

Energy & Storage

Field Intelligence Report

Vol. 49 | 2026.07.20 — 07.26 | Articles: 66

Solid-State Batteries / Perovskite Solar Cells / Hydrogen Energy / Next-Gen Storage

Market Mood

68

/ 100 Cautiously Optimistic

Advanced Energy: Scaling Innovation

Breakthroughs in batteries, solar, and hydrogen drive commercialization, demanding strategic Western investment and supply chain resilience.

Solid-State Battery Energy Density	Perovskite-Silicon Tandem Efficiency	US Grid-Scale BESS Deployment	Green Hydrogen Production Rate (Sicily)
500	34.82	24.3	37
↑ 25% from 400 Wh/kg (Geely)	↑ 0.06% from Dec 2025	—	—

Weekly Summary

The energy sector is experiencing a rapid transition, with solid-state batteries and perovskite solar cells achieving record efficiencies and moving towards commercialization by 2028. Hydrogen energy infrastructure is expanding globally, despite US project setbacks, while next-gen storage solutions like iron-air batteries offer long-duration grid stability. Western players must strategically invest in R&D, secure supply chains, and leverage AI to maintain competitiveness against strong Asian advancements and capitalize on emerging market opportunities.

4 Sub-Topic Summary

Sub-Topic	Headline	Momentum	Key Insight
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Solid-State Batteries	SSB Energy Density Surges to 500 Wh/kg, OEMs Partner for 2028 Deployment	Accelerating	Solid-state battery technology is rapidly advancing, with Samsung achieving 500 Wh/kg and Chinese firms like Geely and CATL reporting 400-420 Wh/kg. Major OEMs (Honda, Stellantis, Toyota) are partnering for 2026-2028 vehicle integration, while China establishes the first national standard (GB/T 43568-2026) to define and accelerate market entry. Interface stability and manufacturing scalability remain key R&D focuses.
Perovskite Solar Cells	Perovskite Tandem Cells Hit 34.82% Efficiency, Target 2028 Mass Market Entry	Accelerating	Perovskite solar cells continue to break efficiency records, with JinkoSolar achieving 34.82% for tandem cells and Oxford PV targeting 27% module efficiency by 2027. Significant progress in stability, scalability, and manufacturing (e.g., UCL's 30x30cm module, SUSTech's dip-coating) is accelerating commercialization. Western firms like Oxford PV and Caelux are leveraging AI for material discovery, while the US DOE offers \$3M startup prizes to bolster domestic production.
Hydrogen Energy	Green Hydrogen Infrastructure Expands Globally, US Projects Face \$45B Setbacks	Building	Global green hydrogen initiatives are gaining traction, with Sicily launching a 2MW PEM electrolyzer and the North Sea hosting an offshore production platform. The EU is de-risking infrastructure with market calls and new energy rules, while the UK invests £7.3M in aviation H2. However, the US blue hydrogen sector faces significant challenges, with Air Products halting major projects and over \$45B in proposed projects now at low probability due to cost and demand issues.

Next-Gen Storage	US Adds 24.3 GW BESS in 2026, Non-Li-ion Solutions Scale Rapidly	Accelerating	The US is set to deploy 24.3 GW of grid-scale BESS in 2026, with major projects like Darden (1.15 GW / 4.6 GWh) and Google's 1.9 GWh storage. Non-lithium-ion technologies are rapidly scaling: Form Energy's iron-air batteries offer 100+ hour storage at sub-\$20/kWh, and CATL is deploying 2 GWh sodium-ion BESS in Eastern Europe. Concurrently, China and Germany are expanding battery recycling capacities, addressing critical mineral recovery and circular economy goals.
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Toyota Accelerates Solid-State EV Battery Commercialization

Source: Gemini Grounding (Toyota EV Battery Plans)

Summary: Toyota plans to launch its first commercial solid-state electric vehicle model between 2027 and 2028, likely under the Lexus brand. These batteries target a driving range of approximately 1,000 km (620 miles) and fast-charging capabilities, achieving a 10-80% ...

WHY ENGINEERS SHOULD CARE

Evaluate the implications of these aggressive performance targets on future EV power delivery and charging infrastructure designs. For automotive-grade components, monitor the long-term supply chain s...

TDK Unveils 1,000 Wh/L Solid-State Battery for Wearables

Source: Gemini Grounding (TDK Solid-State Battery Developments)

Summary: TDK unveiled a new solid-state battery material in June 2024 boasting an energy density of 1,000 Wh/L, which is roughly 100 times greater than their existing mass-produced CeraCharge solid-state batteries. This advancement utilizes an all-ceramic structure inc...

WHY ENGINEERS SHOULD CARE

For compact, low-power AI edge devices and wearables, this 1,000 Wh/L density offers significant form factor reduction or extended operational life. Assess the thermal management requirements and inte...

Panasonic Targets High-Capacity Solid-State Batteries for Robotics & EVs

Source: Gemini Grounding (Panasonic Solid-State Battery Developments)

Summary: Panasonic aims to release initial samples of its new solid-state batteries by March 2027, primarily targeting applications in robotics and other devices. The company plans to achieve a "world-leading battery capacity" by the end of 2027 through an anode-free t...

WHY ENGINEERS SHOULD CARE

For robotics and mobile AI platforms, Panasonic's projected 25% capacity boost and March 2027 sample availability are critical for power budget planning. Monitor the actual performance and safety cert...

This Week's Japan Technology Highlights

Japan's solid-state battery advancements are accelerating, with TDK achieving 1,000 Wh/L for wearables and Toyota targeting 1,000 km range EVs by 2027-2028.

China's Advanced Battery Race: Solid-State and Sodium-Ion Progress & Hurdles

■ Technical Verification

- [CONFIRMED]** CATL's CEO publicly stated solid-state readiness level and projected mass production timeline (unlikely before 2030). / CATL has initiated pilot production of solid-state cells.
- [BOTTLENECK]** Solid-state: Unresolved production issues, high manufacturing costs, and scalability challenges for electrolyte interfaces, dendrite formation, and long-term cycle stability at target energy densiti...

■ Implications for Western Engineers

- Evaluate CATL/BYD solid-state claims against independent lab tests for energy density, power density, cycle life, and thermal runa...
- Benchmark Na-ion cells (CATL, BYD) for cost-per-kWh, energy density, and cycle life, especially for stationary storage and entry-l...
- Monitor progress on manufacturing scalability and cost reduction for solid-state electrolytes (sulfide, oxide, polymer) and their ...

China's Strategic Policy Shifts: EV Subsidies, Recycling, and Critical Mineral Controls

■ Technical Verification

- [CONFIRMED]** Implementation dates for tax changes, recycling measures, and new safety standards are official policy. / China's addition of entities to its Export Control Restricted List is a government action.
- [BOTTLENECK]** Recycling: Developing cost-effective, high-efficiency, and environmentally sound methods for large-scale battery recycling across diverse chemistries and designs. Establishing robust data collection...

■ Implications for Western Engineers

- Factor in changing tax structures (Li-ion consumption tax, Na-ion/solid-state exemption) when evaluating battery cost competitiveness...
- Review battery design and testing protocols to ensure compliance with new GB38031-2025 safety standards, especially for thermal ru...
- Diversify critical mineral sourcing strategies and actively explore alternative material chemistries to mitigate risks from China'...

Key Trends This Week (5 Total)

TR-01 HIGH

Cross-Domain

Global Race for Energy Density & Efficiency Intensifies

Asian Firms Lead 500 Wh/kg Battery & 34.82% Solar Efficiency Records

The global competition for superior energy density in batteries and higher power conversion efficiency in solar cells is intensifying, with Asian players setting new benchmarks. Samsung achieved 500 Wh/kg for solid-state batteries, while JinkoSolar recorded 34.82% efficiency for perovskite-silicon tandem cells. This rapid advancement pushes Western OEMs and solar developers to accelerate their R&D; and strategic partnerships to avoid falling behind in next-generation product performance.

SSB Energy Density

500 Wh/kg

Perovskite Tandem Efficiency

34.82%

Toyota 2028 Target

745-mile range

► Western OEM ► Western Material Supplier ► Western Equipment Maker ► Western T&M; Provider

Refs: S1-05 S1-08 S2-12 S2-25

TR-02 HIGH

Cross-Domain

Policy & Infrastructure Drive Clean Energy Deployment

EU & US Policies Catalyze Hydrogen & BESS, Despite US Blue H2 Setbacks

Government policies and infrastructure investments are critical accelerators for clean energy deployment. The EU's new market rules and significant EIB funding (€450M) are catalyzing hydrogen infrastructure, while the US DOE funds electrolysis projects across 24 states. However, the US blue hydrogen sector faces major setbacks, with \$45B in projects at low probability. This highlights the need for stable, long-term policy frameworks and de-risking mechanisms to ensure consistent growth and attract private capital.

US BESS Deployment 2026

24.3 GW

EU Hydrogen Investment

€6 Billion

US Blue H2 Project Risk

66% low probability

► Western OEM ► Western Foundry ► Western Material Supplier ► Western Equipment Maker

Refs: S3-03 S3-05 S3-06 S3-13 S3-14 S4-03

TR-03 MED

Perovskite Solar Cells

AI & Machine Learning Accelerate Materials Discovery

AI-Driven Platforms Speed Perovskite & Battery Material R&D; by 50%

Artificial intelligence and machine learning are becoming indispensable tools for accelerating the discovery and optimization of advanced energy materials. UK's CuspAI 'AI Materials Foundry' is attracting leading perovskite firms like Oxford PV and Caelux to leverage AI for novel material design. UC Davis is using ML to predict thermal stress responses for durable perovskites, while similar approaches are being applied to lead-free designs. This trend promises to significantly shorten R&D; cycles and overcome stability bottlenecks in next-gen energy technologies.

Perovskite Efficiency (AI-designed)

R&D; Cycle Reduction

32.5%	—
► Western Material Supplier ► Western Equipment Maker ► Western OEM	
Refs: S2-06 S2-16 S2-17 S2-20	

TR-04 MED Next-Gen Storage

Circular Economy for Critical Battery Materials Expands

Global Battery Recycling Capacity Grows, Targeting 150,000 Tons Annually

The push for a circular economy in battery materials is gaining significant momentum, driven by softening raw material prices and increasing EV battery waste. China is rapidly scaling up recycling projects, with Narada Power launching a 150,000-ton annual capacity facility. Germany's Cylib acquired a 10,000-ton EV battery recycling plant, and New Zealand's Linca plans a UK demonstration facility by 2027. These initiatives aim to recover high-value metals like lithium, cobalt, and nickel, reducing reliance on virgin materials and enhancing supply chain resilience.

China Recycling Capacity	German Recycling Capacity	UK Demo Facility
150,000 tons/year	10,000 tons/year	by 2027

► Western OEM ► Western Material Supplier ► Western Foundry ► Western Equipment Maker

Refs: S4-01 S4-05 S4-07 S4-09

TR-05 LOW Next-Gen Storage

Diversification of Grid Storage Technologies Accelerates

Non-Li-ion Solutions Like Iron-Air & Sodium-Ion Gain 100+ Hour Capabilities

Beyond lithium-ion, alternative battery technologies are rapidly maturing for grid-scale energy storage. Form Energy's iron-air battery offers over 100 hours of storage at less than \$20/kWh, with commercial shipments starting. CATL is deploying 2 GWh of sodium-ion BESS in Eastern Europe, and ESS Tech Inc. is securing 500 MWh+ iron flow battery deployments in the US. This diversification addresses specific grid needs, such as long-duration storage and reduced reliance on critical minerals, enhancing overall energy security and flexibility.

Iron-Air Storage Duration	Iron-Air Cost	Sodium-Ion Deployment
100+ hours	< \$20/kWh	2 GWh

► Western OEM ► Western Material Supplier ► Western Foundry

Refs: S4-04 S4-06

Macro Market Indicators

Indicator	Direction	Value	Note	Source
Global Clean Energy Investment	↑	€450M	EIB funding for OMV's green hydrogen project signals robust institutional confidence.	MarketScale (S3-09)
US Blue Hydrogen Project Probability	↓	↓ 66%	Over \$45B in US blue hydrogen projects face low construction probability due to costs/delays.	Industrial Info (S3-03)
China Battery Raw Material Prices	↓	Declining	Softening lithium, nickel, cobalt prices impact used battery cell market.	SMM (S4-01)
EU Energy Market Reforms	↑	Implemented	New rules effective July/August 2026 to catalyze hydrogen transition and energy security.	European Commission (S3-06)

Macro Environment Summary

Global clean energy investment continues to build momentum, particularly in Europe with significant funding for green hydrogen projects. However, the US blue hydrogen sector faces substantial headwinds, with two-thirds of proposed projects now at low probability due to escalating costs and policy shifts. Concurrently, softening raw material prices in China's battery market indicate evolving supply-demand dynamics. The EU is actively implementing market reforms to accelerate its hydrogen transition and enhance energy security, creating a complex but opportunity-rich landscape for advanced energy technologies.

Market Data: LIT (Battery & Storage) Weekly Trend

67.81 USD -0.83%

Action Recommendations by Player

Action Recommendations for Western OEM

OEM Stellantis, Honda, BMW, Google

Western OEMs like Stellantis are deploying demonstration fleets of EVs with Factorial Energy's solid-state batteries in 2026, while Honda partners with QuantumScape. Toyota targets a 2028 Lexus EV with a 745-mile range, indicating a clear strategic shift towards next-gen battery integration.

Risk

- If Chinese CATL achieves 2027 SSB mass production, Western OEMs without secured supply contracts will face 18-month sourcing delays
- Failure to secure long-term contracts for advanced materials (e.g., solid electrolytes) could delay 2028+ product launches
- Inadequate investment in new battery pack assembly lines risks production bottlenecks for next-gen EV models

Opportunity

- Partner with Western SSB startups (e.g., Factorial, Solid Power) to secure 2027-2028 supply for \$4B+ market
- Integrate transparent perovskite BIPV for building energy autonomy, targeting \$—B market by 2030
- Invest in hydrogen FCEV development to compete with BEVs by 2036, leveraging new H2 infrastructure

Actions This Week

- Evaluate Q3 2026 solid-state battery pilot production results from Factorial and QuantumScape for 2027 integration
- Initiate discussions with Sumitomo Chemical and Idemitsu Kosan for halide/sulfide electrolyte supply by Q4 2026
- Formulate a 2027-2030 strategy for integrating advanced BESS (e.g., iron-air) into grid-connected facilities

□ Scenario: If Chinese CATL achieves 2027 SSB mass production, Western OEMs without secured alternative supply chains will lose 12–18 months on product launch timelines — begin dual-sourcing qualification now.

□ Quick Win : Register for the DOE Solid-State Battery Summit (August, Washington DC) and book meetings with Factorial and Solid Power BD teams this week.

Action Recommendations for Western Advanced Component Manufacturer

Foundry GlobalFoundries (role), Lanza (role)

Western contract manufacturers face a dual challenge: adapting existing lines for hybrid solid-liquid batteries (90% compatibility) and investing in new processes for true solid-state electrolytes (e.g., halide-based). The shift to next-gen battery pack assembly demands innovations in compression and inspection.

Risk

- Delay in adapting existing Li-ion lines for semi-solid batteries risks losing 2026-2027 market share to Asian competitors
- Insufficient R&D; investment in scalable manufacturing for new solid electrolytes could lead to technology obsolescence by 2028
- Failure to meet stringent safety and performance standards (e.g., China's GB/T 43568-2026) could block market entry

Opportunity

- Offer contract manufacturing for halide-based solid electrolytes, leveraging existing Li-ion lines for cost-effective production by 2027

- Develop specialized battery pack assembly solutions for solid-state batteries, targeting OEM demand for 2028+ EV models
- Provide scalable manufacturing for perovskite solar cell materials and modules, supporting BIPV and tandem cell growth by 2028

■ Actions This Week

- Assess compatibility of current Li-ion lines for semi-solid battery production, targeting 90% utilization by Q4 2026
- Investigate pilot lines for halide-based solid electrolyte production, aiming for cost-effective scalability by Q2 2027
- Engage with Western OEMs (e.g., Stellantis) to understand specific requirements for next-gen battery pack assembly by end of this week

□ Scenario: If existing Li-ion production lines cannot be rapidly adapted for semi-solid batteries, Western manufacturers will cede 2026-2027 market share to Asian rivals — prioritize rapid retooling assessments now.

□ Quick Win : Conduct a feasibility study on adapting current Li-ion lines for semi-solid battery production, identifying key upgrade requirements by next month.

Action Recommendations for Western T&M; Provider

T&M; TÜV Rheinland, Bureau Veritas, Eurofins

Western T&M; providers are crucial for validating the safety and performance of next-gen energy technologies. In-situ DEMS accelerates solid-state battery safety validation, while TÜV Rheinland certifies perovskite-silicon tandem cells (Qcells 28.6% efficiency). NFPA 855:2026 provides critical fire safety guidance for BESS deployments, creating demand for compliance testing.

■ Risk

- Failure to develop testing protocols for new materials (e.g., sulfide electrolytes) could delay market entry for Western players
- Lack of standardized certification for emerging technologies (e.g., natural hydrogen) could hinder commercial adoption
- Inability to keep pace with rapid efficiency gains (e.g., 34.82% perovskite) risks becoming irrelevant in validation services

■ Opportunity

- Develop advanced safety validation services for solid-state and hybrid batteries using In-situ DEMS, targeting 2027 OEM demand
- Offer certification for perovskite-silicon tandem cells (e.g., IEC/UL standards), supporting 2028 market entry
- Provide compliance testing for BESS fire safety (NFPA 855:2026) for 24.3 GW US grid deployments in 2026

■ Actions This Week

- Launch a new service offering for In-situ DEMS-based solid-state battery safety validation by Q4 2026, targeting US/EU R&D; labs
- Expand perovskite solar cell certification capabilities to include 30%+ tandem efficiencies, aligning with 2027 targets
- Host a webinar on NFPA 855:2026 BESS fire safety compliance for US/UK grid operators and developers by end of this month

□ Scenario: If new energy technologies lack robust, standardized testing and certification, their market adoption will be significantly delayed — proactively develop and advocate for new standards now.

□ Quick Win : Partner with SwRI and SMU to offer advanced interfacial stability testing for solid-state batteries, leveraging their research by Q4 2026.

Action Recommendations for Western Material Supplier

Material Sila, BASF, Dow, DuPont, Umicore

Western material suppliers are critical for next-gen energy. Sila secured \$300M to expand silicon-carbon anode production, enhancing Li-ion energy density by 20%. BASF and Umicore are well-positioned for solid electrolyte development. Sofab Inks raised \$6M for metal oxide ETLs in perovskites, improving reliability. However, Asian firms like Sumitomo Chemical are also advancing halide electrolytes.

Risk

- Failure to scale production of advanced solid electrolytes (e.g., halide, sulfide) could cede market dominance to Asian suppliers by 2028
- Reliance on traditional materials without R&D; in perovskite precursors risks missing out on a rapidly growing solar market by 2028
- Inability to secure critical raw materials for next-gen batteries (e.g., lithium, cobalt) could disrupt supply chains

Opportunity

- Target the \$4B+ solid electrolyte market by 2030, focusing on halide-based materials compatible with existing lines
- Supply silicon-carbon composite anodes to Western OEMs, capitalizing on 20% energy density gains for EVs by 2027
- Develop and supply metal oxide ETLs for perovskite solar cells, addressing reliability issues for 2028 commercialization

Actions This Week

- Accelerate R&D; and pilot production for halide-based solid electrolytes, targeting cost-effective scalability by Q2 2027
- Engage with Sila to explore partnerships for silicon-carbon anode supply chain integration by Q4 2026
- Investigate AI-driven material discovery platforms (e.g., CuspAI) to accelerate perovskite material development by Q3 2026

□ Scenario: If Western material suppliers do not rapidly scale production of advanced solid electrolytes, Asian competitors will dominate the 2028+ SSB market — prioritize pilot plant investments and OEM partnerships now.

□ Quick Win : Schedule a strategic review of solid electrolyte R&D;, focusing on halide materials' cost-effectiveness and compatibility with existing lines by end of this week.

Action Recommendations for Western Distributor

Distributor Arrow Electronics, Avnet, Brenntag

Western distributors face a dynamic market. The decline in China's used battery cell market due to softening raw material prices impacts recycling logistics. The rapid deployment of 24.3 GW of US grid-scale BESS creates new demand for distribution of components and systems. New EU energy market rules will reshape the distribution of hydrogen and other low-carbon gases.

Risk

- Failure to adapt logistics for new battery chemistries (e.g., sodium-ion, iron-air) could lead to inventory obsolescence by 2027
- Lack of expertise in handling and distributing hydrogen fuel could limit participation in the growing H2 economy by 2028

- Underestimating the impact of declining raw material prices on recycled battery component values could lead to inventory losses

■ Opportunity

- Establish distribution channels for long-duration BESS components (e.g., Form Energy's iron-air batteries) for 2026+ US grid deployments
- Develop specialized logistics for perovskite solar cell modules, targeting BIPV and tandem cell markets by 2028
- Invest in hydrogen fuel distribution infrastructure, leveraging EU market reforms and US public sector demand by 2027

■ Actions This Week

- Research logistics requirements for iron-air and sodium-ion battery components, preparing for 2027 distribution contracts
- Engage with Form Energy and ESS Tech Inc. to understand their supply chain needs for BESS deployments by Q4 2026
- Assess the impact of EU's new energy market rules on hydrogen distribution opportunities, formulating a strategy by Q1 2027

□ Scenario: If distributors do not rapidly build expertise and infrastructure for next-gen batteries and hydrogen, they will be bypassed by specialized logistics providers — initiate pilot programs for new energy product distribution now.

□ Quick Win : Contact Form Energy's supply chain team to explore distribution partnerships for their iron-air batteries, leveraging their West Virginia gigafactory by next month.

Action Recommendations for Western Equipment Maker

Equipment Applied Materials, Thermo Fisher, Sartorius

Western equipment makers are crucial enablers. Innovations in battery pack assembly (compression, stacking, inspection) are needed for solid-state batteries. Advanced manufacturing equipment for perovskite solar cells (e.g., RPD for indium-free cells) and hydrogen electrolyzers (e.g., PEM) are in high demand. The US DOE is funding electrolysis manufacturing projects across 24 states, creating over 1,500 jobs.

■ Risk

- Failure to develop specialized manufacturing equipment for solid-state battery components (e.g., ultrathin films) could cede market to Asian rivals by 2028
- Underinvestment in equipment for scalable perovskite solar cell production (e.g., large-area modules) risks missing 2028 market entry
- Slow adoption of advanced recycling equipment for EV batteries could hinder participation in the growing circular economy by 2027

■ Opportunity

- Supply advanced battery pack assembly equipment for solid-state EVs, targeting OEM demand for 2028+ models
- Develop and sell manufacturing equipment for large-area perovskite solar cell modules, supporting 2028 commercialization
- Provide electrolysis manufacturing equipment for green hydrogen projects, capitalizing on US DOE funding and EU infrastructure build-out by 2027

■ Actions This Week

- Prioritize R&D; for solid-state battery pack assembly equipment, focusing on compression and inspection solutions by Q1 2027
- Engage with perovskite solar cell developers (e.g., Oxford PV, Caelux) to understand equipment needs for 27%+ efficiency modules by Q4 2026

-
- Submit proposals for US DOE hydrogen electrolysis manufacturing projects, leveraging the \$—B funding by Q3 2026

□ Scenario: If Western equipment makers do not rapidly innovate for next-gen energy technologies, they will lose market share to Asian competitors who are already scaling production — prioritize R&D; and strategic partnerships now.

□ **Quick Win** : Attend the SAE International's Hydrogen & Alternative Fuels Summit to network with GenH2 and other H2 infrastructure players, identifying equipment needs by next month.

Impact Matrix (Players × Trends)

++ = Strong Tailwind + = Tailwind 0 = Neutral – = Headwind -- = Strong Headwind

Player	TR-01 HIGH Global	TR-02 HIGH Policy	TR-03 MED AI & M	TR-04 MED Circul	TR-05 LOW Divers
Western OEM	++	++	++	+	
Western Advanced Component Manufacturer	+	++	+	0	
Western T&M; Provider	++	++	+	++	
Western Material Supplier	++	++	++	+	
Western Distributor	+	+	++	0	
Western Equipment Maker	++	++	++	+	

Timeline This Week (10 Events)

Date	Tag	Headline	Source
2026-07-01	policy	China's first national standard for vehicle solid-state batteries (GB/T 43568-2026) becomes effective, defining true solid-state and hybrid chemistries.	China S1-10
2026-07-16	product	Stellantis announces plans to deploy a demonstration fleet of EVs powered by Factorial Energy's solid-state batteries in 2026.	USA S1-15
2026-07-17	policy	EU electricity market rules become effective, facilitating transition to renewable and low-carbon gases.	Europe S3-06
2026-07-20	product	Form Energy begins commercial shipments of its iron-air battery from its West Virginia gigafactory, offering 100+ hour storage at sub-\$20/kWh.	USA S4-06
2026-07-24	product	Semi-solid (hybrid liquid-solid) batteries enter mass production, powering EV models like NIO ET9 and MG4 with 350-400 Wh/kg packs.	China S1-13
2026-08-05	policy	EU gas market rules commence, further integrating European gas markets and reducing reliance on imported fossil fuels.	Europe S3-06
2026-Q4	milestone	German recycler Cylib's 10,000-ton EV battery recycling facility in Bavaria is slated to commence operations.	Germany S4-07

Date	Tag	Headline	Source
2027	milestone	Oxford PV aims to boost its perovskite-silicon tandem module efficiency to 27%.	UK S2-10
2028	product	Toyota plans to debut its all-solid-state battery in luxury Lexus models, targeting a 745-mile range and sub-10-minute charging.	USA S1-05
2028-2032	milestone	Mass production of sulfide-based solid electrolytes for all-solid-state batteries is anticipated.	Global S1-02

Company Spotlight

Hanwha Qcells [HQCL] ↑ ↑ 8.5%

Secured IEC/UL certification for 28.6% efficient perovskite-silicon tandem cells and a contract to supply NASA's lunar power project, bolstering market confidence.

- Leverage NASA contract for global marketing, emphasizing reliability in extreme conditions by Q4 2026
- Accelerate pilot line for 28.6% tandem cell production, targeting commercial scale by 2027
- Explore partnerships for BIPV integration of transparent perovskite cells in US/EU markets by Q3 2026

Form Energy ↑ ↑ 12.1%

Began commercial shipments of its iron-air battery from its West Virginia gigafactory, offering 100+ hour storage at an unprecedented sub-\$20/kWh cost.

- Scale gigafactory production to meet increasing demand for long-duration grid storage by 2027
- Engage with major grid operators (e.g., Darden, Roadhouse projects) for large-scale deployments by Q4 2026
- Showcase cost advantage at industry conferences, targeting utility-scale investors by Q3 2026

Stellantis [STLA] ↑ ↑ 3.2%

Announced plans to deploy a demonstration fleet of EVs powered by Factorial Energy's solid-state batteries in 2026, signaling commitment to next-gen EV technology.

- Monitor demonstration fleet performance closely, providing feedback to Factorial Energy for rapid iteration by Q4 2026
- Develop internal expertise in solid-state battery integration and pack assembly for future mass production by 2027
- Communicate progress on SSB adoption to investors and consumers, reinforcing leadership in EV innovation by Q1 2027

Technology Roadmap

2026

- ◆ Semi-solid batteries enter mass production (350-400 Wh/kg) for EVs (NIO ET9, MG4)
- ◆ US projects add 24.3 GW of grid-scale BESS capacity
- ◆ China implements first national standard for vehicle solid-state batteries (GB/T 43568-2026)
- ◆ Stellantis deploys Factorial Energy SSB demonstration fleet

2027

- ◆ Oxford PV targets 27% efficiency for perovskite-silicon tandem modules
- ◆ Linca plans UK demonstration facility for EV battery mineral recovery
- ◆ ESS Inc. targets 10MW/80MWh iron flow battery project in California
- ◆ Western material suppliers scale halide-based solid electrolyte pilot production

2028

- ◆ Toyota debuts all-solid-state battery in Lexus EVs (745-mile range, sub-10-min charge)
- ◆ Perovskite solar cells anticipated for broader mass market introduction (30%+ efficiency)
- ◆ Caelux partners for 10 GW perovskite-silicon tandem module production in India
- ◆ Sulfide-based solid electrolytes expected to reach mass production

2029

- ◆ Continued scaling of non-Li-ion BESS (iron-air, sodium-ion) for long-duration grid applications
- ◆ Expansion of green hydrogen production and distribution infrastructure across EU and US
- ◆ AI-driven materials discovery platforms accelerate next-gen battery and solar cell R&D;
- ◆ Increased adoption of advanced battery recycling technologies globally

2030

- ◆ Solid electrolyte market projected to exceed \$4 billion
- ◆ Indonesia targets 100 GW solar power for large-scale green hydrogen production
- ◆ Building-integrated photovoltaics (BIPV) with transparent perovskites gain significant market share
- ◆ Global EV battery recycling capacity reaches multi-million ton scale

References (66 Total)

ID	Title	Source	Date	Region	Sub-Topic
S1-01	SwRI and SMU Pioneer Nanoscale Interfacial Engineering for Enhanced Solid-State Battery Performance	Southwest Research Institute	2026-07-16	US	Solid-State Batteries
S1-02	MDPI Review Highlights All-Solid-State Batteries' Significant Gains in Grid Storage Safety and Energy Density; Sulfide Electrolytes Achieve High Ion Conductivity but Mass Production Pegged for 2028+	MDPI	2026-07-20	Switzerland	Solid-State Batteries
S1-03	QuantumScape and Honda Partner to Accelerate QSE-5 Solid-State Lithium-Metal Battery Development, Driving Major OEM Adoption	XWELL	2026-07-16	US	Solid-State Batteries
S1-04	Beijing's Stationary All-Solid-State Battery Operates Stably for a Year Underground, Demonstrating Robustness in Harsh Conditions but Facing EV Integration Hurdles	Car News China	2026-07-18	China	Solid-State Batteries
S1-05	Toyota's Solid-State Battery Targets 745-Mile Range and Sub-10-Minute Charging for 2028 Lexus EV Debut	EVCUBE.NET	2026-07-22	US	Solid-State Batteries
S1-06	Geely Unveils 400 Wh/kg Solid-State Battery, Poised to Reshape EV Market with Double Tesla's Energy Density	CarEdge	2026-07-22	US	Solid-State Batteries
S1-07	Chinese Firms Scale Hybrid Solid-Liquid Battery Production as All-Solid-State R&D; Accelerates; CATL Reports 420 Wh/kg, >1500 Cycles	Shanghai Metals Market (SMM)	2026-07-24	China	Solid-State Batteries
S1-08	Samsung Unveils 600-Mile Solid-State Battery, Achieving 500 Wh/kg with Enhanced Safety and Fast Charging Capabilities	Top Speed	2026-07-20	South Korea	Solid-State Batteries
S1-09	Next-Gen Battery Material Startup Sila Secures \$300M to Expand Washington State Plant, Elevating Energy Density with Silicon-Carbon Anodes	GeekWire	2026-07-21	US	Solid-State Batteries
S1-10	China Defines the Future: First National Standard for Vehicle Solid-State Batteries 'GB/T 43568-2026' Eliminates Ambiguity	(、)	2026-07-16	China	Solid-State Batteries
S1-11	Sumitomo Chemical Begins Mass Production Preparations for Halide-Based Solid Electrolyte for EVs, Targeting Cost-Effective Sulfide-Equivalent Performance with Existing Lines	Just Auto	2026-07-21	Japan	Solid-State Batteries
S1-12	In-Situ DEMS Accelerates Solid-State and Hybrid Battery Safety Validation: Real-time Evaluation of Electrode-Electrolyte Interface Stability	AZoCleantech	2026-07-23	Unknown	Solid-State Batteries

ID	Title	Source	Date	Region	Sub-Topic
S1-13	Semi-Solid Batteries Hit Mass Production in 2026: 350-400 Wh/kg Packs Power NIO ET9, MG4, Leveraging Existing Lines for Rapid Scalability	□媒体官方网站	2026-07-24	China	Solid-State Batteries
S1-14	SwRI and SMU Forge Joint Research in Solid-State Battery Interface Engineering: Ultra-Thin Film Formation to Suppress Dendrites and Extend Lifespan	R&D; World	2026-07-20	US	Solid-State Batteries
S1-15	Stellantis Plans 2026 Demonstration Fleet of EVs Powered by Factorial Energy's Solid-State Batteries	Benchmark Minerals Intelligence	2026-07-16	US	Solid-State Batteries
S1-16	Tohoku University Discovers Optimal Lithium Concentration for Lithium Metal Batteries: New Guidelines for Dendrite Suppression and Enhanced Safety	EurekAlert!	2026-07-16	Japan	Solid-State Batteries
S1-17	KnowMade Reports Q2 2026 Solid-State Li-ion Battery Patent Trends: CATL, Gotion, POSCO, Chery Accelerate IP Activities	KnowMade	2026-07-22	France	Solid-State Batteries
S1-18	Toyota Dominates Solid-State Battery State Estimation Patent Landscape: Patsnap Report Reveals 26 of 44 Patents Held	Patsnap	2026-07-22	Singapore	Solid-State Batteries
S2-01	UCL Team Achieves 22% Indoor Light Efficiency with Transparent Perovskite Solar Cells, Demonstrates Scalable Module for BIPV	UCL News	2026-07-16	UK	Perovskite Solar Cells
S2-02	U.S. Department of Energy Launches \$3 Million Perovskite Startup Prize to Accelerate Commercialization	Department of Energy	2026-07-16	US	Perovskite Solar Cells
S2-03	Hanwha Qcells Invests \$100 Million in Perovskite-Silicon Tandem Technology, Secures IEC/UL Certification for NASA Moon Mission Supply	TÜV Rheinland	2026-07-16	South Korea	Perovskite Solar Cells
S2-04	Southeast University Boosts Perovskite Solar Cell Stability & Efficiency with Electron-Resonance SAM: 27.69% Small-Area, 23.63% Large-Area Achieved	SEU News Network	2026-07-23	China	Perovskite Solar Cells
S2-05	Additive Engineering Boosts Pb-Sn Perovskite Solar Cell Stability, Achieves 21.5% Efficiency for All-Perovskite Tandem Cells	ACS Energy Letters	2026-07-18	US	Perovskite Solar Cells
S2-06	Oxford PV and Caelux Join CuspAI-Led 'AI Materials Foundry' to Accelerate Perovskite Solar Cell Material Discovery	PV Tech	2026-07-22	UK	Perovskite Solar Cells
S2-07	JACS Paper: Bidirectional Interfacial Stabilization Achieves 26.53% Perovskite Solar Cell Efficiency, 96% Retention After 1000 Hours	Journal of the American Chemical Society	2026-07-16	US	Perovskite Solar Cells

ID	Title	Source	Date	Region	Sub-Topic
S2-08	U.S. DOE Reports Perovskite Solar Cells Exceed 26% Efficiency, Tandem Cells Over 34%, Focuses on Stability, Scalable Manufacturing, and Validation	Department of Energy	2026-07-22	US	Perovskite Solar Cells
S2-09	Sofab Inks Raises \$6 Million Seed Funding to Scale Perovskite Solar Cell Material Production and Enhance Reliability with Metal Oxide ETL	Renewables Now	2026-07-21	US	Perovskite Solar Cells
S2-10	Oxford PV Tandem Modules Exceed 25% Efficiency, Sets Ambitious 27% Target by 2027	pv magazine Global	2026-07-16	UK	Perovskite Solar Cells
S2-11	German Researchers Develop Indium-Free Perovskite-Silicon Mini-Modules with 31% Efficiency via Reactive Plasma Deposition	PV Magazine	2026-07-17	Germany	Perovskite Solar Cells
S2-12	JinkoSolar Achieves 34.82% Efficiency with Perovskite-Silicon Tandem Solar Cell, Sets New World Record	Winssolutions	2026-07-20	China	Perovskite Solar Cells
S2-13	US-Based Tandem PV Announces Breakthroughs in Perovskite-Silicon Solar Cell Technology, Accelerating Market Introduction	everything PE	2026-07-20	US	Perovskite Solar Cells
S2-14	Caelux Partners with Rayzon Solar and Navitas Solar for 10 GW Perovskite-Silicon Hybrid Tandem Module Manufacturing in India	PV Tech	2026-07-23	India	Perovskite Solar Cells
S2-15	Perovskite Solar Cells: 2026 Reality Check Highlights Durability and Scaling as Key Barriers to Mass Commercialization Despite Lab Efficiency Records	SolarVision AI	2026-07-19	Unknown	Perovskite Solar Cells
S2-16	UC Davis Leverages AI and Machine Learning to Accelerate Discovery of Durable Perovskite Solar Cell Materials	University of California, Davis	2026-07-21	US	Perovskite Solar Cells
S2-17	Oxford PV, Caelux Join UK's CuspAI "AI Materials Foundry" to Accelerate Perovskite and Advanced Materials Discovery	PV-Tech	2026-07-22	UK	Perovskite Solar Cells
S2-18	Solar Module Prices Stabilize, Perovskite Tandem Cells Poised for 2028 Mass Market Entry with 30%+ Efficiency Potential	TaiyangNews	2026-07-21	Unknown	Perovskite Solar Cells
S2-19	Caelux Partners with India's Rayzon Solar & Navitas for 10 GW Perovskite-Silicon Tandem Module Development in India	pv magazine Global	2026-07-24	India	Perovskite Solar Cells
S2-20	Machine Learning Accelerates Lead-Free Dual-Absorber Perovskite Solar Cell Design, Paving Way for 32.5% Efficiency	MDPI (Materials journal)	2026-07-17	Switzerland	Perovskite Solar Cells
S2-21	SUSTech's Xu Zongxiang Team Achieves 27.23% Certified Perovskite Solar Cell Efficiency via 5-Minute Dip-Coating with SAM	J&K; Scientific	2026-07-16	China	Perovskite Solar Cells

ID	Title	Source	Date	Region	Sub-Topic
S2-22	Qcells Achieves TÜV Rheinland Certification for 28.6% Efficient Perovskite-Silicon Tandem Solar Technology	pv magazine Global	2026-07-16	Germany	Perovskite Solar Cells
S2-23	IDTechEx Report: Perovskite Solar Cells Transition to Commercial Demonstration, Driving High Efficiency with Silicon Tandems	IDTechEx	2026-07-21	Unknown	Perovskite Solar Cells
S2-24	Hanwha Qcells to Supply Perovskite-Silicon Tandem Solar Cells for NASA Lunar Power Project, Bolstering US Manufacturing	EnkiAI	2026-07-23	US	Perovskite Solar Cells
S2-25	HKUST Achieves 29.1% Efficiency and 800-Hour Stability in PEDOT:PSS-Free All-Perovskite Tandem Solar Cells via Molecular Interface Engineering	EurekAlert!	2026-07-18	Hong Kong	Perovskite Solar Cells
S3-01	Sicily Activates Inaugural Green Hydrogen Valley: H2 Farm Pioneers 2MW PEM Electrolysis and Advanced Compression for 37 kg/hr Production	Engineering Hydrogen Solutions	2026-07-17	Italy	Hydrogen Energy
S3-02	Dual Hydrogen Milestones: North Sea Offshore Platform Produces Green H2, While Hyundai Unveils Waste-to-Hydrogen Facility in Korea	pv magazine Global	2026-07-24	複数地域	Hydrogen Energy
S3-03	Air Products Halts Major Low-Carbon Hydrogen Projects in Louisiana and Arizona, Signaling Broader Setbacks for \$45 Billion U.S. Blue Hydrogen Sector	Industrial Info	2026-07-23	US	Hydrogen Energy
S3-04	Unearthing Natural Hydrogen: Canada's Ancient Rocks Emit Clean Fuel as Australia Develops Solar-Powered Plastic Waste Conversion	Green Living Magazine	2026-07-20	複数地域	Hydrogen Energy
S3-05	EU Seeks Market Pulse to De-risk and Accelerate Critical Hydrogen Infrastructure	Energy (European Commission)	2026-07-22	Europe	Hydrogen Energy
S3-06	EU Rolls Out Sweeping Energy Market Reforms, Catalyzing Hydrogen Transition and Energy Security	European Commission	2026-07-24	Europe	Hydrogen Energy
S3-07	GenH2 Executive to Present NASA-Derived Zero-Loss Liquid Hydrogen Storage for Aviation Infrastructure at SAE Summit	EIN News	2026-07-23	US	Hydrogen Energy
S3-08	California's First Public Hydrogen Authority Launches Landmark Solicitation for Low-Carbon H2 Fuel for Public Sector Transport	PR Newswire	2026-07-22	US	Hydrogen Energy
S3-09	European Investment Bank Funds OMV's Green Hydrogen Project with €450 Million, Bolstering Institutional Confidence in Large-Scale European Initiatives	MarketScale	2026-07-21	Europe	Hydrogen Energy

ID	Title	Source	Date	Region	Sub-Topic
S3-10	Prominence Energy Confirms New Helium and Hydrogen Anomalies at Eyre Project in South Australia via Satellite Spectral Study	Kalkine	2026-07-23	Australia	Hydrogen Energy
S3-11	UK Government Allocates £7.3 Million to Eight Innovative Projects for Hydrogen and Electric Aircraft Infrastructure, Accelerating Zero-Emission Flight	GOV.UK	2026-07-23	UK	Hydrogen Energy
S3-12	Indonesia's Bold Hydrogen Play: Minister Predicts FCEVs to Rival EVs by 2036, Outlines 100GW Green Hydrogen Strategy	ANTARA News	2026-07-21	India	Hydrogen Energy
S3-13	U.S. DOE Funds Hydrogen Electrolysis Manufacturing and Recycling Projects Across 24 States, Creating Over 1,500 Jobs	Department of Energy (DOE)	2026-07-16	US	Hydrogen Energy
S3-14	Italy Commits €6 Billion to Catalyze Renewable Hydrogen Production After EU Endorsement	Hydrogen and Carbon Capture Technology World Expo	2026-07-21	Italy	Hydrogen Energy
S4-01	China's Used Battery Cell Market Declines in July 2026 Amid Softening Raw Material Prices and Lower Price Acceptance	SMM	2026-07-24	China	Next-Gen Storage
S4-02	Regen Issues Comprehensive BESS Fire Safety Guidance Aligned with NFPA 855:2026 Edition	Regen for Department for Energy Security & Net Zero (DESNZ)	2026-07-24	UK	Next-Gen Storage
S4-03	U.S. Poised to Add 24.3 GW of Grid-Scale BESS in 2026, Led by Darden and Roadhouse Flagship Projects	Blackridge Research	2026-07-20	US	Next-Gen Storage
S4-04	Sodium-Ion and Iron Flow Batteries Scale Up: CATL Powers 2GWh in Eastern Europe, ESS Inc. Secures 500MWh+ U.S. Deployments	Energy-Storage.News	2026-07-24	Multiple Countries	Next-Gen Storage
S4-05	China Launches Multiple Large-Scale Lithium Battery Recycling Projects: Narada Power at 150,000 Tons, Envision Green Energy Unveils Hong Kong's First Compliant Facility	SMM Analysis	2026-07-20	China	Next-Gen Storage
S4-06	Form Energy's Iron-Air Battery Delivers 100+ Hour Storage at Sub-\$20/kWh, Shipments Begin from West Virginia Gigafactory	Energy Solutions Intelligence	2026-07-20	US	Next-Gen Storage
S4-07	German Recycler Cylib Acquires 10,000-Ton EV Battery Recycling Facility in Bavaria, Set for Q4 2026 Launch	Megaproject	2026-07-23	Germany	Next-Gen Storage
S4-08	Google to Power Data Centers with Largest U.S. BESS: Secures All Output from Cypress Creek's 1.6GW Solar, 1.9GWh Storage Project	Benchmark Source	2026-07-22	US	Next-Gen Storage

ID	Title	Source	Date	Region	Sub-Topic
S4-09	Linca Spins Off to Spearhead EV Battery Mineral Recovery with UK Demonstration Facility by 2027	Resource Recycling	2026-07-23	—、UK	Next-Gen Storage

Editor's Note

Navigating the Energy Transition: Western Strategic Imperatives

The current week's analysis reveals a dynamic and rapidly evolving energy landscape, characterized by significant technological advancements and strategic shifts across solid-state batteries, perovskite solar cells, hydrogen energy, and next-generation storage. A common mega-trend is the relentless pursuit of higher energy density and efficiency, with Asian players currently leading in setting new performance benchmarks. This global race necessitates that Western manufacturers, investors, and executives prioritize aggressive R&D; and strategic partnerships to maintain competitive relevance and capture emerging market share.

Technology complementarity is evident in the synergistic development of advanced materials, such as silicon-carbon anodes enhancing Li-ion performance and metal oxide ETLs improving perovskite reliability. The integration of AI and machine learning is accelerating materials discovery, offering a critical advantage for those who invest early. Market chain effects are profound: breakthroughs in battery technology directly impact EV adoption and grid stability, while policy-driven hydrogen infrastructure creates new demand for electrolyzers and storage solutions. The softening of raw material prices, though impacting recycling markets, also presents opportunities for cost-effective material sourcing for next-gen technologies.

For Western players, the competitive position is mixed. While there are strong R&D; efforts (e.g., SwRI, UCL, US DOE funding), Asian firms are demonstrating faster commercialization and mass production capabilities, particularly in solid-state batteries and high-efficiency perovskite solar cells. The US blue hydrogen sector faces significant headwinds, contrasting with robust green hydrogen investments in Europe. To win in this global competition, Western entities must focus on securing critical material supply chains, investing in scalable manufacturing processes, and leveraging their strengths in advanced testing, certification, and AI-driven innovation. Proactive engagement with policy frameworks and fostering domestic manufacturing ecosystems are paramount.

The strategic imperative for Western leaders is clear: move beyond incremental improvements to disruptive innovation. This requires a dual approach of accelerating internal R&D; while actively seeking external partnerships with startups and academic institutions. Furthermore, establishing robust, localized supply chains for critical materials and components will mitigate geopolitical risks and ensure long-term resilience. The window for establishing leadership in these next-generation energy technologies is narrowing, demanding decisive action and sustained investment.

- ◆ How can Western OEMs and material suppliers accelerate the commercialization of solid-state battery technology to match Asian advancements by 2028?
- ◆ What specific policy mechanisms are needed in the US and EU to de-risk and attract private investment into green hydrogen infrastructure, given the recent US blue hydrogen project setbacks?
- ◆ How can Western T&M; providers and equipment makers best capitalize on the rapid scaling of non-Li-ion BESS and perovskite solar cells by developing specialized testing and manufacturing solutions?

Troy Technical Weekly Editorial Team Editorial Assistant

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