SunLine TRANSIT AGENCY

Hydrogen Program History & Overview

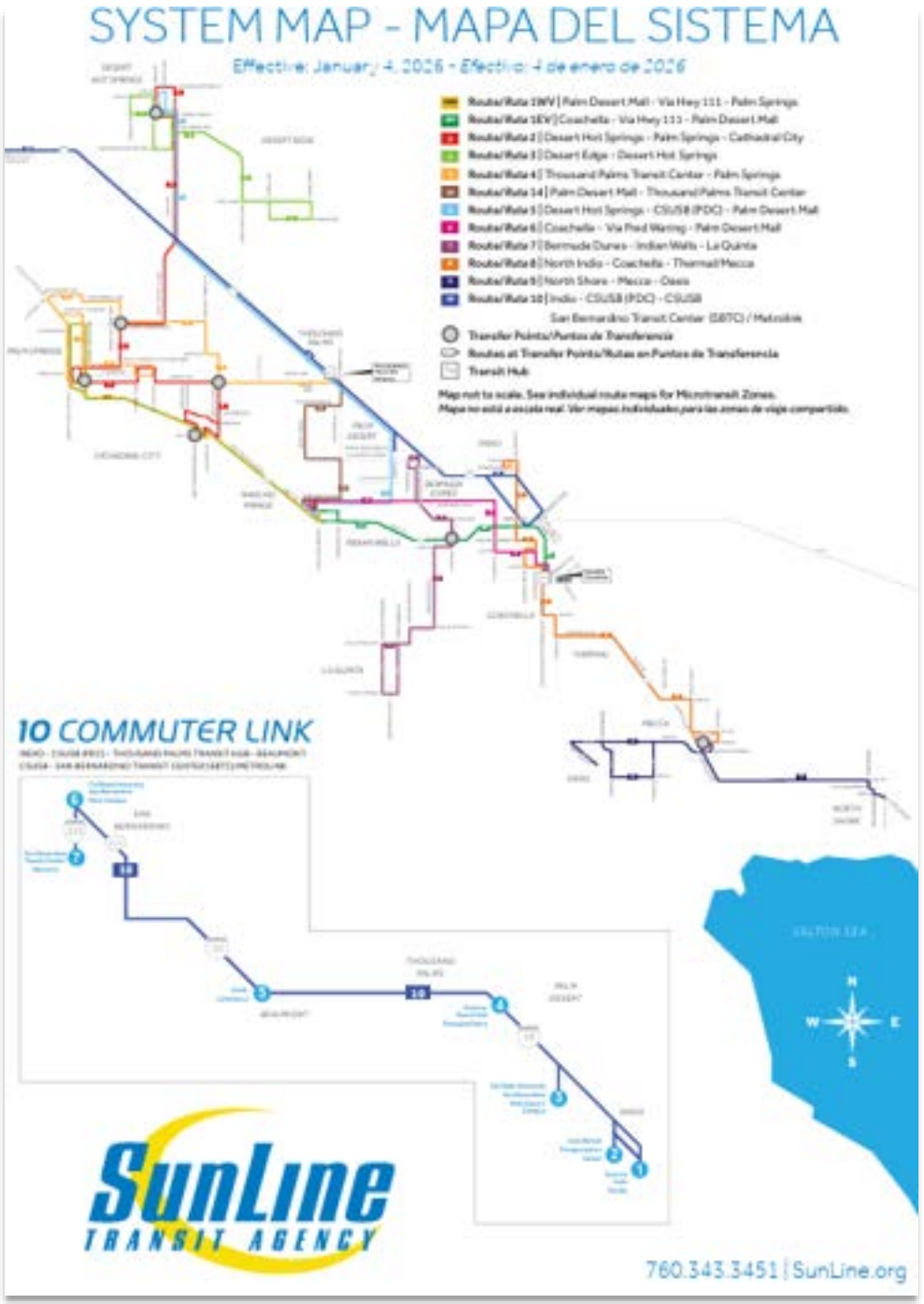
Coachella Valley Innovation Alliance (CVIA)

May 26, 2026

Mona Babauta, CEO/General Manager

SunLine Overview

- Joint powers authority formed in 1977
  - Palm Springs, Palm Desert, Rancho Mirage, Indian Wells, La Quinta, Desert Hot Springs, Cathedral City, Indio, Coachella and unincorporated areas of Riverside County
- Operate in the Coachella Valley
  - 1,120 mile service area
  - Fixed Route (SunBus), Commuter Link, Paratransit (SunDial), Microtransit (SunRide), and Taxi Voucher Program
- 390 Employees (approximately 75% are union represented)
- Annual Operating Budget: Approximately $51 million
  - Heavily dependent on State & Measure A funds
- Annual Capital Budget (as of May 2026): Over $100 million
  - Combination of state and federal funds



SUNLINE'S HISTORY, PRESENT AND FUTURE IN HYDROGEN TECHNOLOGY

Early Zero-emission Adopter

First

Transition to CNG

In 1994, following Board action to move to 100% alternative fuels

First

Hydrogen Fueling Station

In 2000, Agency emerged as a hydrogen pioneer

First

Transit Agency to Own & Operate H2 Generation & Dispensing Station

In 2006, SunFuels was created

32

Fuel Cell Buses

9 ENC

23 New Flyer

Zero Emission Fleet 36

ZEB's or 70% of our

Active Fleet

4

BYD

Battery Electric Buses

Preferred Fuel Path - Hydrogen

- FCEB is closest to 1 for 1 replacement of a CNG bus
- Typical summer temperatures exceed 120° F
- Approximately 200-250 miles operated by each bus daily
- Combination of rural, highway and city routes

ZEB Propulsion Systems Comparison

HYDROGEN FUEL CELL BUSES vs. BATTERY ELECTRIC BUSES

Two Clean Technologies. One Goal: Zero Emissions Transit.

HYDROGEN FUEL CELL BUS		BATTERY ELECTRIC BUS
Uses hydrogen stored in high-pressure tanks to fuel buses at 350 bar.	ENERGY STORAGE	Uses large on-board batteries to store electricity. Battery quantities and size can weigh down the bus and impact range.
Fast refueling: 6–15 minutes depending on the availability of IRDA communications technology, (consistent with diesel fueling times).	REFUELING / CHARGING TIME	Charging: ~2–4 hours (depot charging) or longer for full charge.
Long range: 250–400 miles on a full tank.	RANGE	Typical range: 150–300 miles (depending on bus, route, and environmental conditions).
Best for long routes, high daily mileage, heavy-duty service, and challenging terrain.	BEST SUITED FOR	Best for shorter routes, predictable duty cycles, and depot-based operations.
Requires liquid hydrogen stations with storage, pumping, and dispensing.	INFRASTRUCTURE REQUIREMENTS	Requires electrical infrastructure and charging equipment.
Zero tailpipe emissions: only water vapor.	EMISSIONS	Zero tailpipe emissions.

Both technologies deliver zero tailpipe emissions, reliable performance, and cleaner air for our communities.

SunLine's Hydrogen Fuel Path

- State of California's Innovative Clean Transit (ICT) Rule mandates full transition of fixed route (FR) fleets to zero emission by 2040
- ***TODAY***, over 65% of SunLine's active fleet is composed of hydrogen fuel cell buses (excludes contingency fleet of CNG buses)
- Funding incentives, mostly through California State Cap & Trade/Invest + federal discretionary sources (LowNo), have supported fleet/infrastructure investments
- Hydrogen fleet expansion & fueling infrastructure expansion currently underway

2002

23 years of investment in hydrogen fuel cell technology

2025

SUNLINE'S HYDROGEN FUEL TECHNOLOGY INFRASTRUCTURE INVESTMENTS & DEMONSTRATIONS

Current Hydrogen Fueling Sources

HYDROGEN ELECTROLYZER STATION

900 kg per day

IN SERVICE SINCE NOVEMBER 2019

CONTRACTOR: NEL HYDROGEN

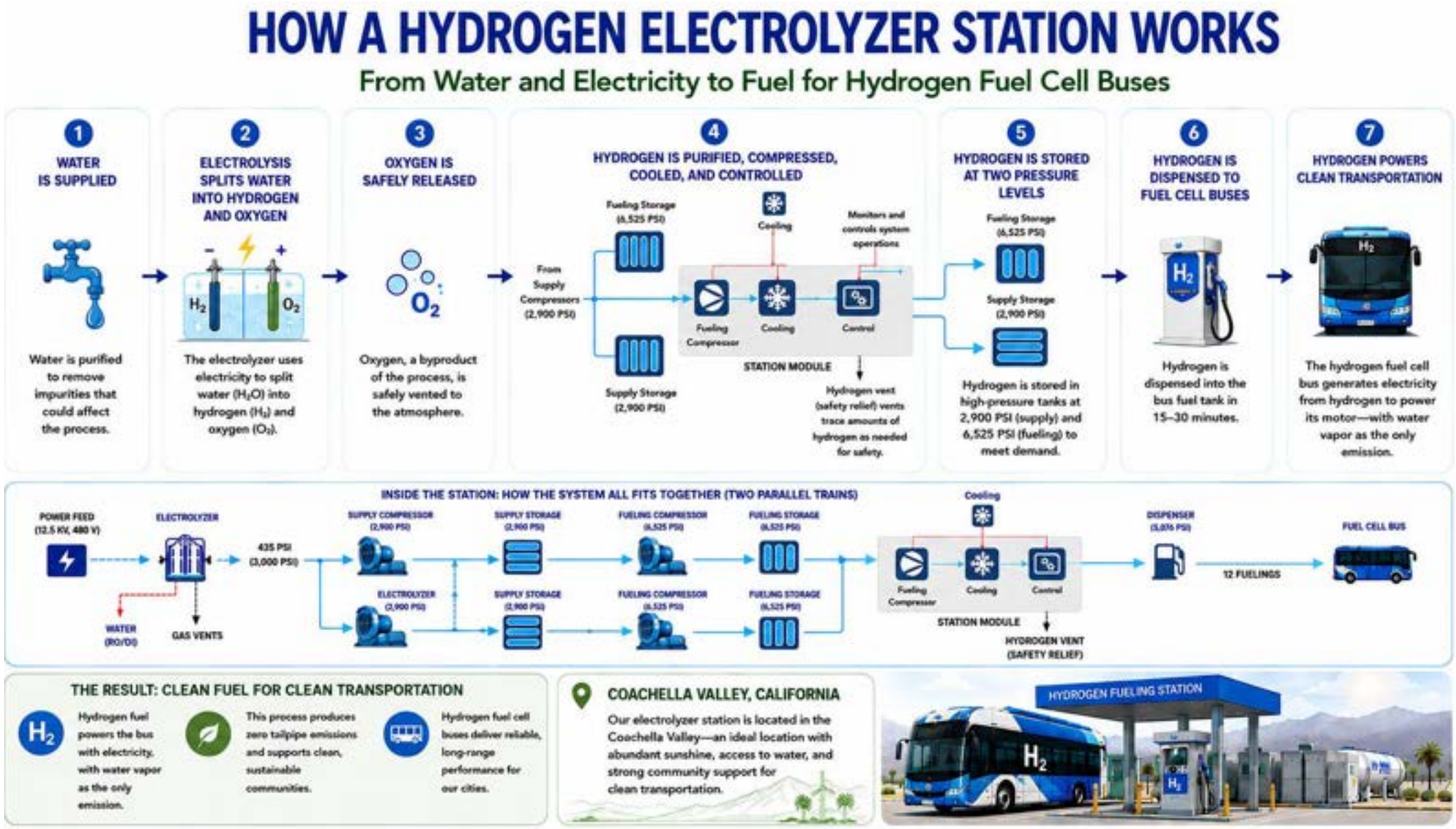
LIQUID HYDROGEN STATION

15,000 Gallon Liquid Storage Capacity

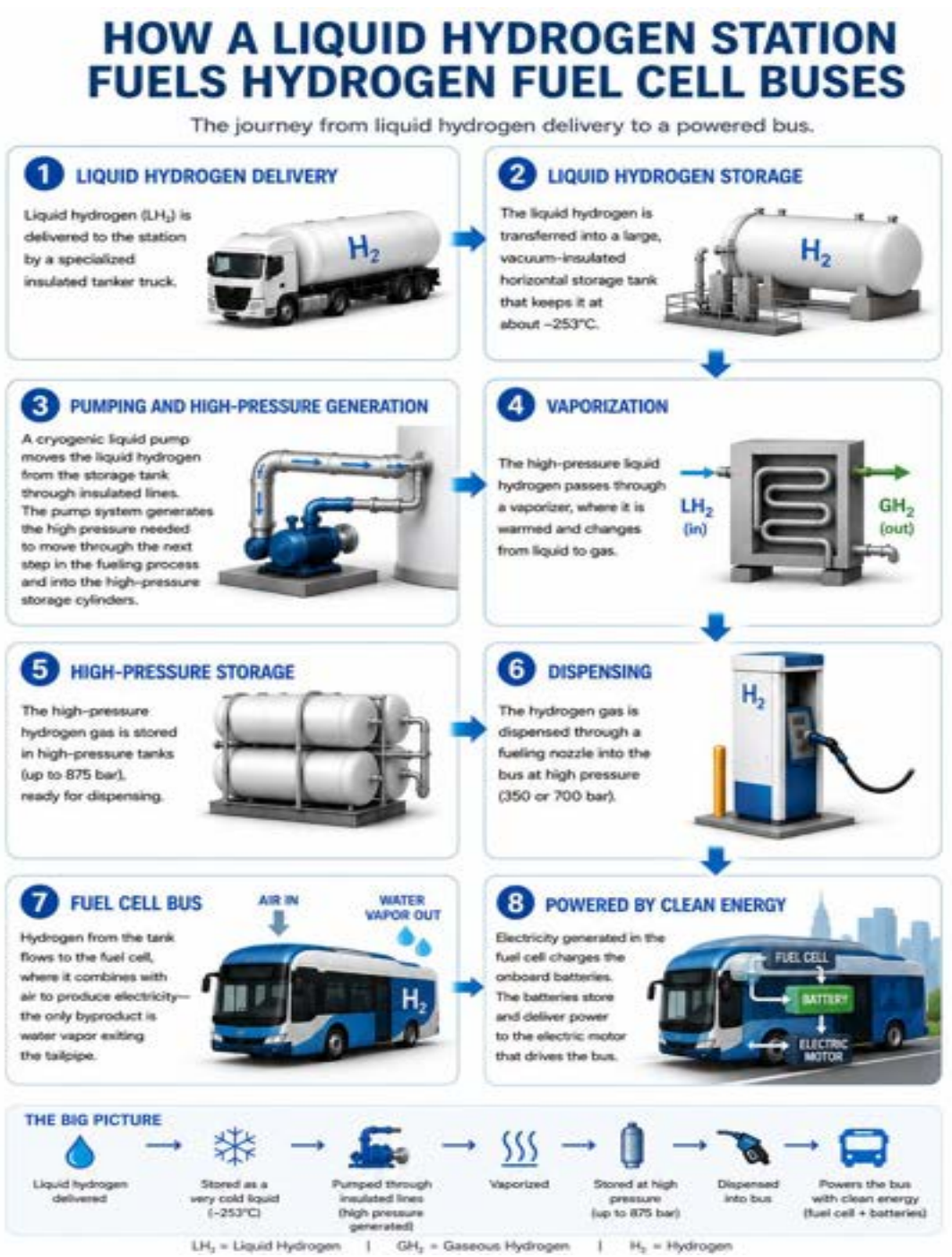
BEGAN FUELING: JULY 2024

CONTRACTOR: NIKKISO/INTEGRATED CRYOGENIC SOLUTIONS

SunLine's Hydrogen Electrolyzer Station



SunLine's Liquid Hydrogen Station



Liquid Hydrogen Station

- Construction began late 2023
- Began test fueling in July 2024
- Steady usage since September 2024
- Dispensing 500kg-600kg per day
- 20% recent reduction in Boil-Off (Truck to Bus)
- Multiple fueling Procedures
- 6–8-minute fills @30kg with (IRDA) Communication
- Most reliable and less complicated to maintain

H2 SilverSTARS Research & Development Project

- 80kg/day hydrogen production
- Created by 3D printing
- H2 production at a lower cost
- In the commission stage using RNG

NICE Liquid Hydrogen Trailer Demo

- Demo period October 2021 – February 2022
- 312 successful vehicle fills
- 6,755 kg of hydrogen dispensed
- Achieved 100% uptime
- Conflict with intellectual property rights

SMR operated from 2006-2019

SMR's maximum production 200 kg

Steam Methane Reformer (SMR)

Decommissioned

In 2019 due to high hydrogen fuel demand

Equipment on Site

- Compressor
- Storage
- Hydrogen dispenser

WORKFORCE INVESTMENTS

SunLine TRANSIT AGENCY

CTW California Transit Works!

ATU

CTTC CALIFORNIA TRANSIT TRAINING CONSORTIUM

COLLEGE of the DESERT

Ongoing & Future Plans

- Hydrogen fuel for sale to public for light duty vehicles – expected by July 2026
- Workforce Training Center – expected construction completion by December 2027
  - Apprenticeship programs for mechanics & bus operators
  - Developing hydrogen technology focused curriculum to support industry workforce needs
- 2nd Liquid Hydrogen Station (Indio division) – expected completion in calendar year 2028
- 12 new hydrogen fuel cell buses – delivery planned for Dec. 2027 through spring 2028
- Microgrid – A&E underway. Goals: Increase energy capacity, reduce operating costs, support green hydrogen production
- New Maintenance Facility – A&E underway. Goals: Employee safety & wellness, operational efficiency, increase maintenance capacity for growth
- Continue to support marketplace innovation & commercialization

Thank You

WEBSITE
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Technical Details

Electrolyzer Station Characteristics

- Proton Exchange Membrane (PEM) Electrolyzer
- 2.5-megawatt station producing gaseous hydrogen
- Power Consumption per kg of H2 produced = 60.3 kWh
- Water Consumption per kg of H2 produced = 14.3L
- Maximum hydrogen production per day = 900 kg
- 2 Dispensers; Max fill per FCEB: 30 kg; Dispensing @ 350 bar, Fill time: 15-20 minutes
- No measurable boil-off losses

Liquid Hydrogen Station Characteristics

- 15,000 gallon/4,000 kg LH_2 tank
- Dual pump trains consisting of;
  - Submerged liquid pumps
  - High pressure piston pumps (120 kg LH_2/hour)
  - Cold capture heat exchangers
  - Priority panel
  - 8 GH_2 storage tanks
    - 4- Low bank- 500bar (7,250psi) tanks
    - 2- Medium bank- 700bar (10,150psi) tanks
    - 2- High bank- 1,000bar (14,500psi) tanks
- 300 gallon heat transfer fluid (HTF) system
- 3 dispensers (**1 public-facing**) capable of IrDA (J2799) H35 (350bar/5,000psi), and H70 (700 bar/10,000psi) fueling
- Public consumption/sale of hydrogen fuel for light duty vehicles at Thousand Palms location- **expected by July 2026**

Losses at Each Stage

Well to Wheel — Delivery → Station → Operations → End Use (Before March 2026)

Delivery Truck: 10-12% (Trans-fill)

LH2 Station (Idle): 5-8%

Operations: 30-35%

Bus: LH2-BOG=Fuel Consumption

Well to Wheel — Current (March – April 2026)

Delivery Truck: 3-5% (Trans-fill)

LH2 Station (Idle): 3-5%

Operations: 14-15%

Bus: LH2-BOG=Fuel Consumption

Data Collection

- Types of variables collected
  - Number of deliveries in a month
  - Delivery quantities
  - Fueling window (number of hours station in operation)
  - Number of times station initiated/stopped
  - Fueling efficiency (dispensed fuel versus what was burnt off)

- Established critical time-stamps throughout the day
  - Monthly Analysis
    - Results in establishing and identifying ‘normal’ parameters
    - Monitor anomalies in Well-to-Wheel stages
      - Normalizes what are “acceptable” losses throughout each stage

Controlling Boil-Off

- Shorten fueling windows as much as possible
- Fuel buses back-to-back all at once
- Utilize communication devices between dispensers and buses to speed up fueling and maximize the fuel fill
- Reduce frequencies of chill downs
- Carefully balance deliveries with full loads
- Monitor and manage storage tank temperatures and pressures
- Plan routes to capabilities of bus ranges to reduce mid-day fueling
- Consider 57kg bus fuel tanks to reduce mid-day fueling
- Foster partnership with fuel station OEM to optimize system operation
- Collect good data and feedback

Next Steps to Controlling Boil-Off

- Explore tank cooling to maintain tank temperatures for long periods between deliveries and extremely hot weather elevating tank temperatures
- Explore an off-load pump system to reduce heat required to off-load tanker
- Assess appropriate tank size to balance current and future fueling needs
- Continue to study data and costs