



www.colorado-hydrogen.org

Monthly Meeting
21 April 2026

Agenda

- Coming Events
 - *Hydrogen 102: How to start a Hydrogen Hub, Colorado Style!* April 30, Ft. Collins
 - Drilling for Hydrogen, Houston, May 13-14
 - ACT Expo, Las Vegas, May 4-6
- Overview of the Ft. Collins Hydrogen event on April 30
- Overview of hydrogen sensors from First Element, Boulder
- Tech Talk
 - Vehicle hydrogen tank designs
- Earth Day (tomorrow)

Coming Events



Hydrogen 102: How to start a Hydrogen Hub, Colorado Style!

Thursday, April 30, 1:00 to 4:30 PM

CSU Powerhouse

430 N College Ave, Fort Collins

All are welcome

Register: hydrogen102.eventbrite.com



Drilling for Hydrogen

May 13 – 14, 2026 Houston, TX

More info and to register at:

www.drilling-for-hydrogen.com

Kathy Anderson has one half-price ticket available.

Contact: kandersen@brint.tech



Coming Events



The Largest Fleet Technology Show

CONFERENCE: MAY 4 - 7, 2026 | EXPO HALL: MAY 4 - 6, 2026
LAS VEGAS CONVENTION CENTER

www.actexpo.com

Hydrogen 102 Event

NEW DAY
HYDROGEN 



ENERGY
INSTITUTE
COLORADO STATE UNIVERSITY



DRIVE CLEAN
COLORADO
a Clean Cities Coalition

Thursday, April 30, 1:00 PM to 4:30 PM
CSU Powerhouse
430 N College Ave, Fort Collins

Seth Terry
CEO New Day Hydrogen



Colorado Fuel Station Timeline

- Aug 2019 – Preso to RAQC regarding modular H₂ Fuel station
 - Colo. Oil & Public Safety (O&PS) identified funding
 - Gov. Polis in favor
- March 2020 – O&PS money lost to state budget for COVID
- Sept 2020 – CHN & NREL obtain donated Nel H₂ station to CSU
- Oct 2020 – New Day Hydrogen formed
- June 2023 – CFI Proposal (Charging Fueling Infrastructure)
- Jan 2024 – CFI grant award
- Mid-2027 – Planned opening of three CFI H₂ Fuel stations
 - Ft. Collins, Denver, Pueblo



William Hoagland
President

Hydrogen Detection Solutions

- **Color-Changing Hydrogen-Detecting Tape – Detectape®**
- **Networked Thin-Film Passive RFID Hydrogen Sensors**



HYDROGEN LEAK DETECTION

Visual and Wireless Detection at Leak Source
CHN 4/21/2026



Element One's products offer a solution to problems that exist with hydrogen sensors available today

Problems with Currently Available Hydrogen Sensors

- ❑ **Hydrogen leaks are missed** because sensors are separated from potential leak sources
- ❑ **Dispersion** characteristics of hydrogen makes it difficult to detect outdoors
- ❑ Area monitors are **expensive** and generally require a source of power
- ❑ **Pipelines** and other remote equipment cannot currently be effectively monitored

Element One's Wireless Sensors Address These Major Shortcomings

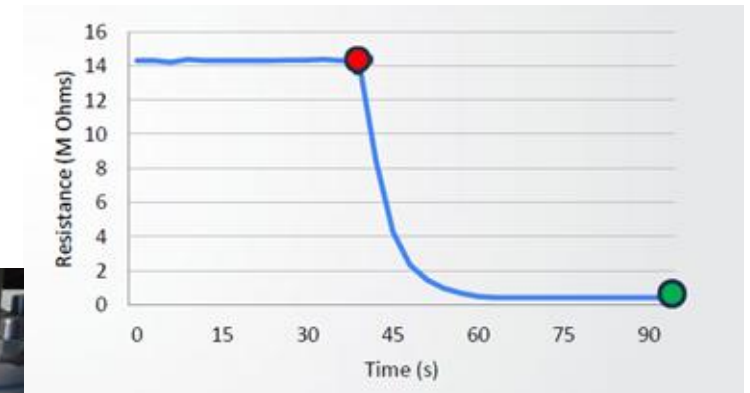
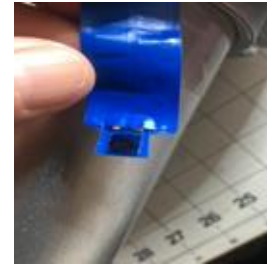
- ✓ Rapidly identify leaks at their source for:
 - ✓ Fewer missed leaks
 - ✓ Increased safety
 - ✓ Reduced downtime and cost
 - ✓ Reduced loss of valuable hydrogen
- ✓ Only react to hydrogen
- ✓ Very low cost
- ✓ Low to no power requirements
- ✓ Can be monitored remotely

Element One's products offer both visual and remote monitoring solutions for hydrogen leak detection

- **DetecTape** is a self-fusing tape that rapidly changes color when exposed to hydrogen (chemochromic reaction)



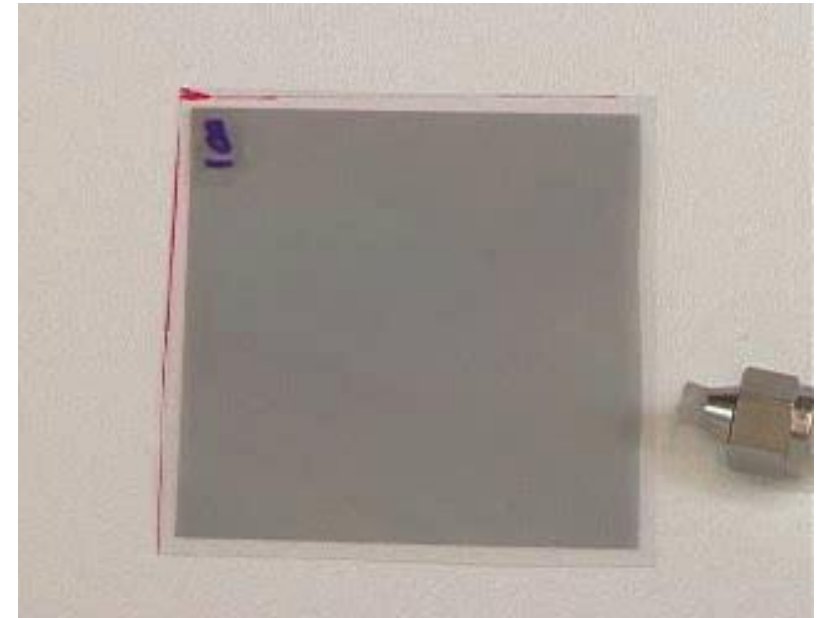
- **Wireless Sensors** provide a rapid, drastic reduction in measured electrical resistance when exposed to hydrogen



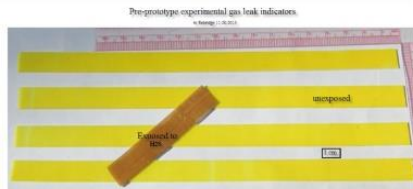
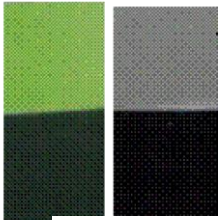
Element One's products function simply and reliably via a chemical reaction in the presence of hydrogen

Advantages/Customer Benefits

- ✓ *Selective - detects hydrogen only*
- ✓ *Sensitive (1/100 of lower flammability limit)*
- ✓ *Reversible or non-reversible versions*
- ✓ *Inherently safe, no electronics*
- ✓ *Convenient/very low cost*
- ✓ *Positive indication of both presence or absence of H₂*
- ✓ *Suitable for Low-cost wireless sensors*

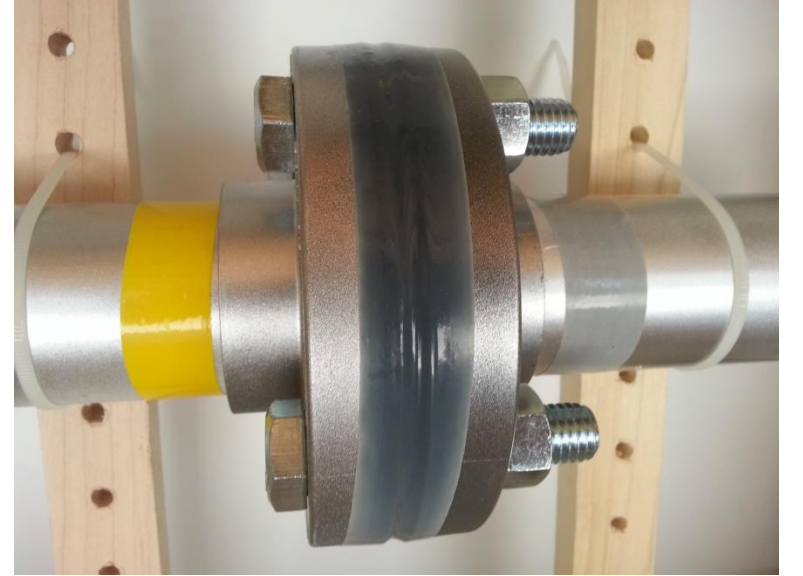
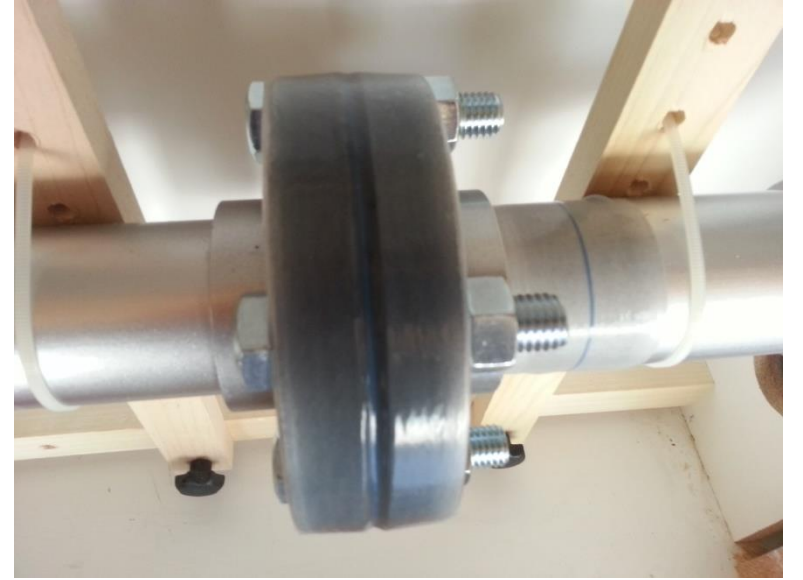
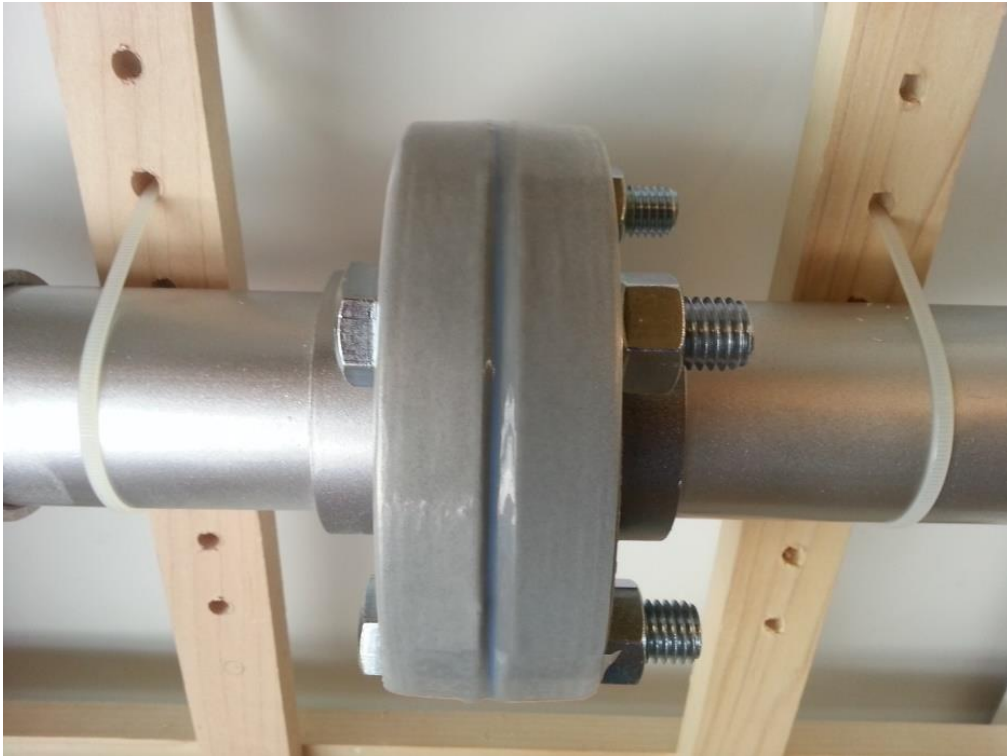


Previous R&D – Visual



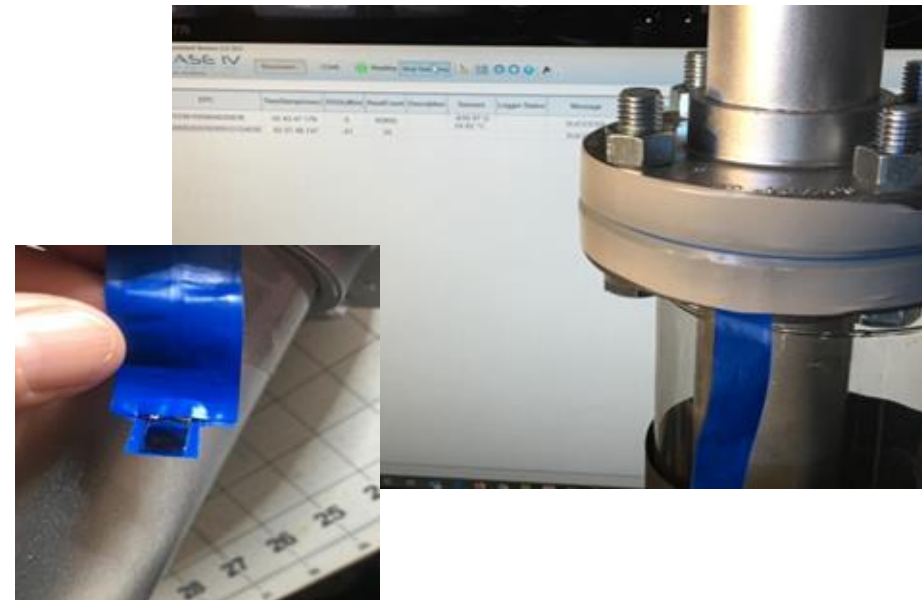
- DeteCoat[®] color changing paints and coatings
- Thin film flexible indicating wraps
- Silicone high temperature, UV resistant coatings
- DetecTape[®] self-fusing indicating tape
- Hydrogen sulfide indicating pigments and thin films

Pipe Flange Covers



The Wireless Leak Detection Solution

- DetecTape® – Visual inspection solution—changes color in presence of hydrogen
- RFID, Zigbee, and Bluetooth Wireless Sensors allow passive and remote interrogation and alerts



Element One's color-changing and wireless hydrogen leak detection technologies allow leaks to be detected inexpensively and rapidly at the source and monitored remotely.

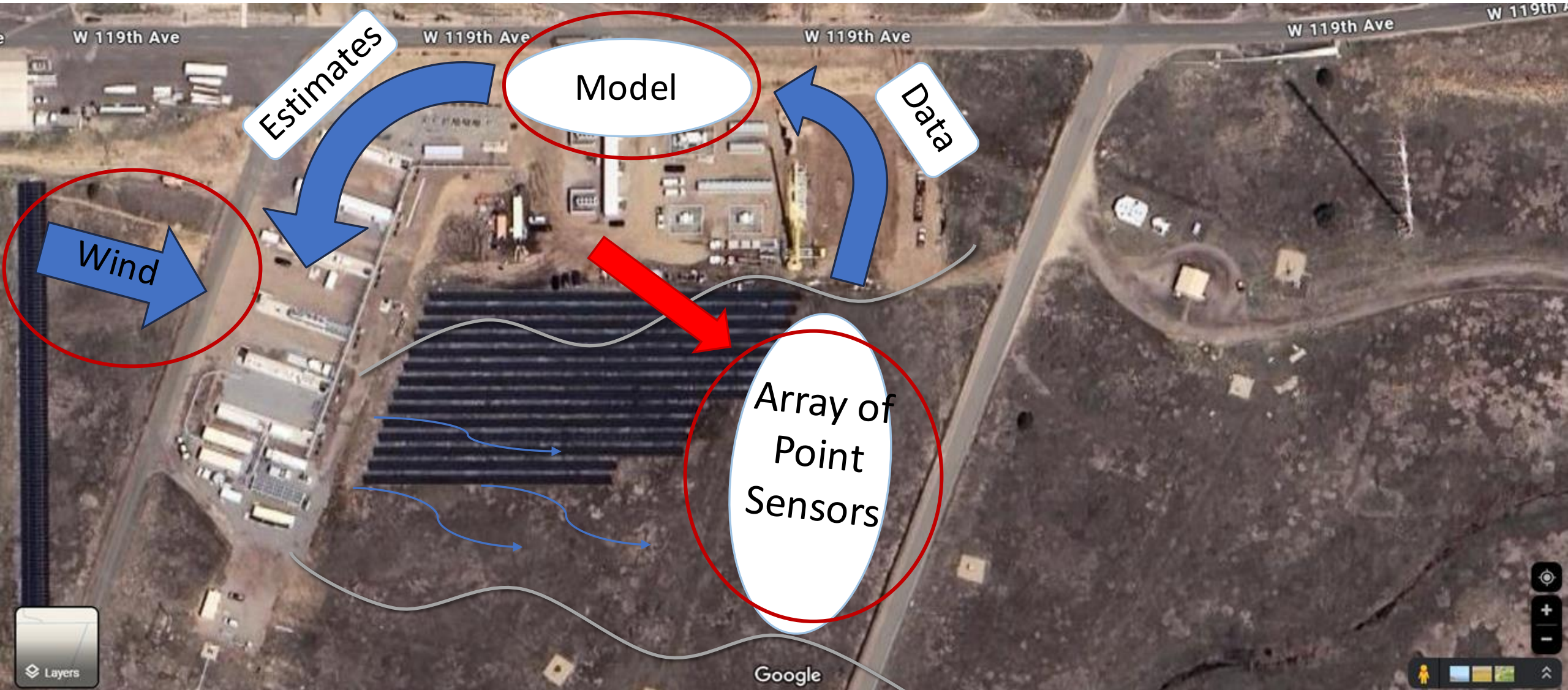
Element One's products offer clear advantages in the current Hydrogen sensor competitive landscape

Features

Types of Hydrogen Sensors

	Accurate	Remote Interrogation	Inexpensive	Deployed at Potential Leak Source	No Power Required
Area Monitors	X	X			
In-Line	X	X			
Handheld	X			X	
Element One	X	X	X	X	X

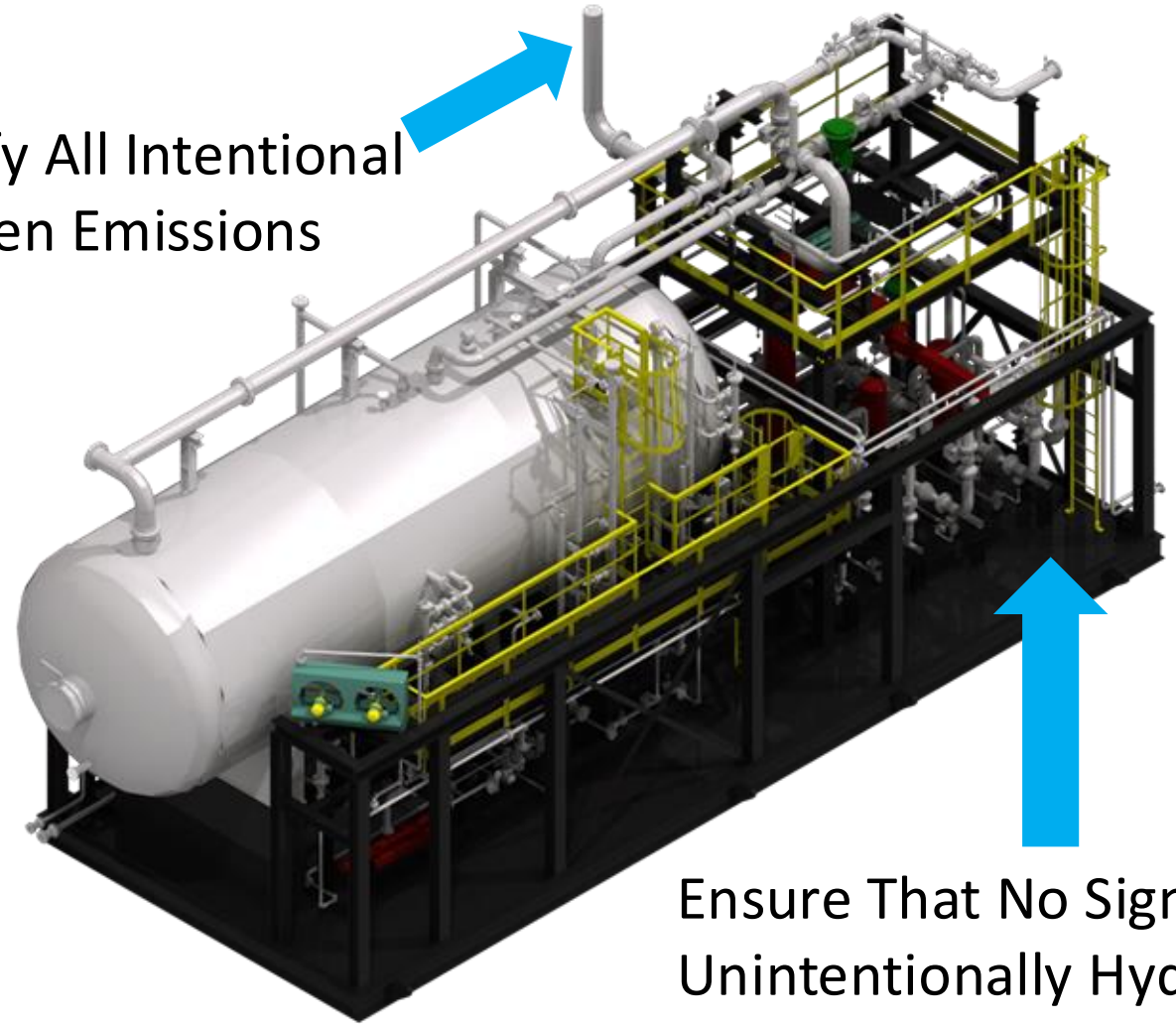
Current Standoff Quantification Strategy



Element One Quantification Strategy

- Widely populating our sensors at potential leak points greatly reduces the chance that hydrogen will escape to the atmosphere without first passing over a sensor
- No modeling or extensive sensor validation needed.
- Strategy is easily transferable from one system to the next.

Quantify All Intentional Hydrogen Emissions



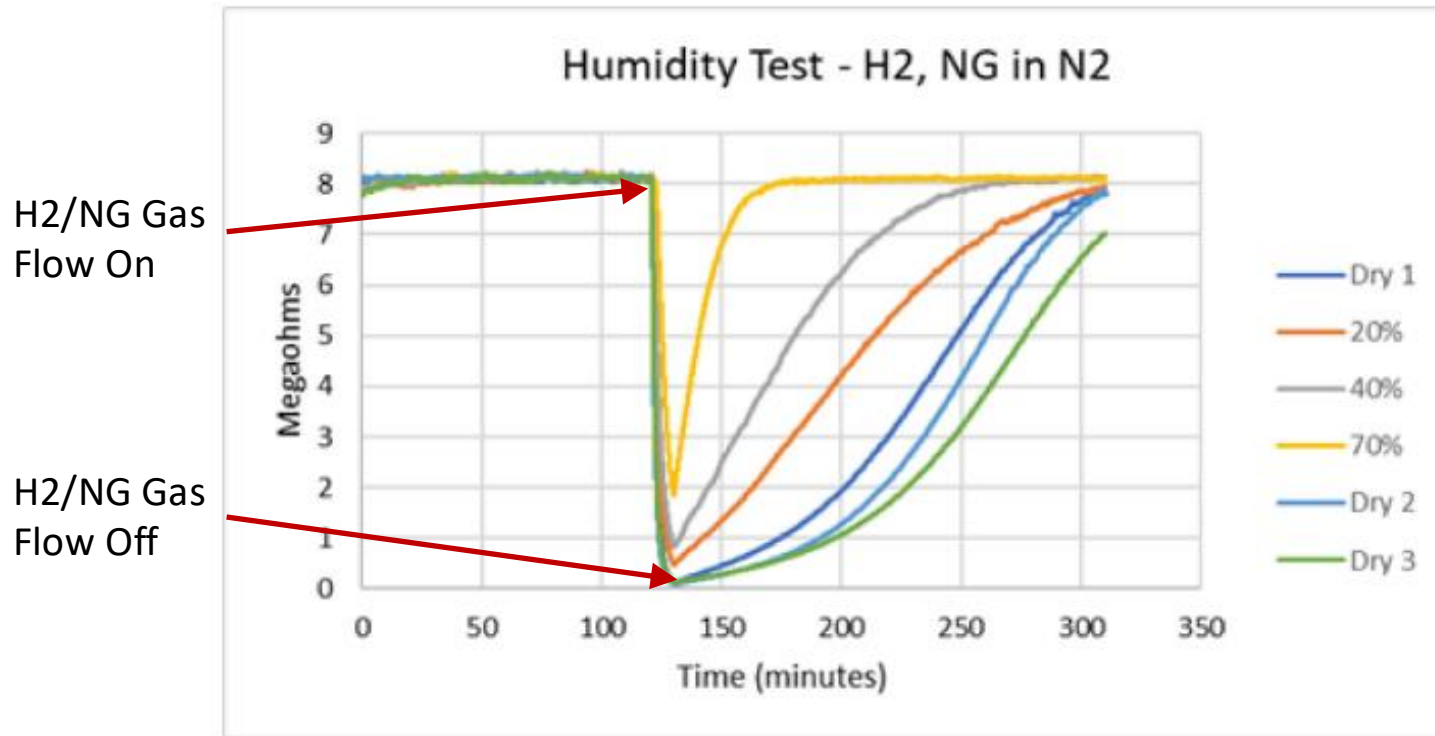
Ensure That No Significant Unintentionally Hydrogen Leaks

Substrates used for testing wireless sensors

- Interdigitated electrodes (left not exposed to H₂, right after exposure)



Sensors are selective to hydrogen, impervious to Natural Gas, and minimally affected by humidity

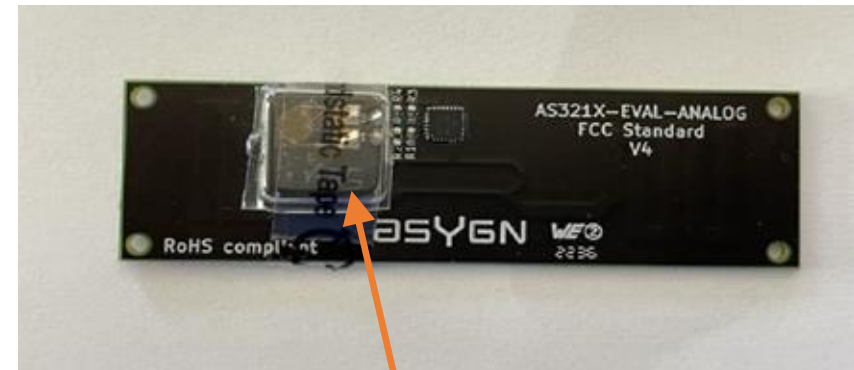


The chart shown here represents the change in measured resistance by Element One's wireless sensors in various humidity test environments both before and after H2 / NG gas flow¹ is turned on

1) 2% Hydrogen, 8% Natural Gas, Balance N2

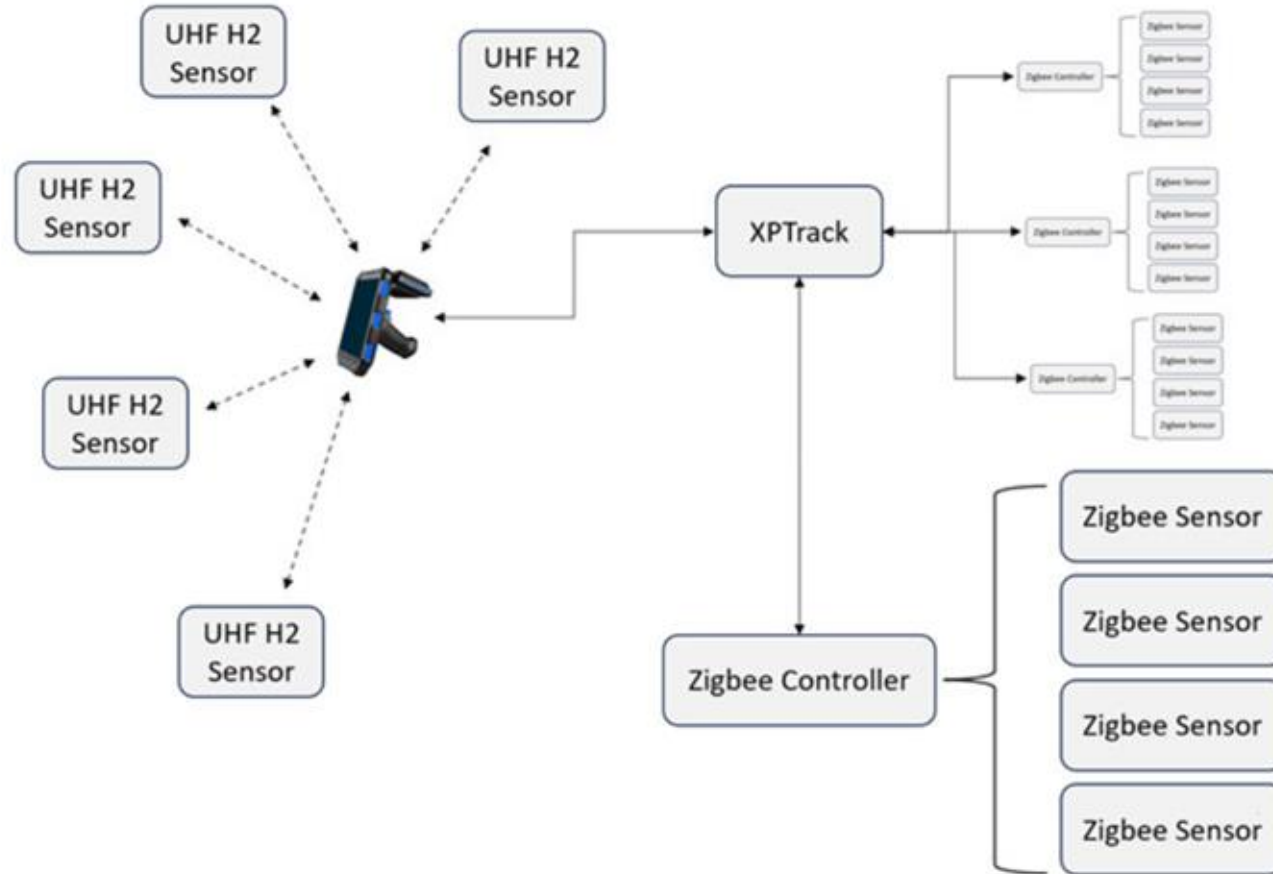
Resistance drops precipitously when Hydrogen / Natural Gas (NG) blend is introduced, with minimal impact on performance due to humidity

Passive RFID sensors can be interrogated by an Android smartphone-enabled handheld RFID reader



Element One Wireless
Hydrogen Sensor

Wireless sensors can remotely monitor and alert to hydrogen leaks while also storing data in the cloud



Wireless sensors are designed to be used with DetecTape for operational efficiency and redundancy

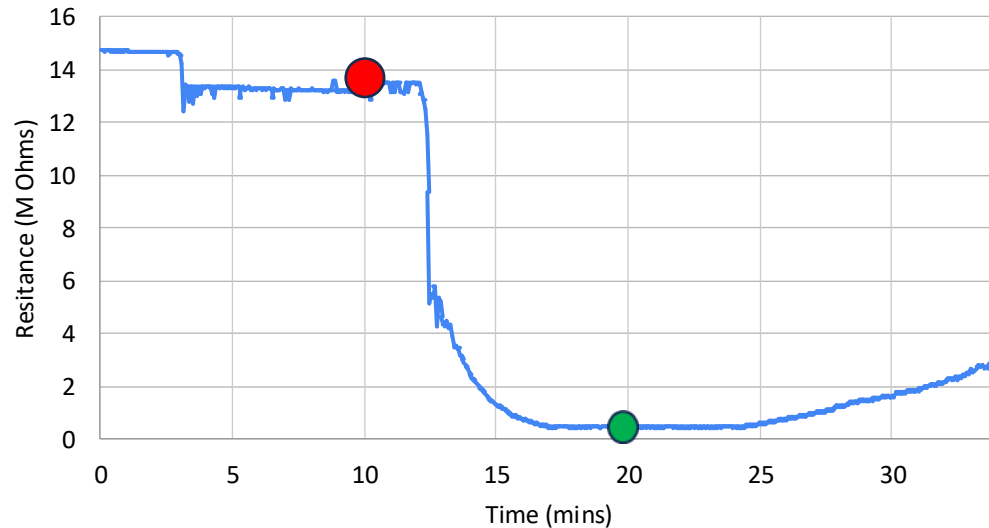
Wireless Sensor and DetecTape Applied Together



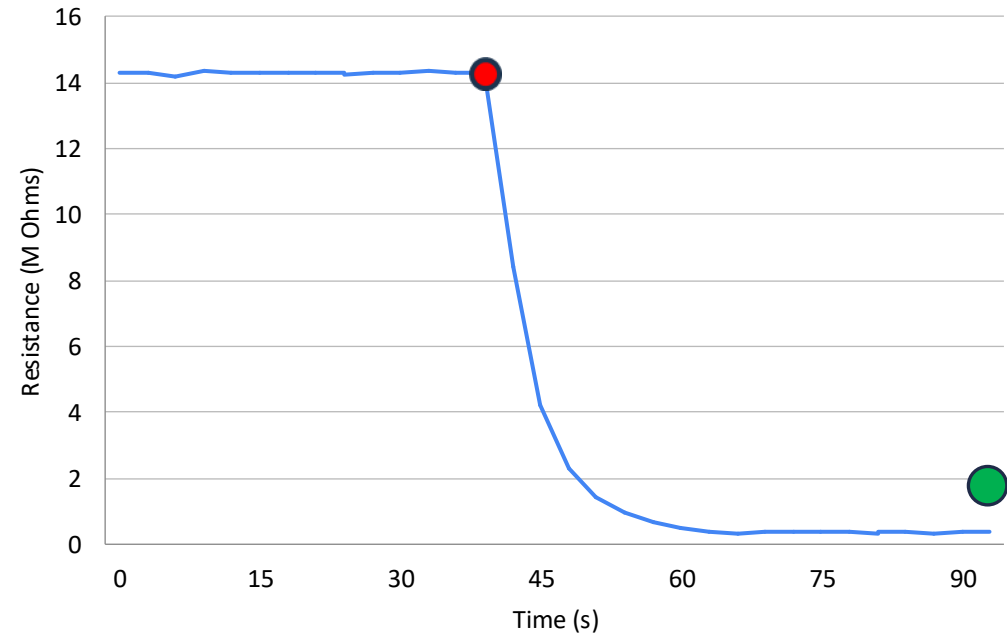
- Wireless sensors can be mounted with DetecTape at potential leak points to enable both visual and remote monitoring of hydrogen leaks
- This simple, effective, and low-cost application method enables:
 - Ease of installation
 - Redundancy of monitoring
 - Widespread use in distributed environments

Sensors demonstrate resistance drop in various test environments using Zigbee mesh network protocol

W020722 M42 --2% H2 in Air in SSTA Resistance (M Ohms) Vs. Time (mins)
Zigbee in SSTA



W020722 M42 --100% H2 in Benchtop Resistance (M Ohms) Vs. Time (s)
Zigbee in Benchtop



● Hydrogen On

● Hydrogen Off

Element One's Wireless Sensors were designed for distributed use and flexibility in implementation

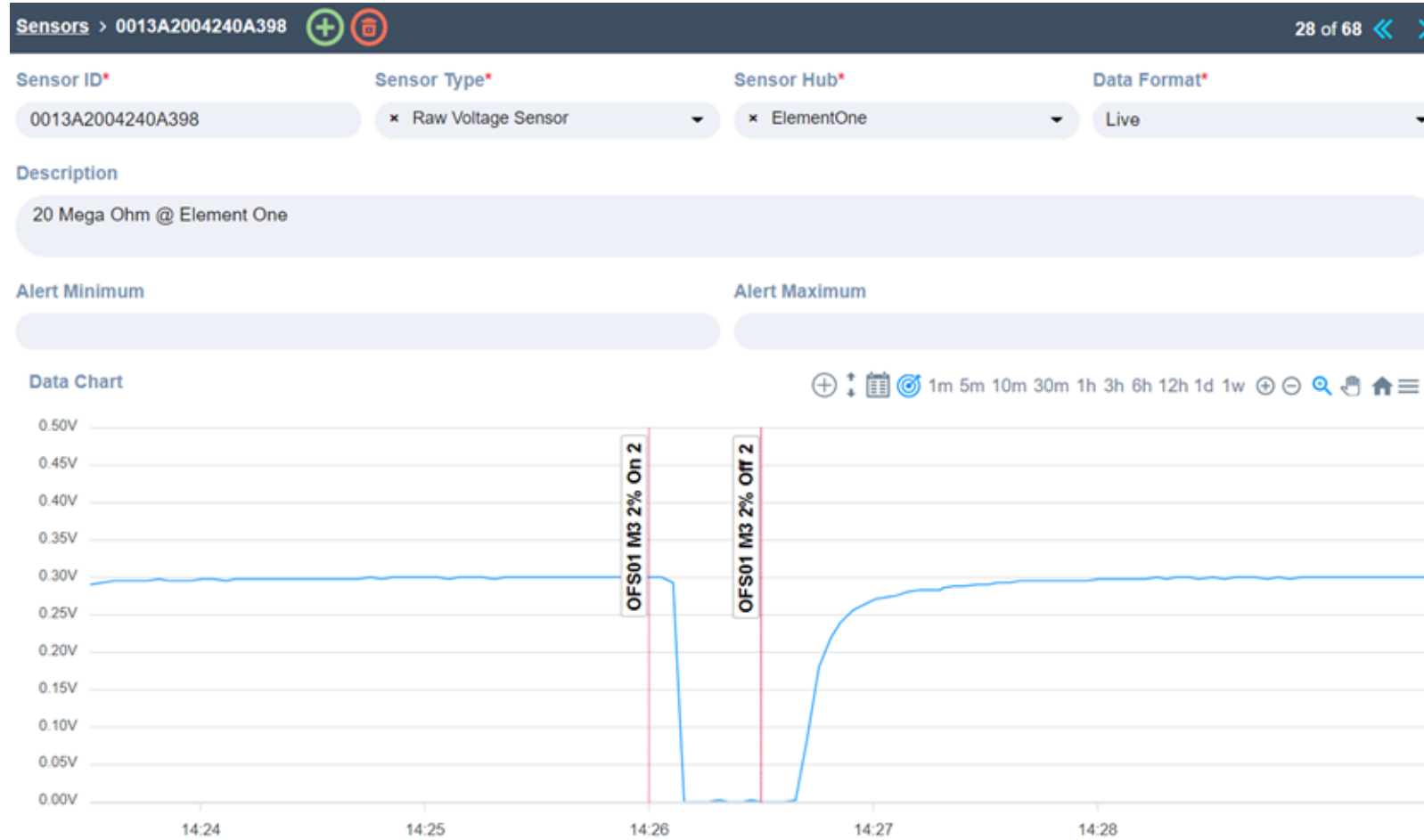
Attributes

- Low cost, scalable production
- Small device footprint
- Protocol agnostic
- RFID power harvesting design

Implications

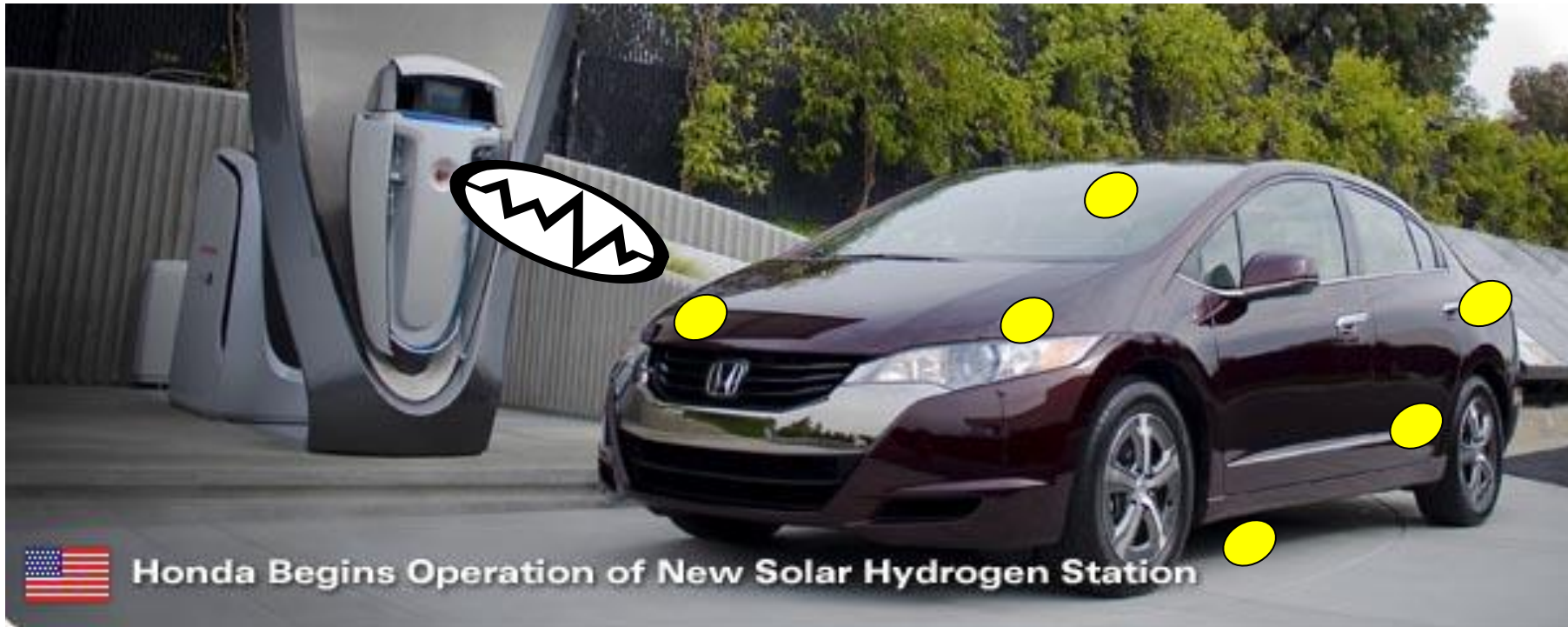
- Enables widespread deployment in distributed environments at likeliest potential leak sources
- Extremely low profile has minimal operational impact and enables confined space applications
- Potential for integration with various common wireless system protocols (e.g. RFID, Zigbee)
- Suitable for zero combustion environments and eliminates need for power source

Wireless Sensor Monitoring



Leak Checking

Hydrogen cars and refueling infrastructure



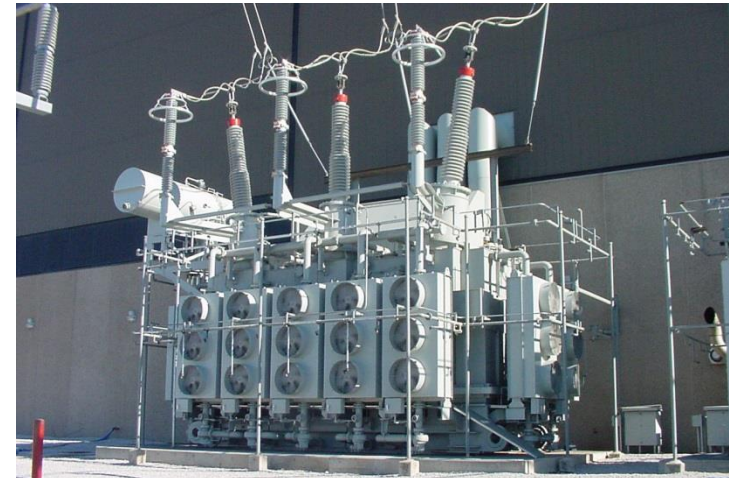
Emergency/First Responders



RFID sensors could be used to check for hydrogen system integrity at accident scenes involving hydrogen vehicles.

Power Transformer Oil Degradation

Indicators to test for presence of dissolved hydrogen in liquids to detect degradation of transformer oil (patent applied for)



More applications...

- ***COPV tanks, fuel cells and related equipment;**
- ***Mining equipment**
- ***Fuel cell portable power units**
- ***Zinc-air battery degradation**
- ***Nuclear waste monitoring**
- ***Wind/Photovoltaic electrolysis for hydrogen generation**
- ***Food processing - hydrogenation**
- ***Hydrogen cooling - power generation**

What's Next

- Tape – Establish Manufacturing in Colorado
- Wireless Sensor –
 - Working with Commercial RFID Company for Cloud Storage and User Interface of Wireless Data
- Partnerships with Companies for Field Test of Wireless Sensors
- Licensing or Develop Business and Marketing Team
- Sensors for Ammonia and Hydrogen Sulfide



4/21/2026

- Thank you!
- Element One, Inc.
- www.detecttape.com
- whoagland@elem1.com
 - 720 222-3214



NREL Name Change

- 12/1/25 NREL became NLR (National Lab of the Rockies)
- E-mail addresses have changed
john.doe@nrel.gov becomes
john.doe@nlr.gov
- **Starting May 29 – Old NREL e-mail addresses will be no longer be redirected to nlr.gov**



**National
Laboratory
of the Rockies**

BMW “Flat” Tank Design



For the iX5

Range: 750 km (466 miles)

Source: <https://www.bmwgroup.com/en/news/general/2026/bmw-ix5-hydrogen-tank-system.html>

Linamar "Flex Form" Type 4 Hydrogen Tank

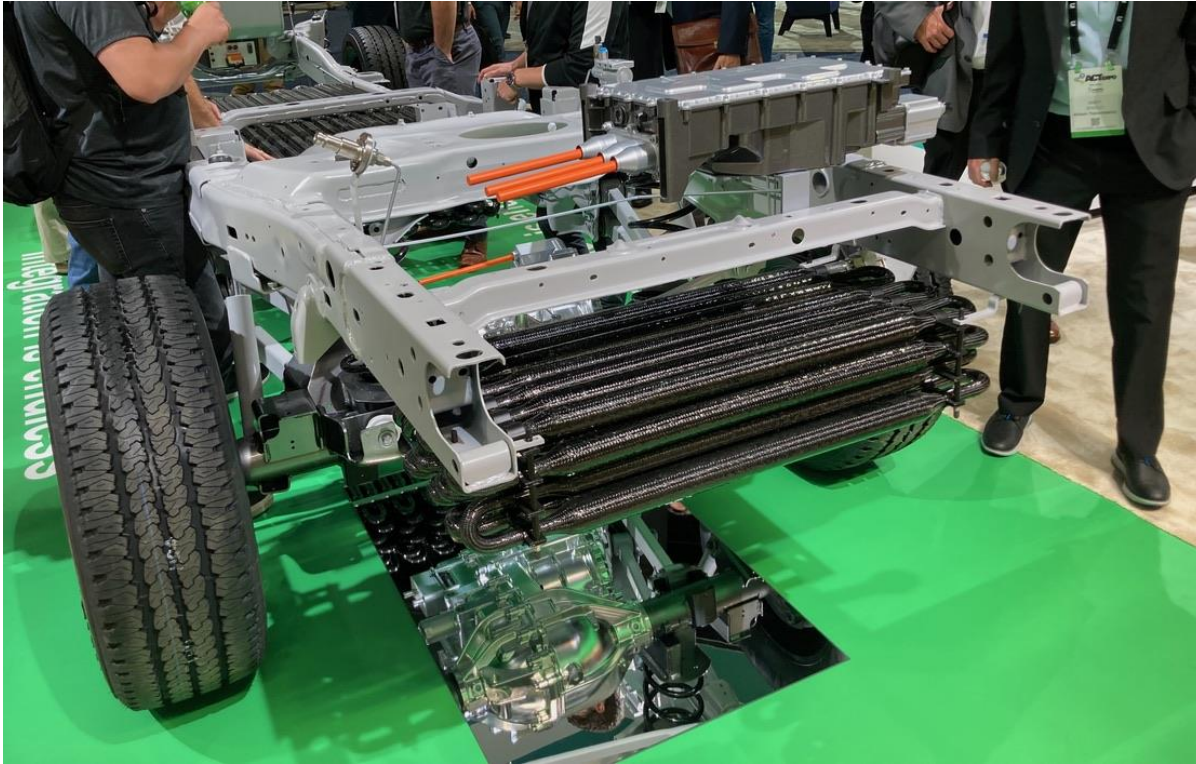
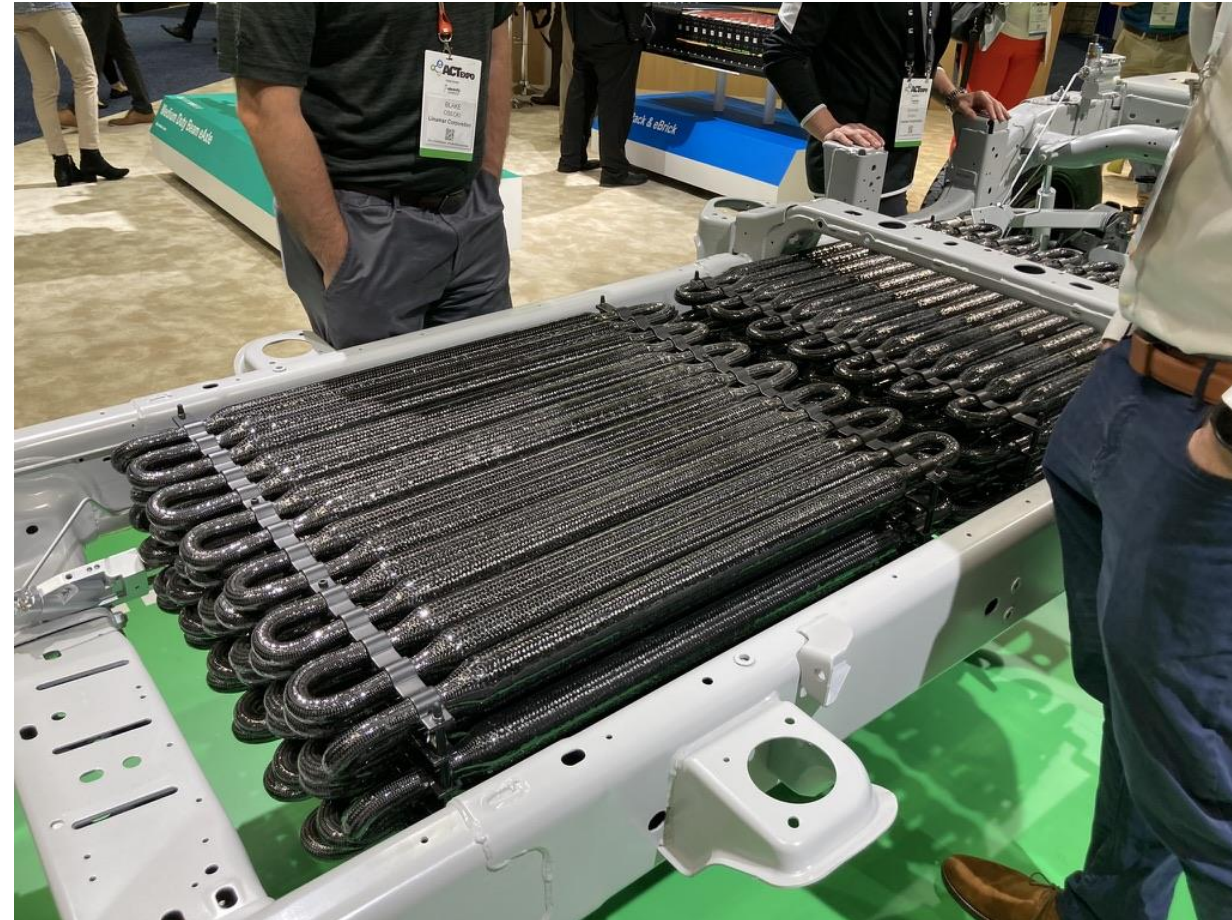


Photo taken at ACT, May 2022



Linamar FlexForm Tank

FlexForm

Type IV Hydrogen Tank up to 700 bar

- Conformable tank that can be configured to fit irregular spaces within a vehicle
- Continuous manufacturing process that creates a foldable design that allows excellent packaging flexibility
- Length and diameter of chambers can be varied to optimize the use of available space



www.linamar.com/mobility

Hydrogen Tank Types

Type I (All-Metal)

Type II (Metal + Composite)

A metal liner (aluminum or steel) with a partial carbon fiber or fiberglass wrapping

Type III (Metal Liner + Composite Wrap)

Metal liner (usually aluminum) with carbon fiber wrap

Type IV (Plastic Liner + Composite Wrap)

Uses a high-density polymer (plastic) liner fully wrapped in carbon fiber

Type used on hydrogen vehicles

Type V (All-Composite, Linerless)

Completely linerless, all-composite construction

Earth Day

- Marks the birth of the modern environmental movement
 - First Earth Day April 22, 1970
 - An estimated 20 million Americans took part in rallies, marches and teach-ins calling for environmental reform
- In 1970, environmental awareness was rising
 - 1962 book “Silent Spring”
 - Zero Population Growth movement
 - Paul Ehrlich’s book “The Population Bomb” in 1968
 - 1968 *Earthrise* NASA photograph
 - January 1969 oil spill in Santa Barbara, CA
- Key Drivers
 - Sen. Gaylord Nelson (D-WI)
 - Rep. Pete McCloskey (R-CA)
 - Denis Hayes, national coordinator
 - United Auto Workers was the most instrumental outside financial and operational supporter.



Earth Day

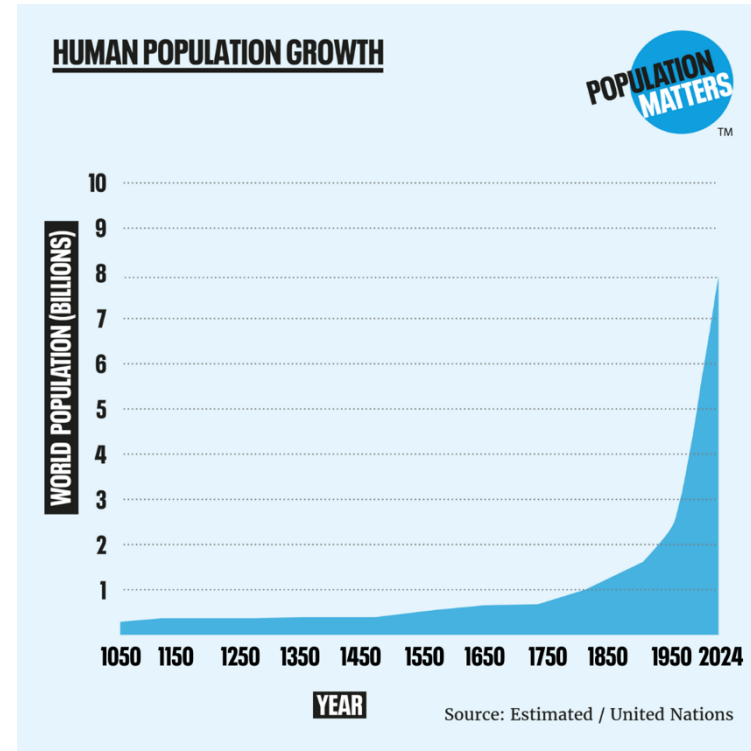
- The first Earth Day was focused on the United States
 - In 1990, Denis Hayes, the original national coordinator in 1970, took it international and organized events in 141 nations
- Earth Day 2016, Paris Agreement signed by 141 nations
- Earth Day 2020 50th anniversary
 - Observed by over 100 million people around the
 - Now the world's largest civic observance

Poster by Walt Kelly to promote Earth Day 1970



Changes Since 1970

- World population
 - 1970 – 3,694,683,794
 - 2026 – 8,300,678,395
 - Increase of 2.5 times
- US Population
 - 1970 – 204 M
 - 2026 – 349 M
 - Increase of 71%
- CO₂
 - 1970 – 324.6 PPM
 - 2026 – 430 PPM
 - Increase of 32%





HydrogenNowCast



Podcast