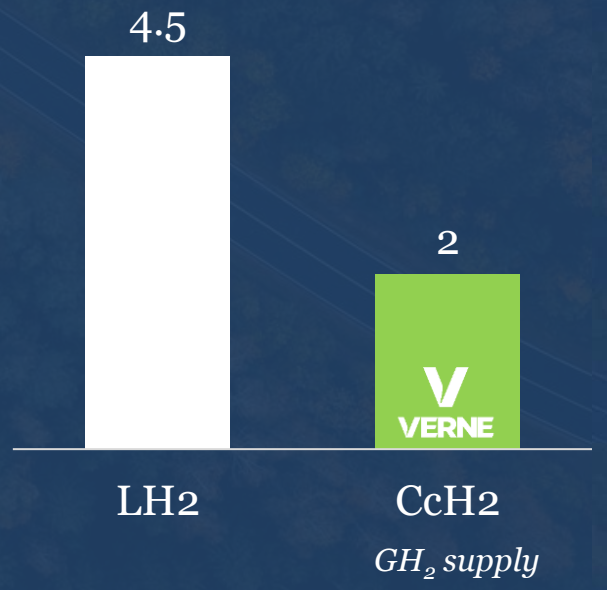
High fuel density

Useable Hydrogen Density (g/L)



At nearly half the cost

Densification cost ($/kg H_2)

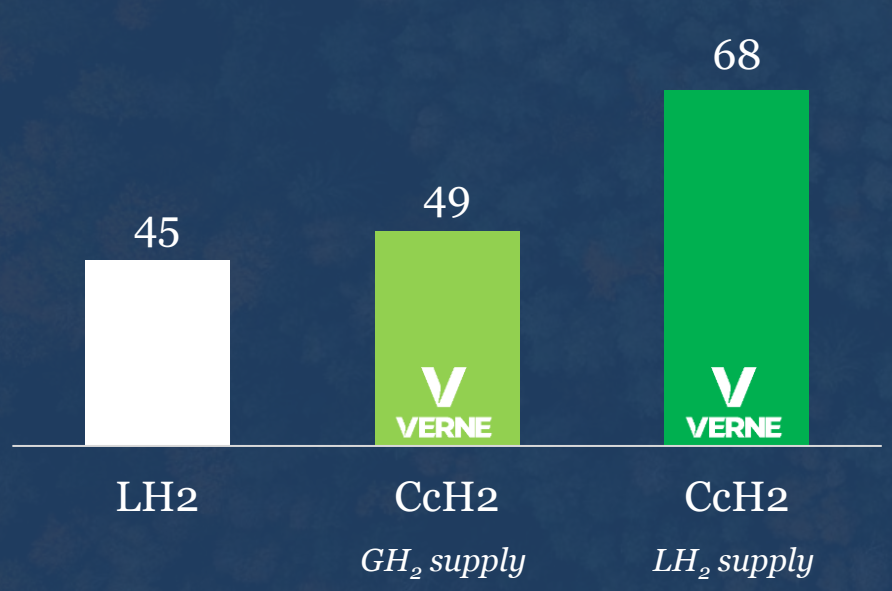


Proprietary & Confidential

Where necessary, Verne can also provide even higher fuel density using liquid hydrogen infrastructure

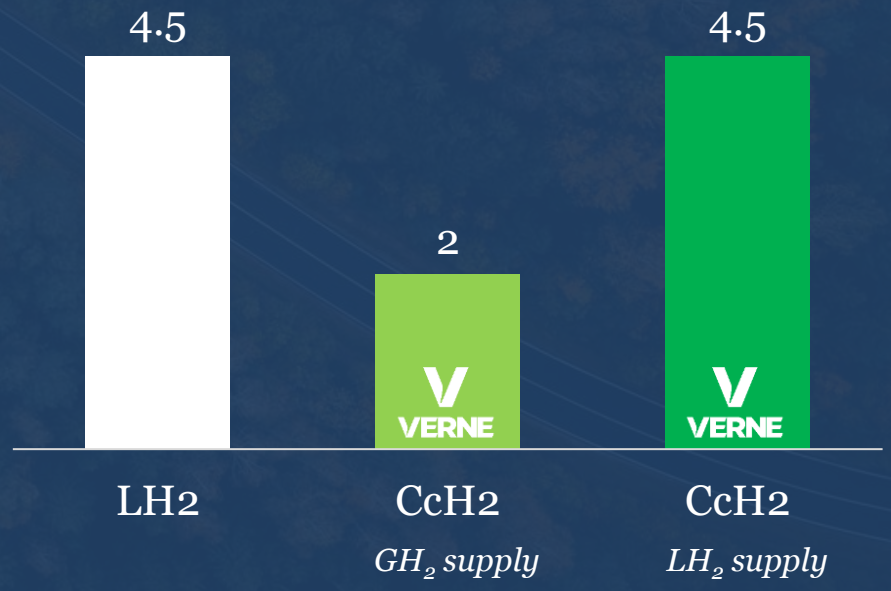
High fuel density

Useable Hydrogen Density (g/L)

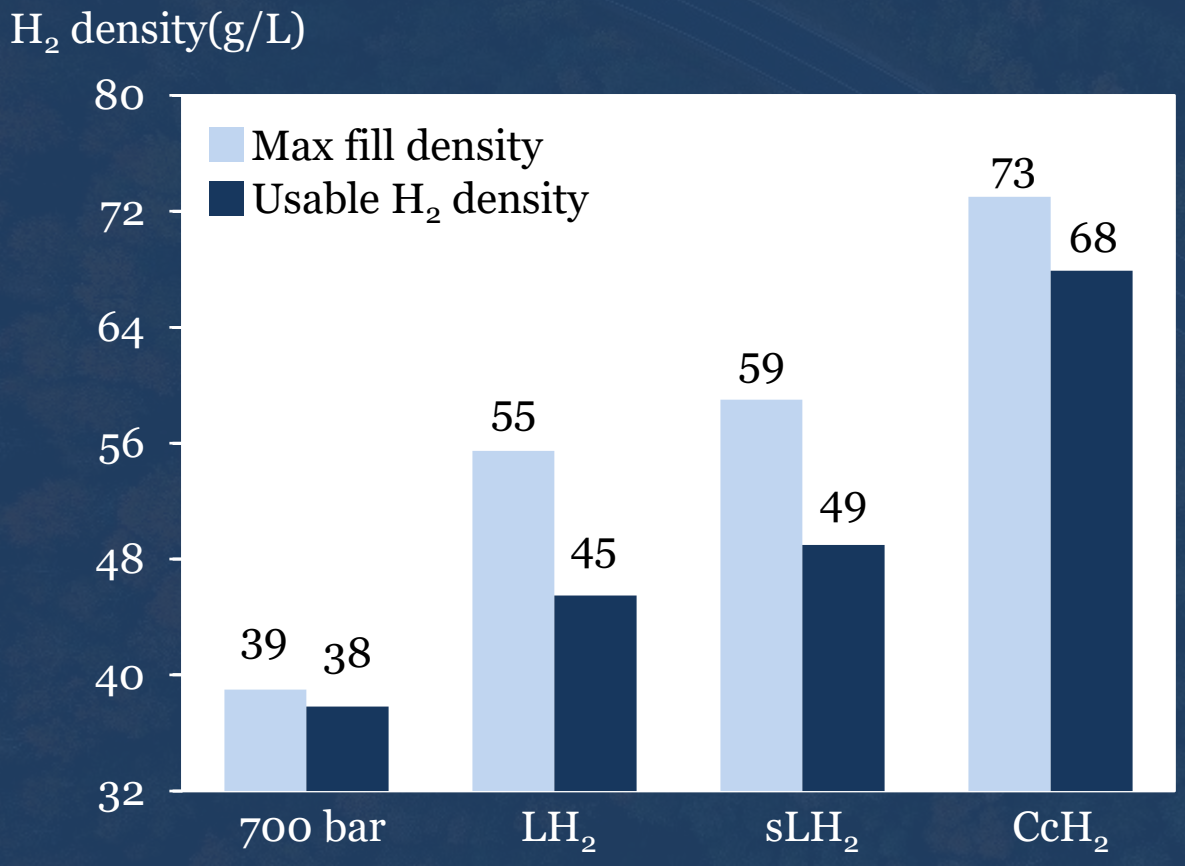


At nearly half the cost

Densification cost ($/kg H_2)



CcH_2 exhibits the highest H_2 usable densities



+80%
usable density vs. 700 bar

+40%
usable density vs. sLH_2

Two products: densifying and storing hydrogen

Cryo-cooler
Compress and cool hydrogen to increase density

Reach high density at half the cost

Verne's 1 tpd cryo-cooler during testing at NREL

Hydrogen storage systems
Insulated hydrogen storage tanks

Store hydrogen at the highest density

Verne's 120 kg hydrogen storage system

Two products: densifying and storing hydrogen

Cryo-cooler
Compress and cool hydrogen to increase density

Reach high density at half the cost

Verne's 1 tpd cryo-cooler during testing at NREL

Efficient, low-cost, modular

Hydrogen storage systems
Insulated hydrogen storage tanks

Store hydrogen at the highest density

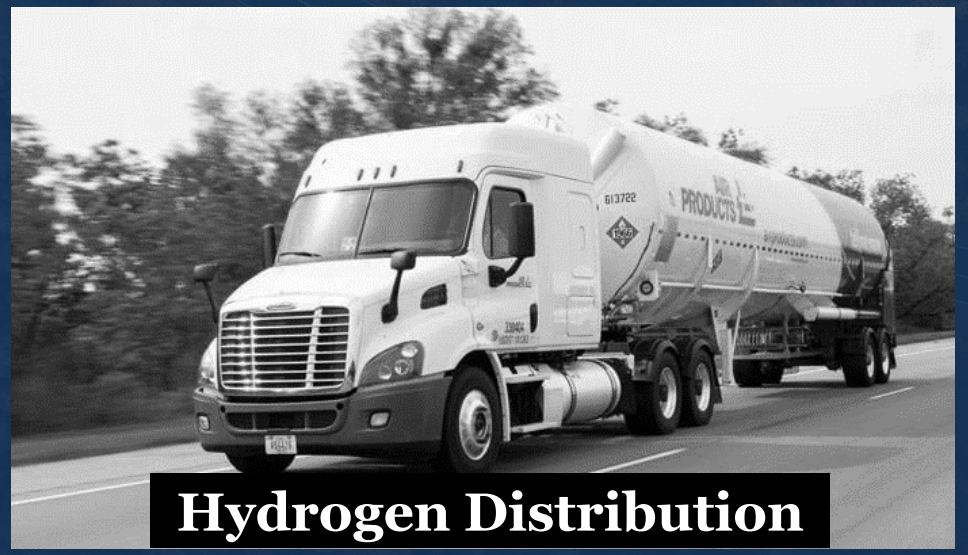
Verne's 120 kg hydrogen storage system

High-density, lightweight, compatible with ICE & FC

VERNE

Proprietary & Confidential

A massive opportunity across many markets



VERNE

Two market applications in near-term

HD truck storage

- Maximize on-board usable hydrogen stored
- Compatible with ICE or FCEV
- Compatible with LH_2 or GH_2 supply
- Low boil-off (station and vehicle)

Hydrogen distribution

- Minimize total cost of delivering hydrogen
- Minimize upfront capex

Impact: maximize vehicle performance

Current hydrogen
700 bar compressed

6 tanks

450 mi

21,500 lb

Verne - Long range

4 tanks

850+ mi

Same weight

Travel Full Routes

Verne - Lightweight

2 tanks

450+ mi

2,500 lb less weight

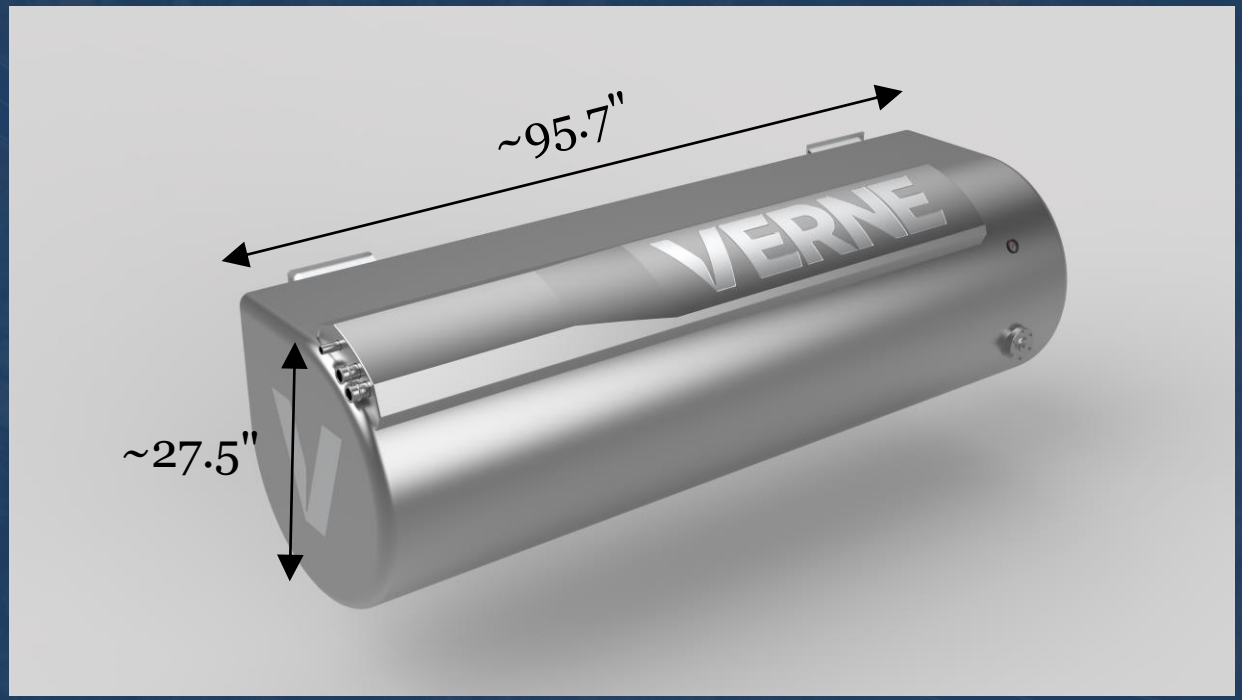
Double Fleet Margins

Gen 3 CcH_2 system stores >40kg per saddle tank

Full system provided to swap with existing H_2 storage:

- Storage tanks
- Balance of Plant:
  - Inlet receptacle
  - Heat exchanger
  - Pressure management
- Storage controls & electronics
- Side-mount attachments to truck frame rail

Gen 3: ~42 kg stored per tank



Note: Dimensions include BOP and vehicle attachments, but may be subject to change.

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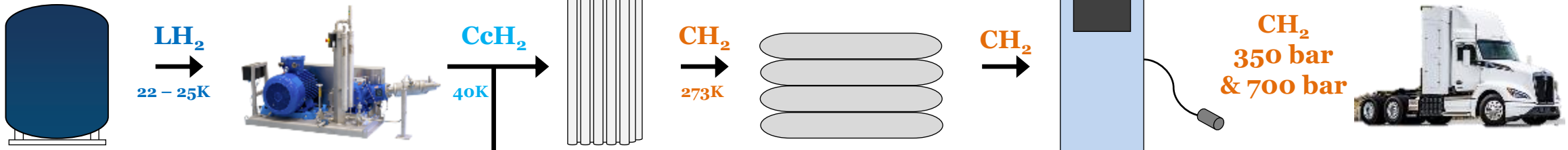
Minor modification to enable CcH_2 truck fueling at LH_2 stations

Current CH_2 fueling



Liquid hydrogen tank

Cryopump

Vaporizer

Buffer storage

Dispenser, hose & nozzle

CH_2 truck storage

Addition: CcH_2 fueling

Verne works with station developers to add CcH_2 fueling with minor retrofit

Insulated piping

CcH_2 350 bar cold gas

Dispenser, hose & nozzle (insulated)

CcH_2 truck storage

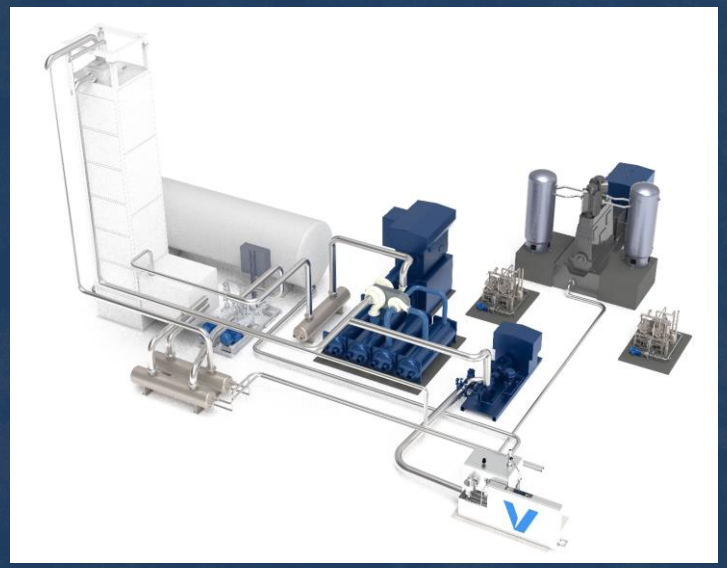
VERNE x ARTA

VERNE

And new low-cost densification alternative for CcH_2

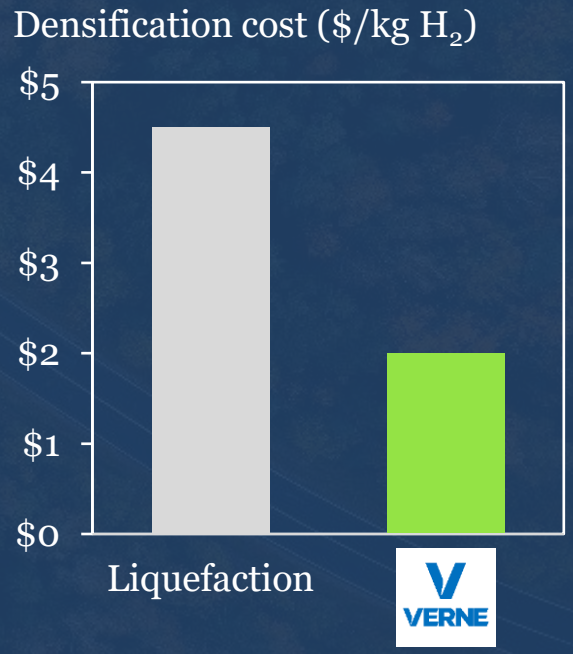
Verne's cryo-cooler

Chills compressed gas to increase density



15TPD cryo-compressor

High density at half the cost



Three independent ways to fill Verne storage

Hydrogen Supply	Station Equipment	On-vehicle Storage

Liquid + Cryo-pump

Delivered liquid hydrogen

Existing

Cryo-pump
(at stations today)

CcH_2 →

Compressed Gas + Verne Cryo-cooler

Delivered gas or on-site production

New

Compressor
(at stations today)

Verne Cryo-cooler

CcH_2 →

Compressed Gas

Delivered gas or on-site production

Existing

Compressor
(at stations today)

$H35$ →

Verne Storage

Q1 2025 Demo Day: First CcH_2 Class 8 truck & mobile refueler

Class 8 dual-fuel ICE with Verne CcH_2 Storage

Verne CcH_2 Mobile Refueler

Two market applications in near-term

HD truck storage

- Maximize on-board usable hydrogen stored
- Compatible with ICE or FCEV
- Compatible with LH_2 or GH_2 supply
- Low boil-off (station and vehicle)

Hydrogen distribution

- Minimize total cost of delivering hydrogen
- Minimize upfront capex

CcH_2 trailers can be filled from both a liquefaction plant and a cryo-cooler plant

Central H_2 production

300K
10-30 bar

Liquefaction plant

40-80K
350 bar

80-100K
350 bar

Compressor & Cryo-cooler

Cryo-compressed H_2 trailers

CcH_2 trailers has advantages when used with either densification plant

Central H_2 production

300K
10-30 bar

Liquefaction plant

40-80K
350 bar

Compressor & Cryo-cooler

80-100K
350 bar

Cryo-compressed H_2 trailers

Flexible trailer fleet

Liquefier → CcH_2 trailers
- **No new densification equipment**
- **Low/no H_2 losses during transfers**
- **Modular trailer capacity**
- **High density trailers: >2,600kg**

Cryo-cooler → CcH_2 trailers
- **65% lower densification cost**
- **Modular densification equipment**
- **Low/no H_2 losses during transfers**
- **Modular trailer capacity up to 2,000kg**

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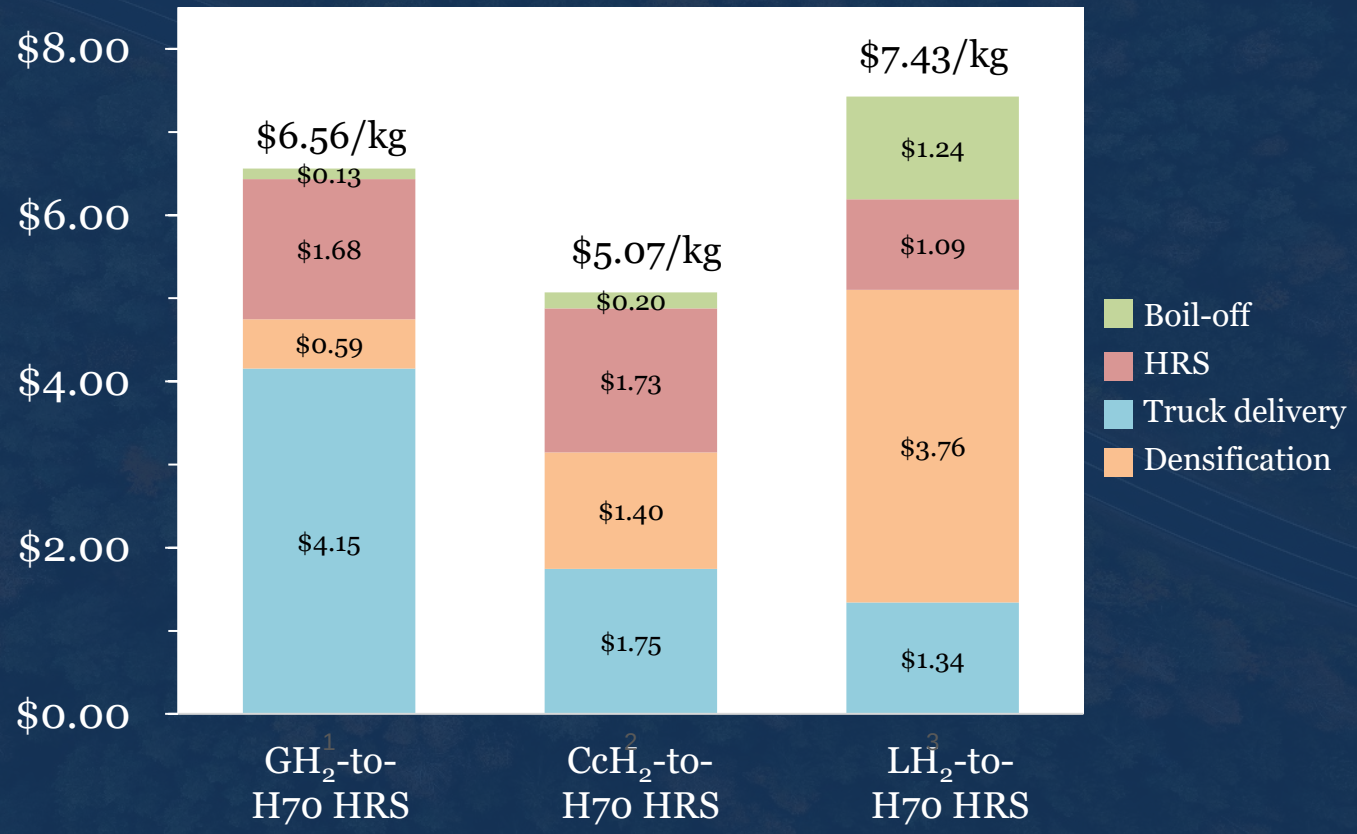
With boil-off considerations, CcH_2 provides total savings of 31%

TCO for 500 mi distribution & supply to 700 bar truck refueling ($/kg H_2)



Verne's leadership team continues to grow

Ted McKlveen
CEO

David Jaramillo
CTO

Bav Roy
COO

Kaushik Mallick
Head of H_2 Storage

Vincent Heloin
Head of H_2 Engineering

Alex Grab
H_2 Storage Manager

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

TRUCKS

UNITED

CATERPILLAR

VERNE

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Q1 2025 Demo Day: First CcH_2 Class 8 truck & mobile refueler

Class 8 dual-fuel ICE with Verne CcH_2 Storage

Verne CcH_2 Mobile Refueler

VERNE

A fossil-free future. Powered by Verne.

Bav Roy
COO & Co-Founder
bav@verneh2.com