

TROY TECHNICAL

HYDROGEN ENERGY WEEKLY REPORT

October 10 - October 16, 2026 | Issue 2026-W41

**Delivered hydrogen economics, infrastructure
readiness and bankable demand**

15

ANALYZED ARTICLES

10

PRIORITY THEMES

Issued 2026-10-16 | English edition | fixed approved cover artwork



Hydrogen Energy: the boundary moved from isolated claims to qualification evidence

15 English articles were reviewed independently from the Japanese edition. Ten themes are retained for management decisions.

SIGNAL 01 | SYSTEM / ADOPTION

Aichi Tokei Denki: Hydrogen Gas Flow Measurement Implementation

Primary-source report: Aichi Tokei Denki is transitioning its hydrogen gas measurement technology from R&D to practical application through a demonstration project in Chita City.

SIGNAL 02 | SYSTEM / ADOPTION

Iridium Anodes: Low-Loading ALD for Zero-gap Electrolyzers

Primary-source report: Researchers have developed ionomer-free iridium anodes using direct Atomic Layer Deposition (ALD) to significantly reduce catalyst loading.

SIGNAL 03 | SYSTEM / ADOPTION

Solid Oxide Electrolysis: AC:DC Operation for 25,000-Hour Life

Collected report (not independently verified): Researchers have demonstrated a solid oxide steam electrolysis stack capable of running for 25,000 hours with a voltage degradation rate of just 0.05 percent per thousand hours.

SIGNAL 04 | BUSINESS / RULES

Hydropulse: Green hydrogen project timeline and 150 MW specs

Collected report (not independently verified): Hydropulse has signed an agreement with a European oil refinery to deploy a 150 MW green hydrogen production facility.

DECISION

Focus this week's management attention on delivered hydrogen economics, infrastructure readiness and bankable demand. Move only when the linked evidence can be reproduced under your own operating conditions.

THREE MANAGEMENT MOVES

1. Buyers: compare projects by contracted demand, energy source, conversion loss, logistics and policy support.
2. Suppliers: tie materials and equipment performance to uptime, safety, maintenance and delivered cost.
3. Executives: track offtake, power price, efficiency, utilization, permitting, transport and subsidy.

EVIDENCE DISCIPLINE

FACT states what the collected English source reports. BUSINESS READ and ACTION are editorial interpretations. UNKNOWN lists information that the source file does not establish. A linked article is not treated as independent confirmation of every claim.

Five numbers or evidence anchors that require conditions

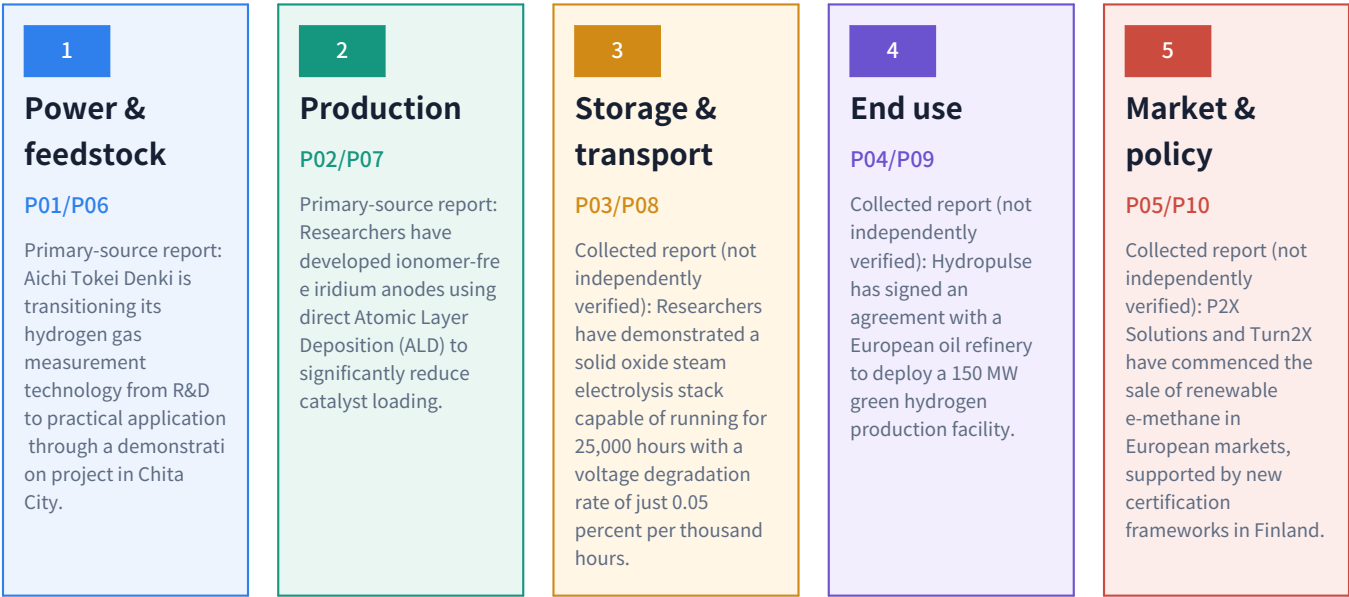
0.21 mg/ cm2 A15	SOURCE-BOUND CONDITION Thermal ALD anode iridium loading
600 h equiv. A15	SOURCE-BOUND CONDITION Accelerated intermittent-equivalent test
0.24 mg/ cm2 A15	SOURCE-BOUND CONDITION Total PGM with low-loading ALD cathode
150 MW A02	SOURCE-BOUND CONDITION Hydropulse project agreement; reported
OPEN A12	SOURCE-BOUND CONDITION Application-specific calibration and transaction terms, reproducibility and deployment terms remain unproven. Published claims are not customer-qualified performance.

HOW TO USE THESE NUMBERS

Each value is shown with the condition stated in the collected English article. Do not compare values across different test methods, device sizes, operating temperatures or commercial stages without normalizing those conditions.

Where the value chain moved

Each stage combines one leading theme and one supporting theme. The report treats handoffs as evidence transfers, not decorative arrows.



EVIDENCE REQUIRED AT EACH HANDOFF

Power & feedstock to Production	Transfer test conditions, acceptance criteria, failure data, owner and decision date. Recheck offtake, power price, efficiency, utilization, permitting, transport and subsidy.
Production to Storage & transport	Transfer test conditions, acceptance criteria, failure data, owner and decision date. Recheck offtake, power price, efficiency, utilization, permitting, transport and subsidy.
Storage & transport to End use	Transfer test conditions, acceptance criteria, failure data, owner and decision date. Recheck offtake, power price, efficiency, utilization, permitting, transport and subsidy.
End use to Market & policy	Transfer test conditions, acceptance criteria, failure data, owner and decision date. Recheck offtake, power price, efficiency, utilization, permitting, transport and subsidy.

COMMON CONTROL POINT

No theme moves to a commercial commitment until a named owner has reproduced the relevant evidence and documented offtake, power price, efficiency, utilization, permitting, transport and subsidy.

Priority map: maturity and next decision locus



REPRODUCIBLE POSITIONING RULE

Horizontal position uses five discrete stages: Research, Prototype, Joint evaluation, Product adoption and Scale. The vertical bands classify the next decision locus: Tech / process, System / adoption, or Business / rules (including supply systems). Article-title cues take precedence; the overview is used only when the title is silent. These are categories, not impact ranks. Bubble diameter reflects the editorial score.

For legibility, scores of 18 or below use an 18-pt bubble diameter; underlying scores are unchanged.

FACT is source-bound. BUSINESS READ, ACTION and UNKNOWN are explicit editorial layers.

P01

Aichi Tokei Denki: Hydrogen Gas Flow Measurement Implementation

A12 | System / adoption | Joint evaluation

2026-10-16

FACT

Primary-source report: Aichi Tokei Denki is transitioning its hydrogen gas measurement technology from R&D to practical application through a demonstration project in Chita City. The initiative focuses on the real-time monitoring of low-carbon hydrogen flow to enable safe and fair transactions within a community-based energy model.

WHY IT MATTERS

In practical terms, Aichi Tokei Denki needs separate tests of flow accuracy and calibration and transaction terms before the result becomes an adoption case.

BUSINESS READ

For Aichi Tokei Denki, compare flow accuracy and calibration and transaction terms under the same application conditions. Request source protocols before extrapolating to customer use. This is an editorial inference.

ACTION

Within 30 days, R&D and quality should compare Aichi Tokei Denki on flow accuracy against a baseline; deliver an acceptance and stop-rule sheet.

UNKNOWN

Application-specific calibration and transaction terms, reproducibility and deployment terms remain unproven. Published claims are not customer-qualified performance.

EDITORIAL SCORE 18/25 | MATURITY 3/5 | DECISION LOCUS: SYSTEM / ADOPTION

P02

Iridium Anodes: Low-Loading ALD for Zero-gap Electrolyzers

A15 | System / adoption | Prototype

2026-10-11

FACT

Primary-source report: Researchers have developed ionomer-free iridium anodes using direct Atomic Layer Deposition (ALD) to significantly reduce catalyst loading. Thermal ALD achieved a loading of 0.21 mg · cm⁻² with performance comparable to commercial anodes, addressing the supply bottleneck of iridium for scaling PEM water electrolysis.

WHY IT MATTERS

In practical terms, Iridium Anodes needs separate tests of Ir loading and accelerated aging and service life before the result becomes an adoption case.

BUSINESS READ

For Iridium Anodes, compare Ir loading and accelerated aging and service life under the same application conditions. Request source protocols before extrapolating to customer use. This is an editorial inference.

ACTION

Within 30 days, R&D and quality should compare Iridium Anodes on Ir loading against a baseline; deliver an acceptance and stop-rule sheet.

UNKNOWN

Application-specific accelerated aging and service life, reproducibility and deployment terms remain unproven. Published claims are not customer-qualified performance.

EDITORIAL SCORE 17/25 | MATURITY 2/5 | DECISION LOCUS: SYSTEM / ADOPTION

FACT is source-bound. BUSINESS READ, ACTION and UNKNOWN are explicit editorial layers.

P03

Solid Oxide Electrolysis: AC:DC Operation for 25,000-Hour Life

A01 | System / adoption | Prototype

2026-10-09

FACT

Collected report (not independently verified):
Researchers have demonstrated a solid oxide steam electrolysis stack capable of running for 25,000 hours with a voltage degradation rate of just 0.05 percent per thousand hours. By utilizing a frequency-dependent electrochemical operation (AC:DC), the team shifted durability control from materials science to operational strategy.

WHY IT MATTERS

In practical terms, Solid Oxide Electrolysis needs separate tests of degradation rate and specific power before the result becomes an adoption case.

BUSINESS READ

For Solid Oxide Electrolysis, compare degradation rate and specific power under the same application conditions. Request source protocols before extrapolating to customer use. This is an editorial inference.

ACTION

Within 30 days, R&D and quality should compare Solid Oxide Electrolysis on degradation rate against a baseline; deliver an acceptance and stop-rule sheet.

UNKNOWN

Application-specific specific power, reproducibility and deployment terms remain unproven. Confirm the original primary record.

EDITORIAL SCORE 14/25 | MATURITY 2/5 | DECISION LOCUS: SYSTEM / ADOPTION

P04

Hydropulse: Green hydrogen project timeline and 150 MW specs

A02 | Business / rules | Product adoption

2026-10-13

FACT

Collected report (not independently verified):
Hydropulse has signed an agreement with a European oil refinery to deploy a 150 MW green hydrogen production facility. The project utilizes ITM Power's Alpha electrolyser platform under a 10-year agreement, with production expected to begin in 2029.

WHY IT MATTERS

In practical terms, Hydropulse needs separate tests of interface function and aging and process window before the result becomes an adoption case.

BUSINESS READ

For Hydropulse, compare interface function and aging and process window under the same application conditions. Request source protocols before extrapolating to customer use. This is an editorial inference.

ACTION

Within 30 days, R&D and quality should compare Hydropulse on interface function against a baseline; deliver an acceptance and stop-rule sheet.

UNKNOWN

Application-specific aging and process window, reproducibility and deployment terms remain unproven. Confirm the original primary record.

EDITORIAL SCORE 17/25 | MATURITY 4/5 | DECISION LOCUS: BUSINESS / RULES

FACT is source-bound. BUSINESS READ, ACTION and UNKNOWN are explicit editorial layers.

P05

Renewable Hydrogen and e-Methane: 2026-2027 Market Developments

A03 | System / adoption | Research

2026-10-16

FACT

Collected report (not independently verified): P2X Solutions and Turn2X have commenced the sale of renewable e-methane in European markets, supported by new certification frameworks in Finland. Concurrent advancements include Stargate Hydrogen's PGM-free catalyst and large-scale green hydrogen project agreements by ITM Power and Nel.

WHY IT MATTERS

In practical terms, Renewable Hydrogen and e-Methane needs separate tests of specific power and degradation rate before the result becomes an adoption case.

BUSINESS READ

For Renewable Hydrogen and e-Methane, compare specific power and degradation rate under the same application conditions. Request source protocols before extrapolating to customer use. This is an editorial inference.

ACTION

Within 30 days, R&D and quality should compare Renewable Hydrogen and e-Methane on specific power against a baseline; deliver an acceptance and stop-rule sheet.

UNKNOWN

Application-specific degradation rate, reproducibility and deployment terms remain unproven. Confirm the original primary record.

EDITORIAL SCORE 15/25 | MATURITY 1/5 | DECISION LOCUS: SYSTEM / ADOPTION

P06

Product Guarantee of Origin: Australia's 2026 Certification Expansion

A05 | Business / rules | Product adoption

2026-10-15

FACT

Collected report (not independently verified): The Australian Government has expanded its Product Guarantee of Origin (PGO) scheme to include aluminium, iron ore, biogas, biomethane, and additional hydrogen production methods. This framework allows producers to document emissions intensity and product origins, providing a standardized substantiation method for supply-chain partners.

WHY IT MATTERS

In practical terms, Product Guarantee of Origin needs separate tests of specific power and degradation rate before the result becomes an adoption case.

BUSINESS READ

For Product Guarantee of Origin, compare specific power and degradation rate under the same application conditions. Request source protocols before extrapolating to customer use. This is an editorial inference.

ACTION

Within 30 days, R&D and quality should compare Product Guarantee of Origin on specific power against a baseline; deliver an acceptance and stop-rule sheet.

UNKNOWN

Application-specific degradation rate, reproducibility and deployment terms remain unproven. Confirm the original primary record.

EDITORIAL SCORE 17/25 | MATURITY 4/5 | DECISION LOCUS: BUSINESS / RULES

FACT is source-bound. BUSINESS READ, ACTION and UNKNOWN are explicit editorial layers.

P07

Plug Power: 280 MW Electrolyzer Order for Danish e-SAF Project

A06 | System / adoption | Product adoption

2026-10-11

FACT

Collected report (not independently verified): Plug Power has signed a 280 MW GenEco electrolyzer supply agreement with Arcadia eFuels for Project ENDOR in Denmark. This partnership, which includes a strategic cooperation agreement for future projects, extends Plug Power's potential electrolyzer capacity beyond 1 GW.

WHY IT MATTERS

In practical terms, Plug Power needs separate tests of specific power and degradation rate before the result becomes an adoption case.

BUSINESS READ

For Plug Power, compare specific power and degradation rate under the same application conditions. Request source protocols before extrapolating to customer use. This is an editorial inference.

ACTION

Within 30 days, R&D and quality should compare Plug Power on specific power against a baseline; deliver an acceptance and stop-rule sheet.

UNKNOWN

Application-specific degradation rate, reproducibility and deployment terms remain unproven. Confirm the original primary record.

EDITORIAL SCORE 17/25 | MATURITY 4/5 | DECISION LOCUS: SYSTEM / ADOPTION

P08

Hiringa Energy: Renewable Ammonia and Hydrogen Project Roadmap

A08 | Tech / process | Research

2026-10-13

FACT

Collected report (not independently verified): Hiringa Energy is implementing a "develop-own-operate" model for renewable ammonia and hydrogen supply chains in Australia and New Zealand. Key initiatives include the GEGHA project in NSW and the Kapuni project in New Zealand, focusing on fertilizer sovereignty and low-carbon fuels.

WHY IT MATTERS

In practical terms, Hiringa Energy needs separate tests of specific power and degradation rate before the result becomes an adoption case.

BUSINESS READ

For Hiringa Energy, compare specific power and degradation rate under the same application conditions. Request source protocols before extrapolating to customer use. This is an editorial inference.

ACTION

Within 30 days, R&D and quality should compare Hiringa Energy on specific power against a baseline; deliver an acceptance and stop-rule sheet.

UNKNOWN

Application-specific degradation rate, reproducibility and deployment terms remain unproven. Confirm the original primary record.

EDITORIAL SCORE 15/25 | MATURITY 1/5 | DECISION LOCUS: TECH / PROCESS

FACT is source-bound. BUSINESS READ, ACTION and UNKNOWN are explicit editorial layers.

P09

Nucera: Electrolyzer assembly consolidation and 2028 timeline

A09 | Business / rules | Product adoption

2026-10-13

FACT

Collected report (not independently verified): Thyssenkrupp subsidiary Nucera is investing €10m to €14m to establish a semi-automated electrolyzer cell assembly center in Vila Nova de Gaia, Portugal. Supported by €3.7m in government funding, the facility aims to reduce assembly times and increase hourly cell output. This move shifts production toward standardized packages to minimize on-site labor for customers.

WHY IT MATTERS

In practical terms, Nucera needs separate tests of interface function and aging and process window before the result becomes an adoption case.

BUSINESS READ

For Nucera, compare interface function and aging and process window under the same application conditions. Request source protocols before extrapolating to customer use. This is an editorial inference.

ACTION

Within 30 days, R&D and quality should compare Nucera on interface function against a baseline; deliver an acceptance and stop-rule sheet.

UNKNOWN

Application-specific aging and process window, reproducibility and deployment terms remain unproven. Confirm the original primary record.

EDITORIAL SCORE 17/25 | MATURITY 4/5 | DECISION LOCUS: BUSINESS / RULES

P10

Electrolyzer Durability Data: Interpreting Hours and Degradation

A13 | Tech / process | Prototype

2026-10-08

FACT

Collected report (not independently verified): Operating hours in durability reports often reflect test duration rather than actual stack lifetime. To accurately assess performance, engineers must evaluate degradation rates ($\mu\text{V/h}$) alongside specific operating conditions and end-of-life criteria.

WHY IT MATTERS

In practical terms, Electrolyzer Durability Data needs separate tests of specific power and degradation rate before the result becomes an adoption case.

BUSINESS READ

For Electrolyzer Durability Data, compare specific power and degradation rate under the same application conditions. Request source protocols before extrapolating to customer use. This is an editorial inference.

ACTION

Within 30 days, R&D and quality should compare Electrolyzer Durability Data on specific power against a baseline; deliver an acceptance and stop-rule sheet.

UNKNOWN

Application-specific degradation rate, reproducibility and deployment terms remain unproven. Confirm the original primary record.

EDITORIAL SCORE 15/25 | MATURITY 2/5 | DECISION LOCUS: TECH / PROCESS

Playbook and 0-5 year roadmap

STAKEHOLDER	NOW 0-30 DAYS	NEXT 1-12 MONTHS	LATER 1-5 YEARS
Operating companies	compare projects by contracted demand, energy source, conversion loss, logistics and policy support	Run production-like qualification with explicit acceptance and stop criteria.	Build a portfolio and architecture that can absorb technology and supplier changes.
Materials, equipment and technology suppliers	tie materials and equipment performance to uptime, safety, maintenance and delivered cost	Create shared reliability, process-window and failure-analysis data with customers.	Standardize interfaces, traceability, lifecycle support and recovery services.
Trading, investment and legal teams	Map offtake, power price, efficiency, utilization, permitting, transport and subsidy.	Contract for capacity, quality, change notice, liability, alternatives and exit.	Diversify regional, technical and customer concentration risk.

ROADMAP

NOW 0-30 DAYS Evidence ledger Owner: Strategy + quality Deliverable: claim, source, condition, owner	NOW 0-30 DAYS Risk screen Owner: Procurement + legal Deliverable: unknowns, alternatives, stop	NEXT 1-12 MONTHS Joint qualification Owner: R&D + supplier Deliverable: process window and failure data
NEXT 1-12 MONTHS Commercial gate Owner: Business + finance Deliverable: unit economics and capacity	LATER 1-5 YEARS Platform strategy Owner: Executive team Deliverable: portfolio and interface roadmap	LATER 1-5 YEARS Service layer Owner: Operations + channel Deliverable: monitoring, maintenance and recovery

GO / NO-GO GATES

GATE	OWNER	REQUIRED EVIDENCE	NO-GO CONDITION
G1 Evidence	Quality	Source, test conditions and reproducibility	No traceable evidence
G2 Integration	R&D	Interface, process window and failure analysis	Cannot meet system conditions
G3 Commercial	Business	Capacity, total cost, contract and alternatives	Economics or supply cannot be supported
G4 Lifecycle	Operations	Monitoring, maintenance, change notice and exit	No accountable operating plan

ANALYZED ARTICLES | ITEMS 01-15

Every title and URL is displayed in full. URLs wrap without shortening and remain clickable. A verified-reference label means the translated HTML did not retain its original source URL.

ID	FULL ARTICLE TITLE	FULL SOURCE / VERIFIED REFERENCE URL - CLICKABLE
A01	Solid Oxide Electrolysis: AC:DC Operation for 25,000-Hour Life	https://bioengineer.org/alternating-current-trick-keeps-hydrogen-electrolysis-stack-running-for-nearly-three-years/
A02	Hydropulse: Green hydrogen project timeline and 150 MW specs	https://www.hydrocarbonengineering.com/refining/13102026/hydropulse-signs-agreement-for-green-hydrogen-project-with-european-oil-refinery/
A03	Renewable Hydrogen and e-Methane: 2026-2027 Market Developments	https://www.pv-magazine.com/2026/10/16/the-hydrogen-stream-p2x-starts-selling-renewable-methane-to-european-markets/
A04	Toyota Hilux FCEV: Hydrogen Fuel-Cell Specs and Roadmap	https://www.autotecnica-subaru.co.uk/13-709517972-toyota-hilux-fcev-driving-the-hydrogen-pick-up/
A05	Product Guarantee of Origin: Australia's 2026 Certification Expansion	https://hunternewenergy.com.au/new-certification-pathways-for-aluminium-hydrogen-and-renewable-gases/
A06	Plug Power: 280 MW Electrolyzer Order for Danish e-SAF Project	https://energiesmedia.com/plug-280-mw-electrolyzer-danish-e-saf-1-gw-mark/
A07	Azolla Hydrogen: Calgary fueling station specs and 2029 roadmap	https://www.petrolplaza.com/news/azolla-hydrogen-expands-fueling-network-via-2-1m-grant
A08	Hiringa Energy: Renewable Ammonia and Hydrogen Project Roadmap	https://ammoniaenergy.org/articles/hiringa-energy-renewable-hydrogen-ammonia-supply-chains-in-australia-and-new-zealand/
A09	Nucera: Electrolyzer assembly consolidation and 2028 timeline	https://hydrogen-central.com/thyssenkrupp-hydrogen-subsi-dary-consolidates-assembly-in-portugal/
A10	Hyundai Hydrogen Mobility: XCIENT Truck deployment and mileage	https://h2accelerate.eu/h2accelerate-make-a-strong-impression-at-iaa-transportation-hannover/
A11	Siesling T 750 HF: Hydrogen Fuel-Cell Conversion Specs and Results	https://www.accessbriefing.com/news/how-to-convert-a-75m-truck-mount-to/8133569.article
A12	Aichi Tokei Denki: Hydrogen Gas Flow Measurement Implementation	https://www.aichitokei.net/news/hydrogen-measurement-technology/
A13	Electrolyzer Durability Data: Interpreting Hours and Degradation	https://hydroxpand.com/en/blog/2026-10-08-reading-electrolyzer-durability-data/
A14	Platinum Fuel-Cell Catalyst: Nitrogen-Graphene Wrapper Specs	https://www.biocatalysiscongress.com/news/platinum-in-fuel-cells-lasts-longer-with-nitrogen-enhanced-graphene-wrapper/
A15	Iridium Anodes: Low-Loading ALD for Zero-gap Electrolyzers	https://arxiv.org/html/2610.15798v1

Scope: retrieving a source does not independently validate performance, cost or clinical utility. The claim ledger distinguishes announcements, papers and secondary reporting. Material published before the reporting week is continuing context, not a new event. Editorial inferences and actions are not investment or medical advice.

HydrogenEnergy — Selected Articles

Date: 2026-10-18

Articles: 15

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#01 Solid Oxide Electrolysis: AC:DC Operation for 25,000-Hour Life

Published October 09, 2026 Bioengineer.org (referencing Nature Communications) USA



OVERVIEW

Researchers have demonstrated a solid oxide steam electrolysis stack capable of running for 25,000 hours with a voltage degradation rate of just 0.05 percent per thousand hours. By utilizing a frequency-dependent electrochemical operation (AC:DC), the team shifted durability control from materials science to operational strategy. This result significantly improves the economic outlook for green hydrogen by reducing the capital cost amortization of electrolyzers.

Key Findings

A team of Danish and Italian researchers has achieved a record-breaking durability benchmark for a full industrial-scale solid oxide electrolysis stack. The 70-cell stack operated in steam electrolysis mode for nearly three years, maintaining a stabilized average voltage degradation rate of 0.05 percent per thousand hours (equivalent to 0.65 millivolts per thousand hours per cell). This low degradation rate was sustained for 22,000 hours following an initial break-in phase, representing the longest and lowest-degradation operation ever reported for a complete stack of this type.

Technical Details

The achievement relies on "frequency-dependent electrochemical operation," or AC:DC operation, rather than the conventional steady direct current (DC). The process involves periodically inverting the polarity of the stack, alternating between:

- **Electrolysis mode:** Splitting steam into hydrogen and oxygen.
- **Fuel-cell mode:** Briefly operating as a power-producing fuel cell.

This rhythmic reversal modulates electrochemical polarization and redistributes Joule heating across cell components. Post-mortem microstructural examinations confirmed that the degradation pathways typically activated during DC electrolysis—such as nickel agglomeration, electrode sintering, and oxygen partial pressure gradients—were not engaged under this alternating regime.

Background & Context

Solid oxide steam electrolysis operates at temperatures between 700 and 850 degrees Celsius, using a nickel-based ceramic cathode and a dense ceramic electrolyte, typically yttria-stabilized zirconia. While electrically efficient, these stacks typically suffer from relentless degradation under continuous DC operation. Previous full-stack benchmarks reported degradation rates an order of magnitude higher, often several percent per thousand hours, with tests frequently ending after a few thousand hours.

Significance & Outlook

By demonstrating that durability can be managed via operational strategy rather than the invention of new materials, the researchers have repositioned stack longevity as a solvable engineering problem. Because stack lifetime directly determines how capital costs are amortized, a 25,000-hour lifespan with near-zero degradation fundamentally alters the economics of green hydrogen production. The study involved a stack supplied by commercial manufacturer SolydEra and researchers from the Technical University of Denmark, DynElectro, SolydEra, and Aalborg University.

Source: <https://bioengineer.org/alternating-current-trick-keeps-hydrogen-electrolysis-stack-running-for-nearly-three-years/>

Collected: October 17, 2026 | Automated Research System (AI)

#02 Hydropulse: Green hydrogen project timeline and 150 MW specs

Published October 13, 2026 Hydrocarbon Engineering UK



OVERVIEW

Hydropulse has signed an agreement with a European oil refinery to deploy a 150 MW green hydrogen production facility. The project utilizes ITM Power's Alpha electrolyser platform under a 10-year agreement, with production expected to begin in 2029.

Key Findings

Hydropulse is developing a green hydrogen project in partnership with a leading European oil refinery. The facility will feature 150 MW of electrolysis capacity to produce green hydrogen on-site. The project is structured under a 10-year agreement, representing the largest commercial commitment for Hydropulse to date.

Technical Details

The project will utilize the Alpha electrolyser platform from ITM Power. To manage operational risks and costs, the project follows a specific division of responsibilities:

- **Hydropulse:** Responsible for building, owning, and operating the facility (BOO model).
- **Customer:** Provides the site and utilities, including power, which serves to mitigate Hydropulse's exposure to electricity price volatility.

This structure is designed to generate long-term contracted and recurring revenues for ITM Power.

Background & Context

The project is currently in the joint Front End Engineering Design (FEED) study phase. Hydropulse is also engaged in constructive discussions with banks regarding project-level financing to ensure capital-efficient scaling.

Significance & Outlook

The project roadmap targets a Final Investment Decision (FID) in 2027, with the commencement of hydrogen production scheduled for 2029. According to CEO Dennis Schulz, the 150 MW scale and 10-year contract duration demonstrate the potential of the company's BOO model. If definitive agreements are reached, the project will establish a material long-term contracted revenue stream for the Group.

Collected: October 17, 2026 | Automated Research System (AI)

#03 Renewable Hydrogen and e-Methane: 2026-2027 Market Developments

Published October 16, 2026 pv magazine USA



OVERVIEW

P2X Solutions and Turn2X have commenced the sale of renewable e-methane in European markets, supported by new certification frameworks in Finland. Concurrent advancements include Stargate Hydrogen's PGM-free catalyst and large-scale green hydrogen project agreements by ITM Power and Nel.

Key Findings

P2X Solutions has begun injecting renewable e-methane produced in Finland into the national natural gas network, facilitating distribution to domestic and European markets via the Balticconnector pipeline. In a parallel development, commodity trader STX Group took its first offtake of Rfnbo-compliant e-methane produced by Turn2X at a commercial plant in Spain in early October 2026.

Technical Details

The e-methane mentioned is produced by combining renewable hydrogen with captured carbon dioxide, allowing the synthetic gas to utilize existing natural gas infrastructure. To verify this, Gasgrid, Finland's state-owned transmission operator, has issued the country's first guarantees of origin for e-methane to distinguish it from fossil natural gas.

In electrolyser technology, Stargate Hydrogen has launched a proprietary ceramic catalyst for alkaline electrolyser stacks. This technology reportedly increases output efficiency to 48 kWh/kg and eliminates dependency on iridium and other platinum-group metals (PGMs). The product is available in stacks up to 0.5 MW, with 5 MW stack integration underway; the company's annual factory production is 140 MW, expandable to 1 GW+.

Background & Context

- **ITM Power:** Its subsidiary Hydropulse signed Heads of Terms with a European oil refinery for a 150 MW Alpha electrolyser platform project. The 10-year agreement targets a Final Investment Decision (FID) in 2027 and production commencement in 2029.
- **Nel:** Signed an MoU with Rheinmetall AG to combine Nel's electrolyser technology with Rheinmetall's Giga PtX concept for decentralized low-carbon synthetic fuels for defense and critical infrastructure. Nel also secured a \$12 million order for MC-series containerized PEM electrolyser units for a US company, with delivery estimated for 2027.
- **Jera:** Invested in Koloma, a US-based natural hydrogen exploration company that has raised over \$400 million from investors including Amazon and Breakthrough Energy Ventures.

- **Hy24:** Signed an agreement to acquire Hynamics, an EDF Group subsidiary producing low-carbon hydrogen for heavy mobility and industry in France and the UK, with completion expected in Q1 2027.

Significance & Outlook

The integration of e-methane into existing grids and the development of PGM-free catalysts indicate a shift toward scalable, infrastructure-compatible renewable fuels. The transition toward large-scale industrial projects and natural hydrogen exploration suggests a diversifying investment landscape for low-carbon hydrogen across Europe and North America.

Source: <https://www.pv-magazine.com/2026/10/16/the-hydrogen-stream-p2x-starts-selling-renewable-methane-to-european-markets/>

Collected: October 17, 2026 | Automated Research System (AI)

#04 Toyota Hilux FCEV: Hydrogen Fuel-Cell Specs and Roadmap

Published October 13, 2026 autotecnica-subaru.co.uk UK



OVERVIEW

Toyota is testing a hydrogen fuel-cell electric (FCEV) prototype of the Hilux pick-up to provide a carbon-neutral alternative to diesel and battery-electric vehicles. The prototype utilizes Mirai technology to achieve a range of 650 kilometres with zero emissions other than water.

Key Findings

Toyota has developed a hydrogen fuel-cell electric version of the Hilux pick-up, currently in the prototype stage. The vehicle has undergone testing in the United Kingdom, covering several thousand kilometres in real-world conditions. While the current prototype is rear-wheel drive, Toyota engineers have stated that a production version would feature four-wheel drive.

Technical Details

The Hilux FCEV integrates the fuel-cell system from the Toyota Mirai. The technical configuration includes:

- **Power Unit:** An electric motor mounted above the rear axle producing 134 kW (182 hp) and 300 Nm of maximum torque.
- **Energy Storage:** Three carbon-fibre tanks holding 7.8 kg of hydrogen at 700 bar of pressure, supported by a battery with a capacity of just over 1.2 kWh.
- **Performance:** A maximum range of 650 kilometres.
- **Emissions:** Zero exhaust-gas emissions; the chemical reaction between hydrogen and oxygen produces only water.
- **Chassis:** A modified rear suspension setup that differs from the rigid axle used in combustion-engined models, improving ride comfort and vibration absorption.

Background and Context

Toyota pursues a "multi-energy" strategy for carbon neutrality, investing in HEVs, PHEVs, BEVs, e-fuels, biofuels, and hydrogen. Within the hydrogen sector, the company is developing both FCEVs and hydrogen-combustion engines, such as the GR Corolla H2 Concept. To further this technology, Toyota has entered an agreement with BMW to develop a third-generation hydrogen fuel-cell system to replace the current technology used in the Mirai and Hilux FCEV.

Significance and Outlook

The commercial viability of the Hilux FCEV depends on the cost reduction of the third-generation fuel cell. Toyota estimates that annual production of 100,000 fuel-cell systems would reduce costs by approximately 37%, while production of 200,000 units would result in a 50% cost reduction. These systems are intended for a broad range of applications, including cars, pick-ups, lorries, buses, and stationary systems.

Source: <https://www.autotecnica-subaru.co.uk/13-709517972-toyota-hilux-fcev-driving-the-hydrogen-pick-up/>

Collected: October 17, 2026 | Automated Research System (AI)

#05 Product Guarantee of Origin: Australia's 2026 Certification Expansion

Published October 15, 2026 Hunter New Energy Australia



OVERVIEW

The Australian Government has expanded its Product Guarantee of Origin (PGO) scheme to include aluminium, iron ore, biogas, biomethane, and additional hydrogen production methods. This framework allows producers to document emissions intensity and product origins, providing a standardized substantiation method for supply-chain partners.

Key Findings

The Clean Energy Regulator announced on 12 October that the Product Guarantee of Origin (PGO) scheme now covers a broader range of industrial products. Beyond electrolysis-based hydrogen, eligibility has been extended to aluminium smelting, iron ore extraction, biogas produced via anaerobic digestion, and biomethane produced by upgrading biogas. Additionally, hydrogen produced through solid gasification, pyrolysis, and gas reforming is now eligible for certification.

Technical Details

The PGO scheme enables eligible producers to create certificates that document the origin, production process, and emissions intensity of product batches. The system is designed to track information as products move through the supply chain; registered businesses involved in transport, storage, or consumption can contribute data to these certificates with the authorization of the production-profile holder.

- **Requirements:** Participants must provide auditable data on energy use, production volumes, and emissions.
- **Registration:** Businesses must enroll as registered persons before applying for production, delivery, or consumption profiles.
- **Costs:** The initial registration fee is \$490. Additional participation fees are waived until July 2027.

Background & Context

The PGO is part of the "Future Made in Australia" framework. In the Hunter region, the inclusion of aluminium is significant due to the presence of Tomago Aluminium, which operates Australia's largest aluminium smelter. Tomago recently announced a 10-year electricity supply agreement (2028–2038) and a \$1.1 billion investment in operations, including \$100 million for demand-response capability and decarbonisation. However, the regulator notes that eligibility does not automatically mean a product is certified as low emissions, nor has Tomago Aluminium announced an application to participate.

Significance & Outlook

The Australian Government intends to further expand the PGO to include low-carbon liquid fuels, ammonia, and other green metals such as steel and alumina. These future additions aim to extend the scheme's relevance to a wider array of industrial supply chains and alternative fuel developers.

Source: <https://hunternewenergy.com.au/new-certification-pathways-for-aluminium-hydrogen-and-renewable-gases/>

Collected: October 17, 2026 | Automated Research System (AI)

#06 Plug Power: 280 MW Electrolyzer Order for Danish e-SAF Project

Published October 11, 2026 Energies Media USA



OVERVIEW

Plug Power has signed a 280 MW GenEco electrolyzer supply agreement with Arcadia eFuels for Project ENDOR in Denmark. This partnership, which includes a strategic cooperation agreement for future projects, extends Plug Power's potential electrolyzer capacity beyond 1 GW.

Key Findings

Plug Power has secured a 280 MW GenEco electrolyzer supply agreement with Arcadia eFuels to support Project ENDOR, a flagship e-SAF (electronic Sustainable Aviation Fuel) facility located at the Port of Vordingborg on the south coast of Denmark. In addition to the ENDOR project, the two companies have entered into a strategic cooperation agreement that designates Plug Power as the preferred electrolyzer supplier for four additional Arcadia eFuels projects across Europe and the Americas, representing a potential capacity exceeding 1 GW.

Technical Details

Project ENDOR will utilize renewable grid power to operate the 280 MW of Plug electrolyzers. Once operational, the facility is estimated to produce 110 tons of renewable hydrogen per day. These net-zero carbon fuels are designed for use in the aviation and shipping sectors, allowing for the direct use of fuels without requiring modifications to existing infrastructure or engines. The current supply agreement follows three years of joint engineering work, with deliveries scheduled to begin after the project issues a notice to proceed.

Background & Context

Plug Power, headquartered in New York, provides a fully integrated hydrogen ecosystem encompassing production, storage, delivery, and power generation. The company supplies electrolyzers, liquid hydrogen, fuel cell systems, and fueling infrastructure to a global client base that includes BMW, BP, Walmart, Amazon, and Home Depot. Arcadia eFuels focuses on developing facilities to produce future net-zero carbon fuels for the transport sector.

Significance & Outlook

This agreement positions Plug Power as a key partner in the development of e-SAF pipelines in Europe and the Americas. According to Jose Luis Crespo, the partnership reflects confidence in GenEco technology and Plug's capacity to deliver high-capacity, complex projects at scale. As the hydrogen energy sector evolves, the integration of such high-capacity facilities is expected to contribute to large-scale decarbonization and energy independence.

Source: <https://energiesmedia.com/plug-280-mw-electrolyzer-danish-e-saf-1-gw-mark/>

Collected: October 17, 2026 | Automated Research System (AI)

#07 Azolla Hydrogen: Calgary fueling station specs and 2029 roadmap

Published October 16, 2026 MobilityPlaza Canada



OVERVIEW

Azolla Hydrogen is deploying a rapid deployment hydrogen fueling station in Calgary supported by a C\$3 million (\$2.1 million) grant from Emissions Reduction Alberta (ERA). The project establishes a heavy-duty transportation corridor between Edmonton and Calgary, targeting a reduction of 1,429 tonnes of emissions per year.

Key Findings

Azolla Hydrogen is expanding its fueling network with the deployment of a rapid deployment station in Calgary. The project is supported by C\$3 million (\$2.1 million) in funding from Emissions Reduction Alberta (ERA). This initiative is part of a larger C\$12.5 million (\$8.8 million) project designed to link Edmonton and Calgary, creating Canada's longest heavy-duty hydrogen transportation corridor.

Technical Details

The Calgary station is engineered to dispense up to 300 kg of hydrogen daily. The system produces hydrogen from methanol, which is then compressed, stored, and chilled on-site. Azolla Hydrogen has set a target dispensed cost of below C\$20/kg (\$14/kg) for the Calgary site.

Simultaneously, the company is upgrading its Edmonton operations to 700-bar dispensing. This higher pressure allows vehicles to travel approximately twice as far as those using 350-bar fuel. The target cost for fueling in Edmonton is below C\$12/kg (\$8.4/kg).

Background & Context

The expansion is intended to build the necessary infrastructure to grow the hydrogen market in Alberta. According to Jared Sayers, President and CEO of Azolla Hydrogen, the move into Calgary is a critical step in this infrastructure development.

Significance & Outlook

By 2029, the network is designed to support a diverse fleet of hydrogen-powered vehicles, including:

- Approximately 10 long-haul Class 8 fuel cell trucks
- Four extended-range coach or transit buses
- 50 public and light-duty fleet vehicles

ERA estimates that the overall project will result in the avoidance of 1,429 tonnes of emissions annually.

Source: <https://www.petroplaza.com/news/azolla-hydrogen-expands-fueling-network-via-2-1m-grant>

Collected: October 17, 2026 | Automated Research System (AI)

#08 Hiringa Energy: Renewable Ammonia and Hydrogen Project Roadmap

Published October 13, 2026 Ammonia Energy Association International



OVERVIEW

Hiringa Energy is implementing a "develop-own-operate" model for renewable ammonia and hydrogen supply chains in Australia and New Zealand. Key initiatives include the GEGHA project in NSW and the Kapuni project in New Zealand, focusing on fertilizer sovereignty and low-carbon fuels.

Key Findings

Hiringa Energy is developing a portfolio of renewable ammonia and hydrogen projects to support fertilizers, refueling networks, and green fuels. The company emphasizes a development-own-operate model and strategic partnerships with offtakers and end users to establish low-carbon value chains. In New Zealand, Hiringa has operated a hydrogen refueling network since 2024, utilizing 4 MW of electrolysis capacity across four sites.

Technical Details

The Good Earth Green Hydrogen and Ammonia (GEGHA) project in Moree, NSW, reached financial close in 2025. It is designed for an annual production of 4,500 tons of renewable ammonia. Technical specifications include:

- Power: 36 MW solar PV (9 MW existing, 27 MW newbuild) and 51 MWh battery storage.
- Electrolysis: 15 MW alkaline capacity (3x 5 MW modules).
- Technology: Ammonia production modules provided by KAPSOM.
- CAPEX: Estimated at AUD\$113-119 million, with AUD\$45.2 million in funding from the NSW Government.

In New Zealand, the Kapuni Green Hydrogen Project reached financial close in early 2026. This project features four wind turbines with a 25.6 MW peak capacity and a 5 MW electrolyzer producing approximately 2,000 kilograms of hydrogen per day.

Background & Context

The GEGHA project is integrated with the Wathagar cotton ginning facility to support Sundown Pastoral Company's "Good Earth Cotton" production. This integration aims to displace diesel—estimated at 1-2 million liters annually for cotton production—with hydrogen. Similarly, the Kapuni project supplies renewable hydrogen to the Ballance Agri-Nutrients plant for urea production and to Hiringa's refueling network.

Significance & Outlook

Hiringa Energy aims to reduce Australia's vulnerability to global fertilizer price shocks by establishing local production. Future scaling is evident in the Riverina Green Fertilizer Project, which plans 100 MW solar PV, 85 MWh battery storage, and 100-150 MW electrolysis capacity to produce 40,000 tons of ammonia and other nitrates. Operations for GEGHA and Kapuni are scheduled for Q1 2027 and Q2 2027, respectively.

Source: <https://ammoniaenergy.org/articles/hiringa-energy-renewable-hydrogen-ammonia-supply-chains-in-australia-and-new-zealand/>

Collected: October 17, 2026 | Automated Research System (AI)

#09 Nucera: Electrolyzer assembly consolidation and 2028 timeline

Published October 13, 2026 Hydrogen Central International



OVERVIEW

Thyssenkrupp subsidiary Nucera is investing €10m to €14m to establish a semi-automated electrolyzer cell assembly center in Vila Nova de Gaia, Portugal. Supported by €3.7m in government funding, the facility aims to reduce assembly times and increase hourly cell output. This move shifts production toward standardized packages to minimize on-site labor for customers.

Key Findings

Nucera, the hydrogen subsidiary of Thyssenkrupp, is consolidating its assembly operations in Portugal to optimize the production of electrolyzer cells. The company plans an investment between €10m and €14m to develop an assembly center located in Vila Nova de Gaia, south of Porto. The project is supported by the Portuguese government, which is providing approximately €3.7m in funding.

Technical Details

The facility will transition from manual assembly to standardized, semi-automated processes. According to Nucera, these technical improvements are designed to achieve the following:

- Reduction in turnaround times for cell assembly.
- A significant increase in the number of cells assembled per hour compared to previous manual methods.
- The creation of ready-to-assemble cell packages for end users.

Background & Context

The strategic shift toward consolidation in Portugal is intended to streamline the supply chain between assembly and service. Construction of the new facility is scheduled to commence next winter. Once construction is complete, assembly operations are set to begin in 2028.

Significance & Outlook

For customers and investors, the transition to semi-automated assembly is expected to result in less required work on-site due to the delivery of pre-assembled packages. By integrating assembly and service more closely, Nucera aims to reduce overall assembly times and improve the scalability of its electrolyzer cell production.

Collected: October 17, 2026 | Automated Research System (AI)

#10 Hyundai Hydrogen Mobility: XCIENT Truck deployment and mileage

Published October 15, 2026 H2Accelerate International



OVERVIEW

Hyundai Hydrogen Mobility has deployed around 170 XCIENT trucks, which have collectively driven over 21 million km since 2020. This operational data demonstrates the scalability of hydrogen-powered heavy-duty transport in real-world customer environments.

Key Findings

Hyundai Hydrogen Mobility reported that its XCIENT Truck fleet has achieved a cumulative distance of over 21 million km. As of the reporting date, around 170 trucks have been successfully delivered and deployed to customers, establishing a significant operational footprint for hydrogen fuel cell technology in the heavy-duty transport sector.

Technical Details

The deployment of the XCIENT Truck focuses on high-utilization transport cycles. While specific technical specifications of the fuel cell stack were not detailed, the operational results emphasize two primary performance indicators reported by customers: low-emission performance and a comfortable driving experience. These factors contribute to the viability of the vehicle as a replacement for traditional internal combustion engine trucks.

Background & Context

The XCIENT Truck has been in operation since 2020. The growth of the fleet indicates a transition from initial pilot phases to broader customer adoption. This expansion was highlighted during the IAA Transportation Hannover event, where Hyundai Hydrogen Mobility shared the successes of the vehicle's integration into commercial logistics.

Significance & Outlook

The achievement of 21 million km in total mileage provides critical empirical data on the durability and reliability of hydrogen trucks in commercial service. For investors and engineers, the successful deployment of around 170 units suggests that the technology is moving beyond theoretical application into a phase of scalable operational impact. The positive feedback regarding emissions and driver comfort further supports the potential for wider adoption across the transport industry.

Source: <https://h2accelerate.eu/h2accelerate-make-a-strong-impression-at-iaa-transportation-hannover/>

#11 Siesling T 750 HF: Hydrogen Fuel-Cell Conversion Specs and Results

Published October 12, 2026 Access Briefing Netherlands



OVERVIEW

Rental specialist Siesling has converted a 75m Ruthmann truck mount to hydrogen fuel-cell power, achieving a 450km driving range and 20-minute refueling. The project demonstrates that hydrogen can provide zero-emission high-level access without the weight and charging constraints of battery-electric systems.

Key Findings

Siesling has successfully transitioned a 75m Ruthmann T 750 HF truck mount from diesel to hydrogen fuel-cell technology. The converted machine delivers a driving range of at least 450km and a refueling time of approximately 20 minutes, maintaining performance levels comparable to diesel equivalents. In real-world operations, the unit has been deployed for cleaning and installation work at sites including the Groningen Forum and the Martini Church.

Technical Details

The conversion was executed in collaboration with hydrogen specialist Holthausen. The system architecture includes:

- **Fuel Storage:** Nine hydrogen tanks with a total capacity of 45kg (approximately 5kg per tank).
- **Power Conversion:** A fuel cell converts hydrogen into electricity, which is stored in three batteries to power both the truck and the aerial platform.
- **Weight Profile:** The fully loaded hydrogen truck weighs approximately 36.5 tonnes, an increase from the original diesel machine's 33 tonnes.

Following the conversion, the machine returned to Ruthmann for testing. This process involved reweighing the unit, assessing the working envelope against the new weight distribution, and reprogramming the control system for the electric powertrain. These adjustments resulted in a revised working envelope that gained approximately one metre of range in some areas.

Background and Context

Siesling initially attempted to convert a smaller 30m truck on a 7.5 tonne chassis but found that the weight of hydrogen tanks and batteries exceeded the chassis weight limit. This led the company to utilize the 75m chassis, which provided the necessary space and weight capacity. This shift is critical for operating in zero-emission zones such as Schiphol Amsterdam Airport and Natura 2000 protected sites.

Significance and Outlook

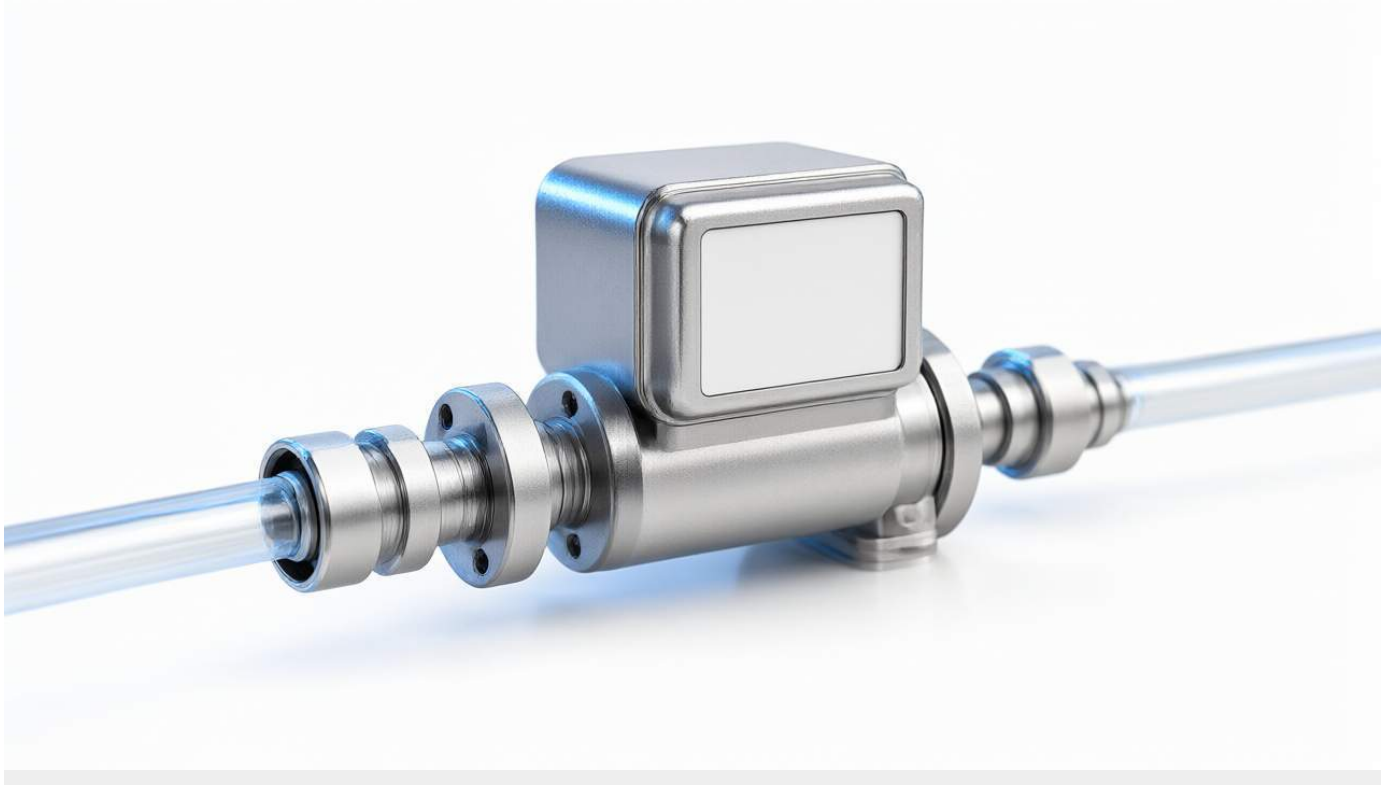
Hydrogen was selected over battery-electric technology to avoid long charging times; Siesling noted that a battery-electric truck with a 250km range could require six to eight hours to recharge. While infrastructure remains a limitation, the Netherlands is developing a network of hydrogen stations at roughly 75km intervals. Early operational results have been encouraging, despite initial cooling system leaks and programming errors.

Source: <https://www.accessbriefing.com/news/how-to-convert-a-75m-truck-mount-to/8133569.article>

Collected: October 17, 2026 | Automated Research System (AI)

#12 Aichi Tokei Denki: Hydrogen Gas Flow Measurement Implementation

Published October 16, 2026 Aichi Tokei Denki Co., Ltd. / Chita High Pressure Gas Co., Ltd. (Press Release) Japan



OVERVIEW

Aichi Tokei Denki is transitioning its hydrogen gas measurement technology from R&D to practical application through a demonstration project in Chita City. The initiative focuses on the real-time monitoring of low-carbon hydrogen flow to enable safe and fair transactions within a community-based energy model.

Key Findings

Aichi Tokei Denki has moved its hydrogen gas measurement technology from the research phase to real-world implementation. The company is currently participating in the "Low-Carbon Hydrogen Model Town Demonstration Project" in Chita City, Aichi Prefecture. This project utilizes the Chita Hydrogen Station, operated by Chita High Pressure Gas, to supply renewable energy-derived low-carbon hydrogen to business sites, public facilities, and residential homes.

Technical Details

The technical objective is to accurately monitor the real-time flow rate of hydrogen gas, which is essential for safety, facility management, and fair commercial transactions. Because hydrogen possesses physical and flow characteristics distinct from natural gas, Aichi Tokei Denki developed specialized measurement technology through technical validations with energy providers, research institutions, and universities. Key R&D focus areas include:

- Advancing hydrogen gas flow measurement technology.
- Conducting measurement evaluations in pure hydrogen and hydrogen co-firing environments.
- Verifying safety and reliability for hydrogen supply infrastructure.
- Utilizing ultrasound for measuring hydrogen flow.

Background and Context

This initiative aligns with Aichi Tokei Denki's Mid-Term Management Plan 2026, which emphasizes contributing to a sustainable society through measurement and connectivity technologies. The company is leveraging its existing expertise in fluid measurement for water, gas, and thermal energy to address the specific requirements of a decarbonized society. The Chita City project serves as a testing ground to verify how these technologies function in actual living environments and community settings.

Significance and Outlook

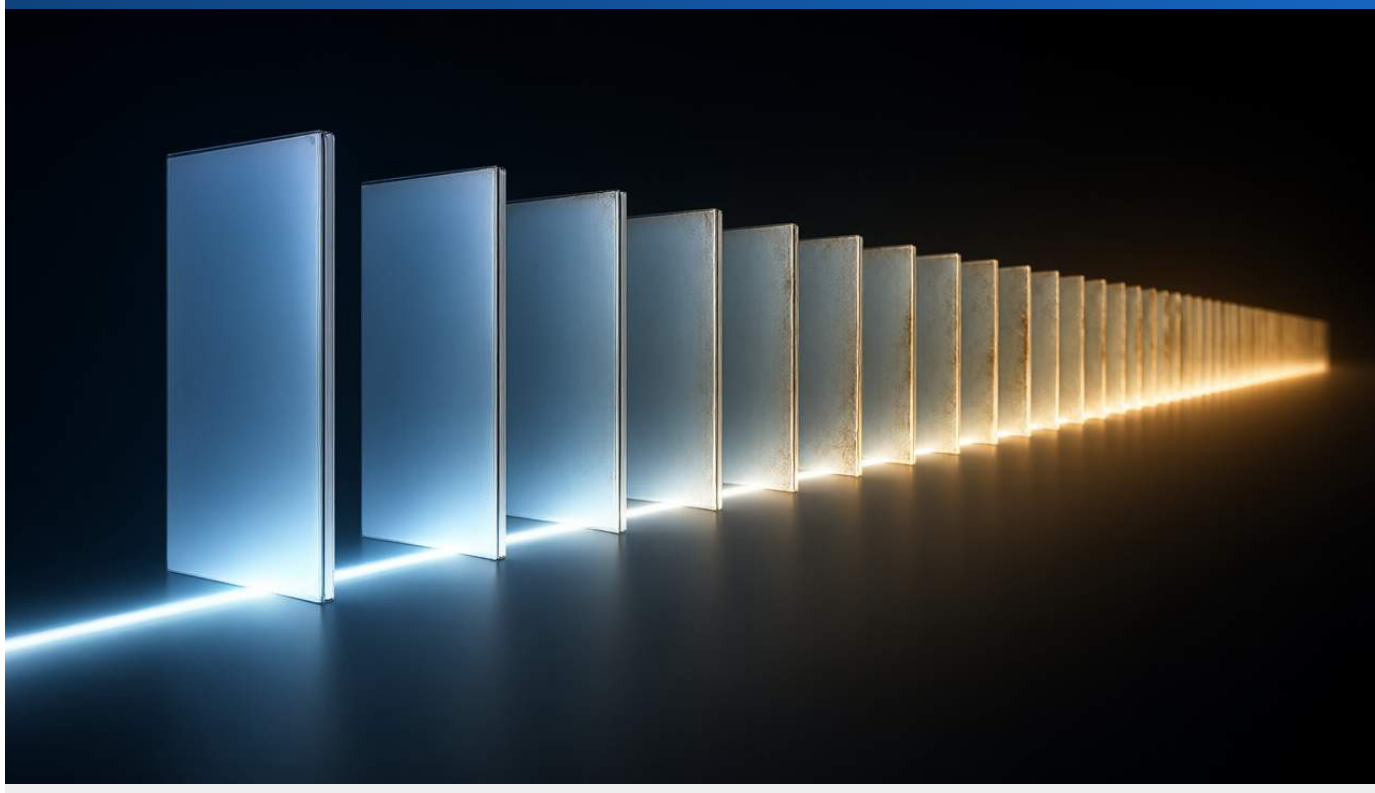
The integration of accurate measurement technology is presented as a foundational requirement for the "produce, transport, and use" cycle of a hydrogen society. By applying hydrogen to fuel cells and hydrogen water heaters within a model town, the project seeks to reduce the costs of hydrogen supply networks. The goal is to establish a scalable model for low-carbon hydrogen utilization that can be deployed nationwide to help achieve carbon neutrality by 2050.

Source: <https://www.aichitokei.net/news/hydrogen-measurement-technology/>

Collected: October 17, 2026 | Automated Research System (AI)

#13 Electrolyzer Durability Data: Interpreting Hours and Degradation

Published October 08, 2026 HydroXpand USA



OVERVIEW

Operating hours in durability reports often reflect test duration rather than actual stack lifetime. To accurately assess performance, engineers must evaluate degradation rates ($\mu\text{V/h}$) alongside specific operating conditions and end-of-life criteria.

Key Findings

Operating hours reported in durability data typically indicate how long a stack was tested, not its total lifespan. A number such as 2,000, 5,000, or 10,000 hours does not inherently reveal if a cell remained healthy or reached its limit. To determine actual lifetime, an end-of-life criterion—the maximum allowable voltage rise—must be established, though this is often not documented by suppliers.

Technical Details

Degradation rate, measured in microvolts per hour ($\mu\text{V/h}$) per cell, allows for the comparison of runs with different lengths. When analyzing these rates, three factors are critical:

- **Unit Scale:** Rates can be expressed per cell or per stack; for a 23-cell stack, $20 \mu\text{V/h}$ per cell equals 0.46 mV/h for the whole stack.
- **Fitting Window:** Including the initial settling period increases the calculated rate compared to fitting only the later, stable part of the run.
- **Current Stability:** Rates are normally calculated at a fixed current; changing loads cannot be reduced to a rate in the same manner.

Furthermore, hours may be continuous or cumulative, with the latter including shutdowns and restarts that add specific loads to the cell.

Background & Context

Durability is heavily influenced by current density, temperature, electrolyte concentration, and outlet pressure. For example, a published AEM run reached 8,900 hours at 0.2 A/cm^2 , starting at 1.92 V with a rise of $18 \mu\text{V/h}$. In contrast, a two-cell, 16 cm^2 short stack using an HXP-an anode and a PiperION $80 \mu\text{m}$ membrane ran for 6,358 hours at a higher current density of 0.625 A/cm^2 , with voltage rising from 1.893 V to 1.979 V .

Significance & Outlook

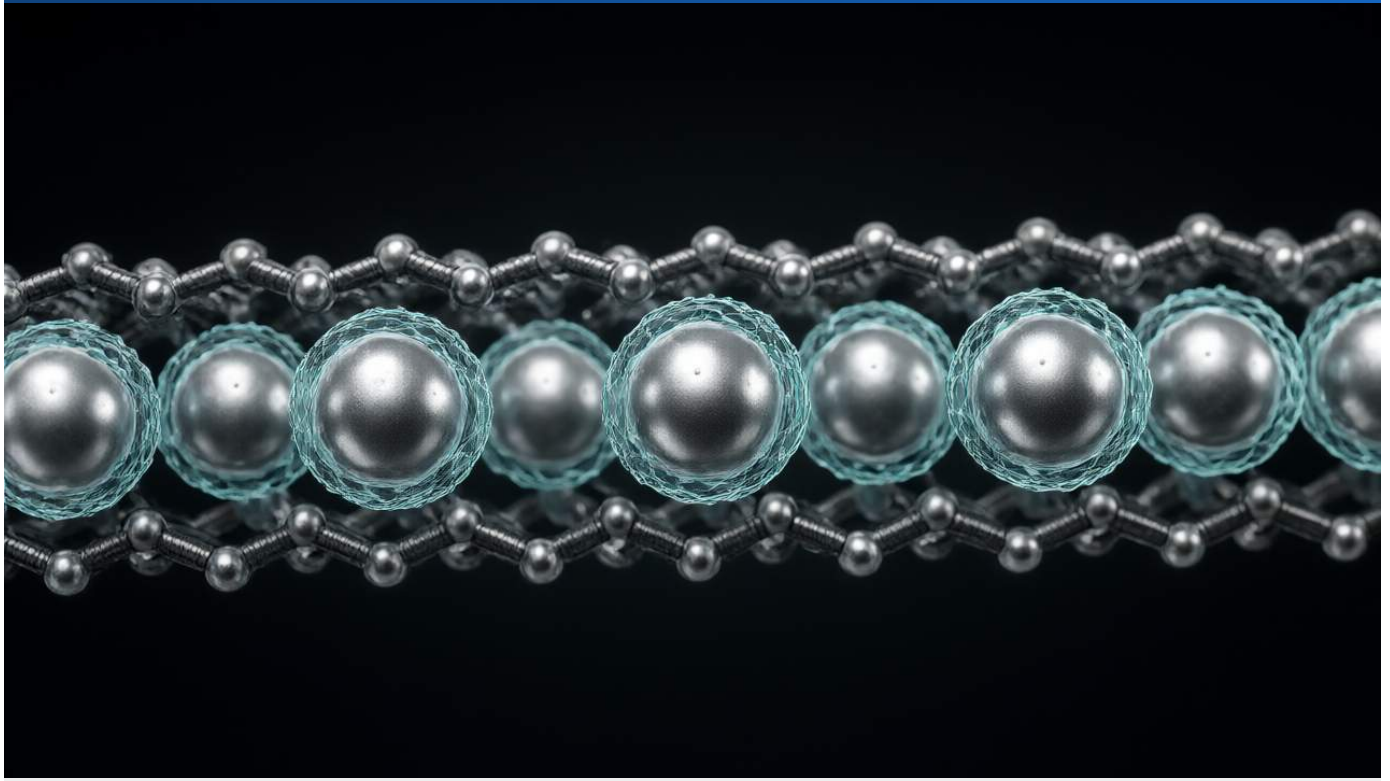
Component synergy is vital; the same anode in the aforementioned short-stack test yielded only 1,234 hours when paired with a different membrane. This demonstrates that durability figures for a single electrode cannot be transferred to different cell configurations. Currently, the HXS-2 2 kW stack has achieved over 3,000 hours of cumulative operation at 0.3 M KOH, 40 °C, and 50 A.

Source: <https://hydroxpand.com/en/blog/2026-10-08-reading-electrolyzer-durability-data/>

Collected: October 17, 2026 | Automated Research System (AI)

#14 Platinum Fuel-Cell Catalyst: Nitrogen-Graphene Wrapper Specs

Published October 08, 2026 Nagoya University Japan



OVERVIEW

Researchers at Nagoya University have developed a fuel-cell catalyst using platinum nanoparticles encapsulated in nitrogen-doped graphene shells on single-walled carbon nanotubes. The material retained 96.9% of its active platinum surface after 30,000 cycles, offering a path toward reducing platinum costs and improving durability for heavy-duty clean-energy applications.

Key Findings

The developed catalyst demonstrated an active platinum surface area of 96.3 square metres per gram, significantly higher than the 60.6 square metres per gram recorded for a commercial catalyst. In accelerated durability testing, the material retained 96.9% of its active platinum surface after 30,000 cycles, with a voltage decrease of only 22.8 millivolts. Additionally, the catalyst exhibited strong resistance to carbon corrosion during high-voltage cycling tests.

Technical Details

The catalyst architecture utilizes a multi-layered approach to prevent degradation:

- **Nitrogen-doped graphene shells:** These wrappers encapsulate platinum nanoparticles. The nitrogen modifies the interaction between platinum and oxygen-containing molecules, which maintains catalytic activity while protecting the nanoparticles.
- **Single-walled carbon nanotubes:** These serve as a corrosion-resistant support structure. They restrict the movement of platinum, thereby reducing the formation of larger particles that typically diminish the active surface area.

Background & Context

Fuel cells provide a method for converting hydrogen's chemical energy directly into electricity with water as the primary by-product, making them suitable for public transportation and heavy-duty vehicles. However, widespread adoption is hindered by the high cost of platinum and the tendency of conventional catalysts to lose efficiency. This efficiency loss is primarily caused by particle aggregation and the corrosion of carbon supports under demanding operating conditions.

Significance & Outlook

By combining nitrogen-enhanced graphene with carbon nanotubes, this structure addresses the critical issues of catalyst corrosion and platinum migration. The researchers intend to further refine the performance to reduce the total amount of platinum required. Lowering these material requirements could reduce overall costs and support the broader implementation of hydrogen-based clean-energy technologies.

Source: <https://www.biocatalysiscongress.com/news/platinum-in-fuel-cells-lasts-longer-with-nitrogen-enhanced-graphene-wrapper/>

Collected: October 17, 2026 | Automated Research System (AI)

#15 Iridium Anodes: Low-Loading ALD for Zero-gap Electrolyzers

Published October 11, 2026 arXiv USA



OVERVIEW

Researchers have developed ionomer-free iridium anodes using direct Atomic Layer Deposition (ALD) to significantly reduce catalyst loading. Thermal ALD achieved a loading of $0.21 \text{ mg} \cdot \text{cm}^{-2}$ with performance comparable to commercial anodes, addressing the supply bottleneck of iridium for scaling PEM water electrolysis.

Key Findings

Direct Atomic Layer Deposition (ALD) enables the creation of ionomer-free catalyst layers with significantly lower iridium (Ir) loading than traditional methods. Thermal ALD using O₃ as a counter-reactant resulted in an electrode Ir loading of 0.21 mg·cm⁻², which is 7 times lower than commercial catalyst-coated membrane anodes while maintaining comparable cell-level performance. This performance was sustained over an accelerated durability test equivalent to 600 hours of intermittent operation. When paired with a low-loading ALD-made cathode, the total platinum group metal loading was reduced to 0.24 mg·cm⁻².

Technical Details

The approach utilizes custom-made microporous substrates and the Ir(EtCp)(CHD) precursor. Two ALD processes were evaluated:

- **Thermal ALD:** Yields mostly metallic Ir/IrO_x and achieves the 0.21 mg·cm⁻² loading.
- **Plasma-enhanced ALD:** Further reduces Ir loading to 0.04 mg·cm⁻² by tailoring catalyst distribution, although it yields lower-activity IrO₂.

Because the process deposits the catalyst directly onto the porous transport layer (PTL), it eliminates the need for ionomer-bearing inks. This makes the anodes compatible with various membrane materials, including anion exchange membranes for CO₂ electrolysis to hydrocarbons.

Background & Context

Proton exchange membrane water electrolysis (PEMWE) is critical for renewable energy storage and chemical feedstock production. However, the scarcity of iridium, the standard catalyst for the oxygen evolution reaction (OER), poses a scaling bottleneck. Technological roadmaps suggest reducing Ir loading from typically >1 mg·cm⁻² to ≤0.2 mg·cm⁻² or ≤0.4 g·kW⁻¹. Traditional wet deposition methods—involving catalyst synthesis, ink formulation, and coating—struggle in the sub-mg·cm⁻² range due to catalyst particle size, which causes inhomogeneity and increases overpotential.

Significance & Outlook

By uniting synthesis and deposition into a single step, direct ALD reduces fabrication complexity and eliminates the electrical contact issues associated with non-contiguous layers in traditional wet deposition. This method provides a pathway to high power densities and compatibility with intermittent electricity supplies while mitigating the risks associated with the inelastic supply of platinum group metals.

Source: <https://arxiv.org/html/2610.15798v1>

Collected: October 17, 2026 | Automated Research System (AI)