GRIDSTAB NEWS · TECHNICAL REPORT

GRID-FORMING MATURITY CHECK

Where each technology stands, and what still has to be proven

SEPTEMBER 2026 — FREE PREVIEW

Gilles Chaspierre — GridStab News — September 2026

> **About this preview.** It contains the verdicts for eight technologies, the method behind them, and one complete chapter. The full report, with all eight technology chapters and the closing sections, is sent to paid subscribers of GridStab News.

ABOUT THIS REPORT

Three questions, eight technologies

Grid-forming is how a grid built on renewables stays stable. Every operator, developer and investor now hears the term. Few can say how ready it is, for which equipment, and what is still missing.

This report answers those three questions for eight types of equipment. How mature is grid-forming today? What is proven? What is still missing?

Public evidence only. Every verdict rests on commissioned projects, published grid codes, operator reports and market data. Claims by vendors and owners are marked as such. Where two sources disagree, both figures are given.

One scale, four jobs, two questions. Each technology gets a Technology Readiness Level (TRL) from 1 to 9. Level 1 is an idea on paper. Level 9 is equipment proven in commercial service. Grid-forming covers four jobs, and each job needs different things. Two questions decide how far a technology can go. Chapter 1 explains all of this in plain words. Every chapter after it uses the same method.

What this report is not. It does not ask whether the energy transition will work. It asks how ready each building block is today. An open question is a proof not yet delivered, not a flaw.

A snapshot, dated on purpose. This report describes the situation in September 2026. Verdicts move within months. Each chapter ends with what to watch, so readers can update the verdict themselves.

IN THIS PREVIEW

The verdicts at a glance
Chapter 1 — What grid-forming means
Chapter 2 — Batteries (complete chapter)
Inside the full report

IN THE FULL REPORT

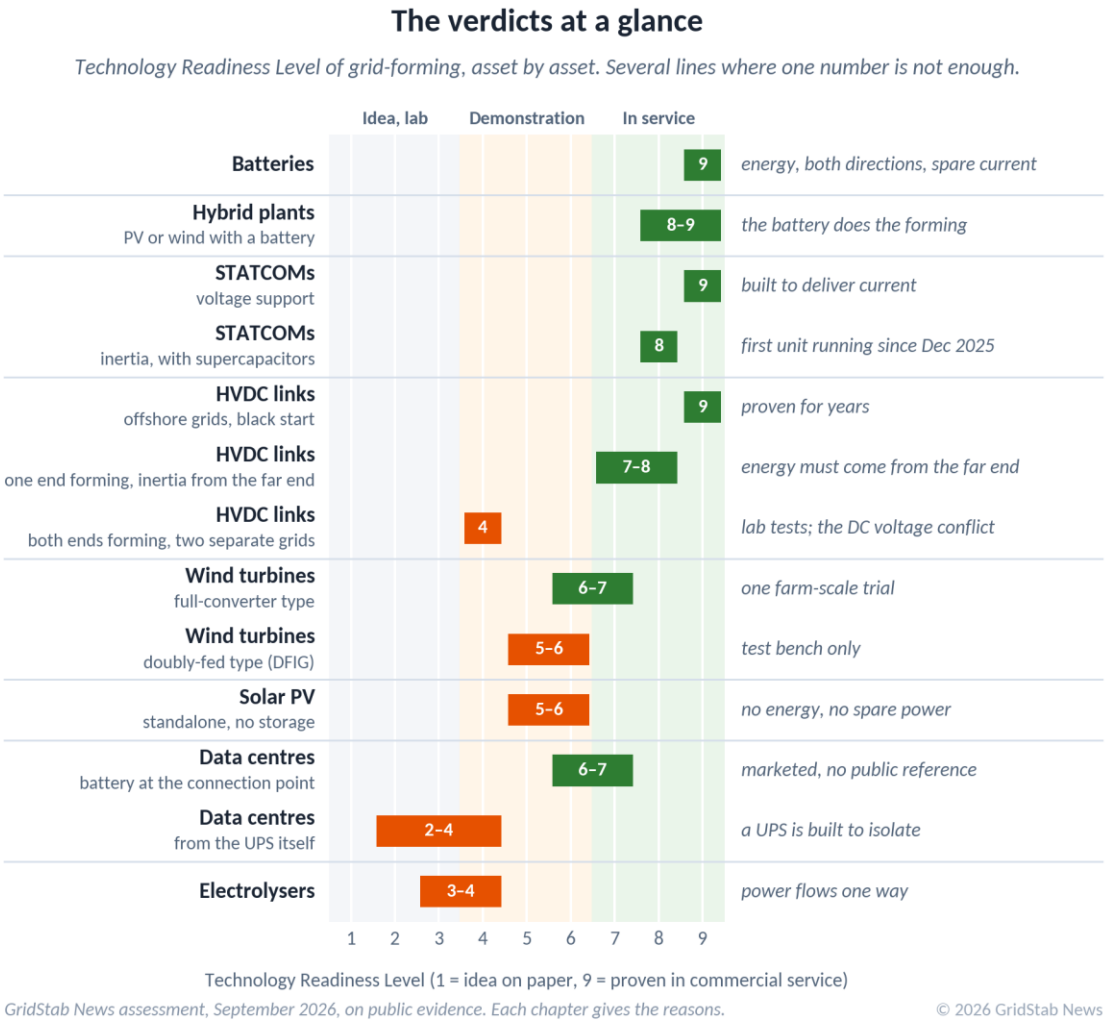
Chapters 3 to 9 — STATCOMs, HVDC links, hybrid plants, wind turbines, solar PV, data centres, electrolysers
One page that applies the two questions to every asset
Closing — synchronous condensers, the benchmark; what to watch in 2027

THE VERDICTS AT A GLANCE

One ladder, thirteen verdicts

The ladder below places every technology on the TRL scale. Where one number would hide the real picture, a technology gets several lines: one per job or per use. A STATCOM, for example, is proven for voltage support and brand new for inertia.

The colour tells the stage. Green is equipment in service. Orange is demonstrations. Red is ideas and laboratory work. The short note on the right gives the reason in a few words. Each chapter gives the full evidence.



Grid-forming maturity, technology by technology (GridStab News assessment, September 2026).

One pattern runs through the ladder. The technologies at the top have energy behind the converter, and can move power in both directions. The technologies lower down have no energy of their own, or can move power only one way. Chapter 1 explains why that decides everything.

CHAPTER 1

What grid-forming means

The four jobs, the two questions, and how the verdicts are made

1.1 A converter that behaves like a generator

Solar plants, wind turbines and batteries connect to the grid through power electronics, called inverters. Most inverters today are grid-following. They measure the grid voltage and inject current that follows it. They need a strong grid to follow.

A grid-forming inverter works the other way round. It holds its own voltage steady, like a small generator. When the grid is disturbed, it reacts at once. It does not wait for a measurement or a command.

Spinning generators have always behaved this way. It came for free, from the way they are built. As these plants close, the grid loses that support. Grid-forming inverters are how a grid built on renewables gets it back.

1.2 Four jobs

In practice, grid-forming covers four jobs:

- **Hold the voltage steady.** Be a firm reference that other equipment can follow.
- **Slow down frequency changes.** This is inertia. When a large plant suddenly disconnects, frequency falls. Inertia slows the fall and gives other reserves time to act.
- **Feed current into a short circuit.** Protection systems detect a fault by the large current that flows. Without that current, a fault can go unnoticed.
- **Restart a dead grid after a blackout.** Engineers call this black start.

1.3 Two questions decide maturity

The four jobs do not need the same things. The first job needs only smart control. It is software.

The other three need hardware. Inertia needs energy: a burst of power for a few seconds, and that energy must be stored somewhere. Fault current needs spare current: for a moment, the inverter must deliver more than in normal operation. Black start needs both.

So two questions decide how mature any technology can be. **Where does the energy come from? Where does the extra current come from?** Every chapter of this report starts from these two questions.

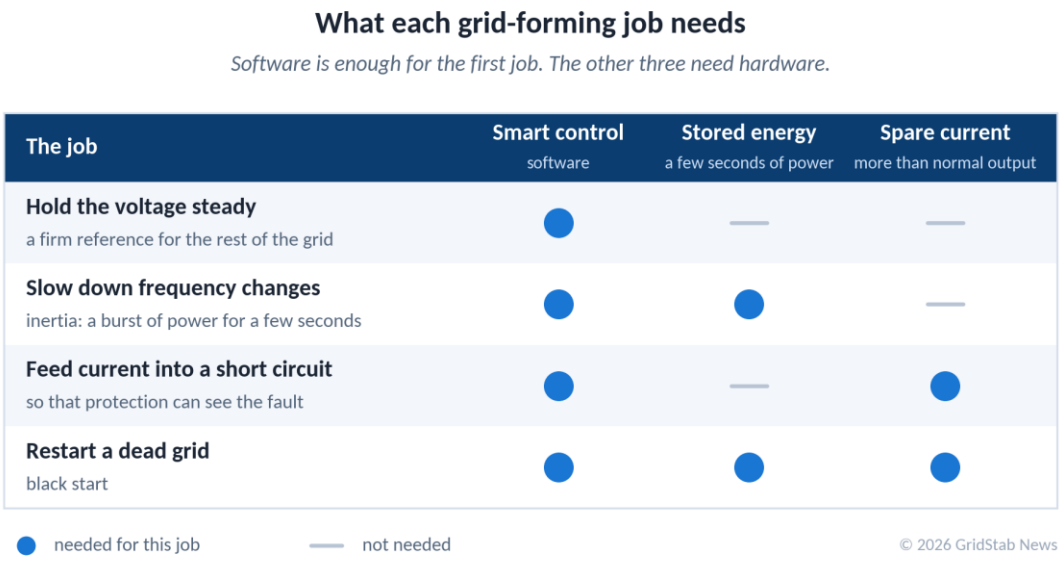


Figure 1.1. The four grid-forming jobs and what each one needs.

1.4 How the verdicts are made

Each technology gets a Technology Readiness Level, TRL, from 1 to 9. Levels 1 to 3 are ideas and laboratory work. Levels 4 to 6 are demonstrations in the field. Levels 7 to 9 are equipment in service, up to proven commercial operation at level 9.

One number is not always enough. A technology can be at level 9 for one job and level 4 for another. Where that happens, the chapter gives two verdicts.

A second line matters as much as the TRL. Can an operator rely on the technology yet? That needs three things. A rule that defines the behaviour. A market or a contract that pays for it. A test route that certifies it. Each chapter’s scorecard rates the four jobs. The text says where the rules, the markets and the certification stand.

CHAPTER 2

Batteries

The most mature grid-forming technology, and what it still has to prove

VERDICT

TRL 9 — proven in commercial service

Batteries have energy, power in both directions and, if the owner pays for it, spare current. Paid contracts, a growing fleet and binding rules exist. Still open: fault current that protection can trust, and a clear route to certification.

2.1 The short answer

On 3 March 2025, a large battery started commercial service in the north-east of Scotland. Its name is Blackhillock. Like any battery, it stores energy. But it also does a second job. It helps keep the grid stable, and the British system operator pays for that service.

Until then, this job belonged to the spinning generators of power plants. Blackhillock's owner presents it as the first transmission-connected battery in the world to deliver these stability services.

For batteries, the answer is TRL 9. They are the most mature grid-forming technology today. But mature does not mean finished. Some important questions are still open. This chapter covers both sides.

2.2 Why batteries went first

Chapter 1 set out the two questions. Where does the energy come from? Where does the extra current come from?

A battery has good answers to both. The energy is already there. That is what a battery is. Power can flow both ways, so it can respond when frequency falls and when it rises. And the inverter can be built with spare current, if the owner pays for it.

Compare with a solar plant. It stores nothing, and it already delivers all the power the sun gives. A wind turbine has only the energy of its spinning blades. Both have their own chapter in the full report.



Figure 2.1. What a battery brings to the three ingredients of grid-forming.

2.3 What is proven

Eight years in the field. In 2018, a 30 MW grid-forming battery entered service at Dalrymple, in South Australia. When the line feeding the area was out, the battery ran the local network on its own. No spinning generator was involved. By 2023, Australia's main power system had 230 MW of grid-forming

batteries in operation. By late 2025, it had ten sites and 1,070 MW. About three quarters of the 33 GW of batteries in the Australian connection pipeline are now grid-forming.

Paid contracts. Blackhillock is a 200 MW battery. It is under contract to provide inertia and short-circuit level around the clock. Published figures are about 370 MW·s of inertia and about 116 MVA of short-circuit level. Its owner has also shown data from a disturbance on 14 March 2025. That day, Great Britain lost about 1.8 GW of supply. According to the owner, the battery responded at once and helped slow the fall in frequency.

Rules and markets. Great Britain approved the first grid-forming specification in a grid code in January 2022. Australia published a voluntary specification in 2023. In Texas, the regulator approved a grid-forming requirement for new storage projects in November 2025. In Germany, the four transmission operators started buying inertia on 22 January 2026, with contracts of two to ten years. The European Union is preparing its rule. The Commission's draft connection code asks for grid-forming capability from new storage plants of 1 MW and above. The Commission consulted the public on the draft in summer 2026. It has given no date for adoption. After adoption, grid operators have up to three years to write the rule into national practice. So the obligation will bind new plants around 2029 at the earliest.

Several suppliers. In early 2024, at least eight manufacturers already offered grid-forming controls.

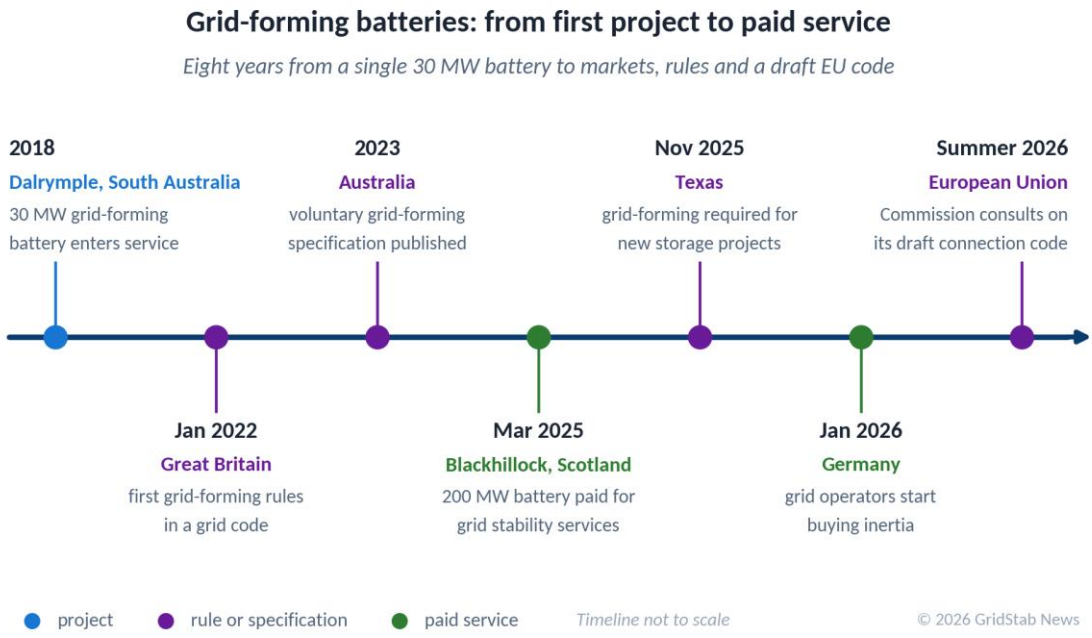


Figure 2.2. Main milestones for grid-forming batteries, 2018–2026.

Figure 2.2 puts these milestones in order. This is what TRL 9 looks like: several countries, several suppliers, paid contracts and real disturbances.

2.4 What is still open

Fault current that protection can trust. A spinning generator delivers several times its rated current into a short circuit. An inverter cannot. Its electronics limit the current to a value close to its rating. Is that enough for protection systems to work?

In July 2026, the Australian operator AEMO gave a careful answer. Grid-forming batteries have shown that they support the voltage waveform. They have not yet been confirmed to deliver "protection-

quality" fault current at scale. AEMO is preparing a trial on real equipment. It will check the size, the duration and the composition of the current.

This has real consequences. In New South Wales, Transgrid proposes 900 MW of grid-forming batteries in place of two planned synchronous condensers. That plan depends on the answer. This is not a failure of the technology. It is a proof that has not been delivered yet.

Certification. Germany's inertia market opened in January 2026. In early September, no inverter had yet been prequalified for it, according to Aurora Energy Research. The hardware exists, but the test route is new. And every region defines grid-forming in its own way. Great Britain, Australia, Germany, Texas and the EU each have their own text and their own tests. A manufacturer must prove the same behaviour several times.

Who pays. Grid-forming has a cost. The battery must keep some power and energy in reserve, and that reserve cannot be traded. Britain and Germany pay for the service. Texas requires it from new projects. One storage developer told the Texas operator that it could not support an unfunded mandate. Texas has since proposed a one-time payment for plants that the rule does not cover. The debate is open.

Behaviour at the limit. When an inverter reaches its current limit, it must stay stable and stay connected. Soon, hundreds of grid-forming units will run close to each other, and their controls must not disturb one another. The simulation models must also match the real equipment. European grid operators already include these points in their proposed compliance tests.

2.5 The scorecard

The job	Status today	Why
Hold the voltage steady	**Proven in service**	Shown by the operating fleets in Australia and Great Britain.
Slow down frequency changes (inertia)	**Proven and paid**	Under contract in Great Britain. Bought by grid operators in Germany since January 2026.
Feed current into a short circuit	**Partly proven**	Paid as short-circuit level in Great Britain. Not yet confirmed as good enough for protection in Australia.
Restart a dead grid	**Demonstrated**	Dalrymple has run a local network on its own. Larger trials are being prepared in Australia.

Table 2.1. Grid-forming batteries, job by job (GridStab News assessment, September 2026).

2.6 What to watch

- The results of AEMO's fault current trial.
- The first inverters prequalified for the German inertia market.
- Adoption of the EU connection code, which has no fixed date, and the guidance that follows.
- Transgrid's first system strength contracts with batteries, expected before the end of 2026.

KEY TAKEAWAYS

- Batteries are the most mature grid-forming technology today: TRL 9.
- The reason is simple. A battery has stored energy, power flows both ways, and the inverter can carry spare current.
- The proof is public. Britain pays for it. Australia runs a growing fleet. Germany buys inertia. Texas requires it, and the EU has a draft rule.
- Two points are still open: fault current that protection can rely on, and a clear route to certification.
- Neither is a flaw in the idea. Both are proofs still to be delivered.

Sources

[1] Zenobē announcement, reported by Solar Power Portal, 3 March 2025. *[Blackhillock commercial start; presented as first transmission-connected battery to deliver stability services to NESO]*

[2] SMA Solar Technology, press release, 6 March 2025; Zenobē, ESIG grid-forming workshop slides, 2026. *[370 MW·s and 116 MVA (SMA); 380 MW·s and 120 MVA contracted, and the 14 March 2025 event (owner's account)]*

[3] N. Modi, C. Mock (AEMO) and C. Christiansen (ARENA), "Australian Landscape of Grid-Forming Batteries", ESIG, August 2023. *[Dalrymple 2018 and its islanded operation; 230 MW in 2023; AEMO voluntary specification]*

[4] AEMO, 2025 Transition Plan for System Security and Connections Scorecard Q1 2026, reported by Energy-Storage.news, 5 December 2025 and 24 April 2026. *[ten grid-forming sites, 1,070 MW; 74% of a 33.2 GW battery pipeline]*

[5] Great Britain Grid Code modification GC0137, approved January 2022. *[first grid-forming specification in a grid code]*

[6] ERCOT NOGRR272 and PGRR121, approved by the Public Utility Commission of Texas, November 2025. *[applies to storage with interconnection agreements signed from 1 April 2026]*

[7] Netztransparenz.de and TransnetBW, market-based procurement of inertia (Momentanreserve); BNetzA determination BK6-23-010. *[start on 22 January 2026; contracts of two to ten years]*

[8] ENTSO-E, "Grid Forming Capability of Power Park Modules", Phase II report, final version of 3 October 2025. *[draft EU requirements and proposed tests]*

[9] ACER, recommendation on the amended network code on requirements for generators, December 2023; Grid Connection European Stakeholder Committee, minutes of the 37th and 38th meetings, 2025; Union Française de l'Électricité, reply to the European Commission's public consultation on the draft revised code, 31 August 2026. *[Commission: no adoption in 2025 and no date given; public consultation on the draft in summer 2026; the draft is a delegated regulation, so Parliament and Council have an objection period after adoption; up to three years for national implementation]*

[10] MISO, draft whitepaper on grid-forming battery performance requirements, July 2024. *[at least eight manufacturers with grid-forming controls, as presented at a UNIFI seminar in March 2024]*

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[12] Transgrid, "Meeting System Strength Requirements in NSW", July 2026; Energy-Storage.news, 16 July and 3 August 2026. *[900 MW pathway in place of two synchronous condensers; first battery services expected in 2026]*

[13] Energy-Storage.news, interview with Aurora Energy Research, early September 2026. *[no inverter prequalified yet for the German inertia product]*

[14] Plus Power, comments on NOGRR272 filed with ERCOT, 16 September 2025; Energy-Storage.news, 28 May 2026. *["unfunded mandate"; ERCOT's proposed one-time incentive programme]*

[15] RenewEconomy, 26 October 2025. *[AEMO transitional service trials, including black start from inverter-based plant]*

INSIDE THE FULL REPORT

Seven more technologies, the same method

Chapter 2 shows how each technology is examined. Two questions, the evidence, the open problems, a scorecard and a watch list. The full report applies the same method to seven more technologies.

Chapter 3 **STATCOMs.** Plenty of current, almost no energy. The first unit with supercapacitors was switched on in December 2025. Why two seconds of energy can imitate a large flywheel.

Chapter 4 **HVDC links.** Proven for years at forming offshore grids and restarting dead ones. Inertia for the onshore grid is a different story: the energy must come from the other end. Grid-forming at both ends of a link between two separate grids is still laboratory work.

Chapter 5 **Hybrid plants.** Solar or wind with a battery. The simple answer to how a solar plant becomes grid-forming, and what the pipeline in Australia already shows.

Chapter 6 **Wind turbines.** The energy is the rotor, so every phase jump becomes a torque step. What the one farm-scale trial showed, and why turbine makers stay cautious.

Chapter 7 **Solar PV.** Half of grid-forming, and only in daytime. Why a plant with no storage and no headroom can absorb but not give.

Chapter 8 **Data centres.** Two very different questions: a battery at the connection point, or the UPS itself. Why regulators are still one step earlier, on ride-through.

Chapter 9 **Electrolysers.** Can a load form a grid? Why the rectifier decides, and why power that flows one way limits what inertia can mean.

Closing **The benchmark and the watch list.** Synchronous condensers as the competitor to beat. One page that applies the two questions to every asset. What to watch in 2027.

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