Accelerating LDES Bankability

A Practical Framework for Overcoming Obstacles to Investment in Long Duration Energy Storage (LDES)

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Challenge and Overview

Long duration energy storage (LDES) is a critical component of future energy systems. It stores energy for when it is needed most, enabling high penetration of renewable generation, industrial decarbonisation and reliable, secure and affordable energy for consumers. LDES stores and dispatches energy as power, heat or cooling for extended periods ranging from 8 hours to days, weeks or seasons.

LDES is currently being deployed commercially on six continents across multiple technology types. However, it is not being deployed at the scale required to meet global and national decarbonisation, energy security and affordability goals. The LDES Council estimates that ~2 GW will be required by 2030 and up to 8 TW by 2040, implying a 50x scale-up from today's pace. A significant barrier is a lack of bankability.[1]

To understand the core issues around bankability, the LDES Council, in collaboration with Teneo, conducted two workshops in 2025, one in London and a second in New York City, with investors and technology providers to identify best practices for addressing bankability challenges.[2]

1. For the purposes of this effort, bankability of Long Duration Energy Storage (LDES) refers to the degree of confidence that financial institutions, investors, and project developers have in the ability of an LDES technology or project to generate reliable, predictable, and sufficient financial returns under operating, market, and regulatory conditions in a specific market or jurisdiction. This includes financing using non-recourse or limited-recourse debt (similar to mature renewable projects such as solar PV or wind) but encompasses additional funding mechanisms as well, as discussed below.
2. See the Appendix for a list of session participants.

The Value of the Workshops:

Understand the obstacles LDES companies and projects face in obtaining financing

Identify emerging best practices

Articulate actions stakeholders can take individually and through the LDES Council to address these obstacles

This report summarises the findings from these sessions. The discussions highlighted several key needs to make LDES bankable:

Business Model: The central role of business model choice for enabling investment. Investors don't finance technology; they finance predictable, long-term revenue, so LDES must be built on a bankable business model.

Capital Alignment: It is important to match project maturity and revenue certainty with the right capital, from early concessional funds to long-term debt.

Standards: Shared technical and commercial standards reduce uncertainty and information asymmetry and help build the investor confidence required to scale.

Market Signals: Markets and policy must explicitly value the resilience, flexibility and adequacy LDES provides.

Procurement: Long-term procurement or market mechanisms with guaranteed revenues are needed to de-risk investment.

Cost of Capital: Scaling LDES requires shifting from expensive venture equity to more affordable long-term debt and project finance.

Public Investment and Funding: Public finance institutions (regional, national, and multilateral) can play a critical catalytic role through the provision of grants, guarantees and financing for LDES.

Early-Stage Financing: Combining multiple financial and risk management tools, including insurance, supports earlier-stage financing.

Emerging Markets: Emerging markets often host highly ambitious conglomerates and regional champions willing to partially support LDES projects. Combining sovereign guarantees with multilateral finance and local co-investment can reduce political and credit risk while enabling rapid development.

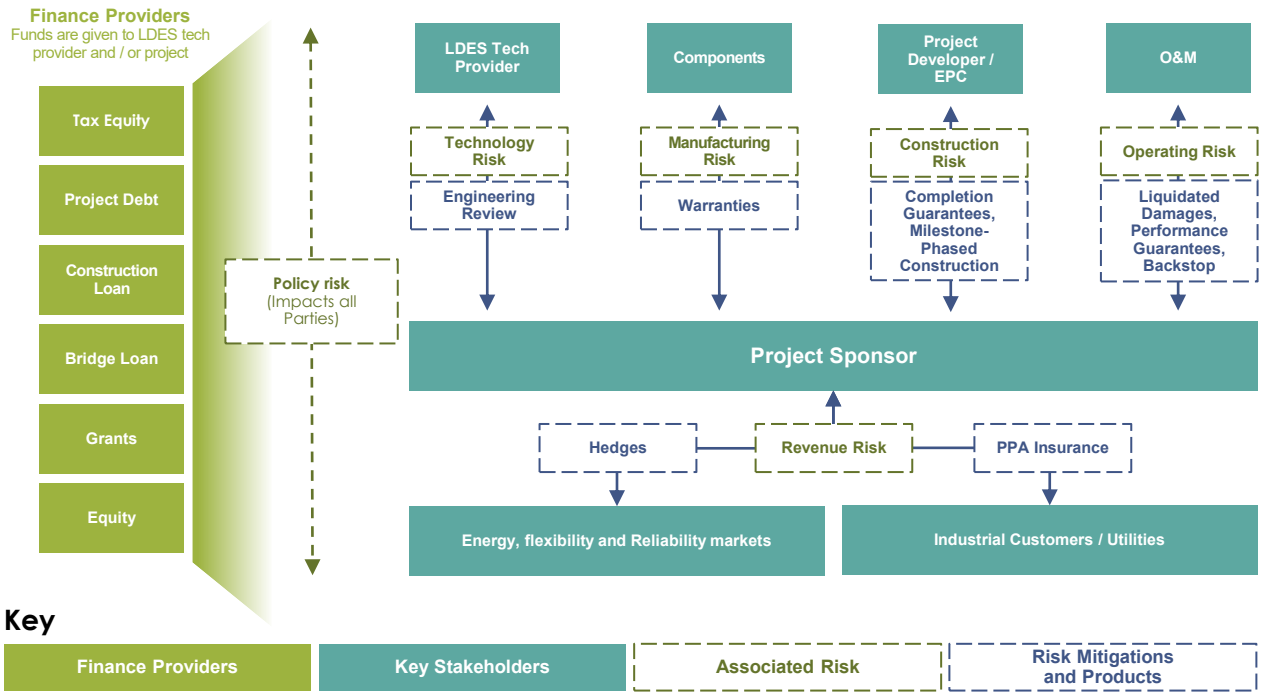
The report concludes with recommendations and a bankability assessment framework for industry. The LDES Council will work with members and partners to implement these recommendations and support the adoption of the checklist.

Understanding and Managing LDES Risks

Given its capital intensity, reducing the cost of capital for LDES is essential to lowering total cost of ownership and accelerating adoption. Lowering the cost of capital requires substituting expensive forms of capital with cheaper ones, which in turn requires mitigating key risks and allocating residual risks to investors willing to accept them.

LDES technology providers, developers and their investors must address key risks that depend on the maturity of a specific LDES technology and the use case under consideration. These risks generally fall into various categories, including revenue, technology, manufacturing, construction and operations. Effective tailoring of the mix and design of contracts with non-financial stakeholders to realistically reflect capabilities and the risk tolerances of different actors is a powerful route to reducing the residual risk facing potential LDES investors at both the project or enterprise level (see Figure 1).

FIGURE 1
LDES Project Stakeholders, Associated Risks, and Mitigants



Source: WSGR, Teneo research and analysis.

According to investors, LDES faces additional challenges due to technological diversity and, for many technologies, relative immaturity. This, combined with limited public subsidies and well-established revenue streams, limits transparency and market depth, increasing cost and complexity. Risks shift as technologies progress from R&D to full-scale commercial deployment (see Figure 2). New capabilities and risk mitigation measures are required to access cheaper forms of capital during the most perilous period for many companies, which is during the transition phases from one stage of maturity to the next. Location also matters; emerging-market partnerships require tailored structures. Multilateral lenders, sovereign guarantors and local developers can combine to address credit risk and accelerate deployment in high-growth regions.

Addressing Revenue Risk

LDES projects can access a wide variety of revenue sources, depending on use-case and location, with corresponding types of risks. Reliable revenue streams sufficient to cover costs are the single most important determinant of bankability of LDES projects and their companies, according to participants in both workshops.

Government subsidies can be critical for early-stage technologies like LDES. Credit support, tax incentives and policy mandates come in many forms. While often essential, subsidies need to be treated as temporary solutions, with line of sight to purely commercial viability of the LDES technology. For many investors, excessive reliance on politically vulnerable subsidies is an unacceptable risk.

Co-located use cases with long-term purchase agreements and creditworthy counterparties are typically the most attractive from a bankability standpoint. These projects benefit from predictable behind-the-meter savings—such as avoided demand charges or accelerated interconnection—and multi-stream value capture, often including heat-related output. However, contracts for heat-related outputs are typically bespoke and complex, making risks harder for lenders to assess.

Co-located projects often need liquidated damages provisions with offtakers. Standard tools for customers are operational key performance indicators (KPIs), covenants with defined Service Level Agreements (SLAs) and availability guarantees. Credit support via letters of credit are a standard tool for insulating project sponsors and their creditors from counterparty risk. Stabilisation clauses in long-term PPAs to manage tax or tariff changes are also common. Often, there is a mismatch between contract term and asset life; this may expose project sponsors to merchant risks or require renegotiation under less favourable terms.

The riskiness of LDES use cases relying on wholesale electricity markets can be reduced by contract features that emphasise reliability-related sources of value (e.g., contracts for capacity and resource adequacy or grid services). Use cases relying on highly volatile, merchant energy market revenue streams, like energy arbitrage and ancillary services, face the greatest risks. The level of risk and appropriate mix of hedges associated with merchant power market exposure naturally depends on the volatility and unpredictability of the relevant revenue streams, which in turn reflects:

The characteristics of the underlying generation supply – steepness of the supply curve, transmission constraints, reliability

Size and transparency of the market

Demand for electricity – load shape, volatility, predictability

The specifics of market design

The range and cost of risk management instruments available varies dramatically by region reflecting the maturity and depth of the relevant market. Most wholesale power markets employ various forms of physically-settled swaps or financial hedges and contracts for difference. The emergence of instruments such as the “cap-and-floor” contracts in the UK as well as longer-term capacity payment contracts are especially promising for LDES.

In more developed markets, LDES project sponsors often rely on third party specialists to manage unit dispatch, market operations, and associated risk management contract decisions, enabling them to choose whether to trade off higher cash flow uncertainty with the chance for revenue upside. Tolling arrangements, in which the project owner’s responsibilities and associated revenue streams are limited to ensuring an agreed level of asset reliability and efficiency, enable lower but more predictable revenues which are more attractive to investors and creditors offering lower cost of capital. These types of arrangements enable dispatch and trading decisions to reside with qualified and sufficiently capitalised market participants, while technology providers and Engineering, Procurement, and Construction (EPC) contractors take responsibility for availability and performance.

Addressing Technology, Construction and Operating Risks

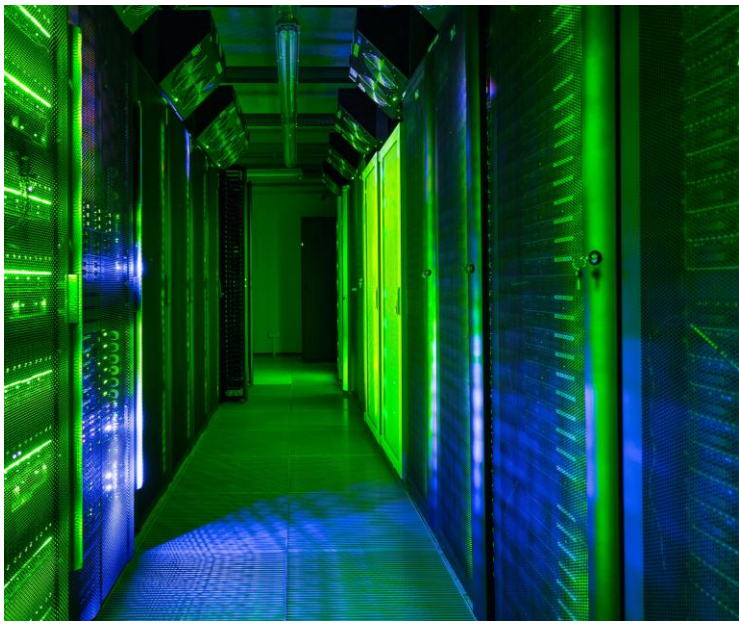
Engineering reviews, warranties and performance insurance products are especially important at lower technology readiness levels (TRLs). Confidence improves when prescriptive, technology-appropriate standards allow for comparability. Clear information on the design and operating parameters that matter most for returns is critical for novel LDES technologies. While these parameters share some basic similarities with those employed by lithium-ion, technology-specific measures for variables such as availability, efficiency, and test procedures are critical and remain to be fully developed and for many LDES technologies.

Credible engineering and performance data reduce the cost of insurance and re-insurance products. This can be accomplished through collaboration with peer-reviewed academic or public scientific bodies, sponsoring independent engineering reviews, or implicitly through being awarded subsidies from well-respected state research bodies, or investments by reputable suppliers or offtake agreements with sophisticated buyers.

As technologies mature, risk can be allocated to third parties. First-of-a-kind (FOAK) projects are most challenging. Full turnkey wraps[3] are prohibitively expensive without actuarial data. Instead, construction risk is managed through completion guarantees and performance security instruments (letters of credit, surety bonds) linked with construction milestones. Supply chain delays are handled through force majeure carve-outs. Collateral warranties tied to IP and equipment may be required by lenders.

A layered approach to risk allocation often includes:

- Technology provider warranties (with re-insurance where available)
- Relatively narrowly defined EPC obligations
- Performance-based insurance instruments for more mature components



More mature technologies are more likely to benefit from richer actuarial data, improving the transparency and predictability of equipment performance. This unlocks the potential to access more affordable performance guarantees, as well as a broader, more competitive range of service providers (especially EPCs) and suppliers to drive savings. Identifying reliable regional partners is important because local labour markets, permitting regimes, and grid conditions vary materially. While partnering with a small number of local suppliers creates strong incentives for investment in the specialised skills associated with a given LDES technology, non-exclusivity preserves competitive tension and increases exposure to a range of best practices from across different service providers.

Ultimately, nothing substitutes for an operational commercial project. Demonstrating commercial viability quickly and focusing on meaningful metrics such as cycles is essential. Avoid “death by testing” or perpetual prototyping.

3. A "full turnkey wrap" refers to a complete service where a vendor handles an entire project from concept to final installation and fulfilment, requiring virtually no effort from the customer once the initial agreement is made

Achieving LDES Bankability

Business Model

An overlooked source of risk mitigation is business model design, including how companies make money and which capabilities they keep in-house versus outsource.

During the transition from pilots to the first commercial project, LDES companies often develop and operate projects themselves, using their own balance sheets, staff and origination capabilities, supplemented by public grants or subsidies. As noted above, when available dedicated bilateral offtakes (including behind-the-meter (BTM) use cases) are especially attractive for earlier stage technology. Data centres and industrial heat users can anchor contracts through behind-the-meter savings or tolling structures. Their credit strength and operational urgency improve bankability compared to purely merchant grid plays.


Sumitomo


Kraftblock

Early-stage projects are typically most efficiently designed by internal engineering and procurement teams rather than third-party EPCs providing a more costly wrap.

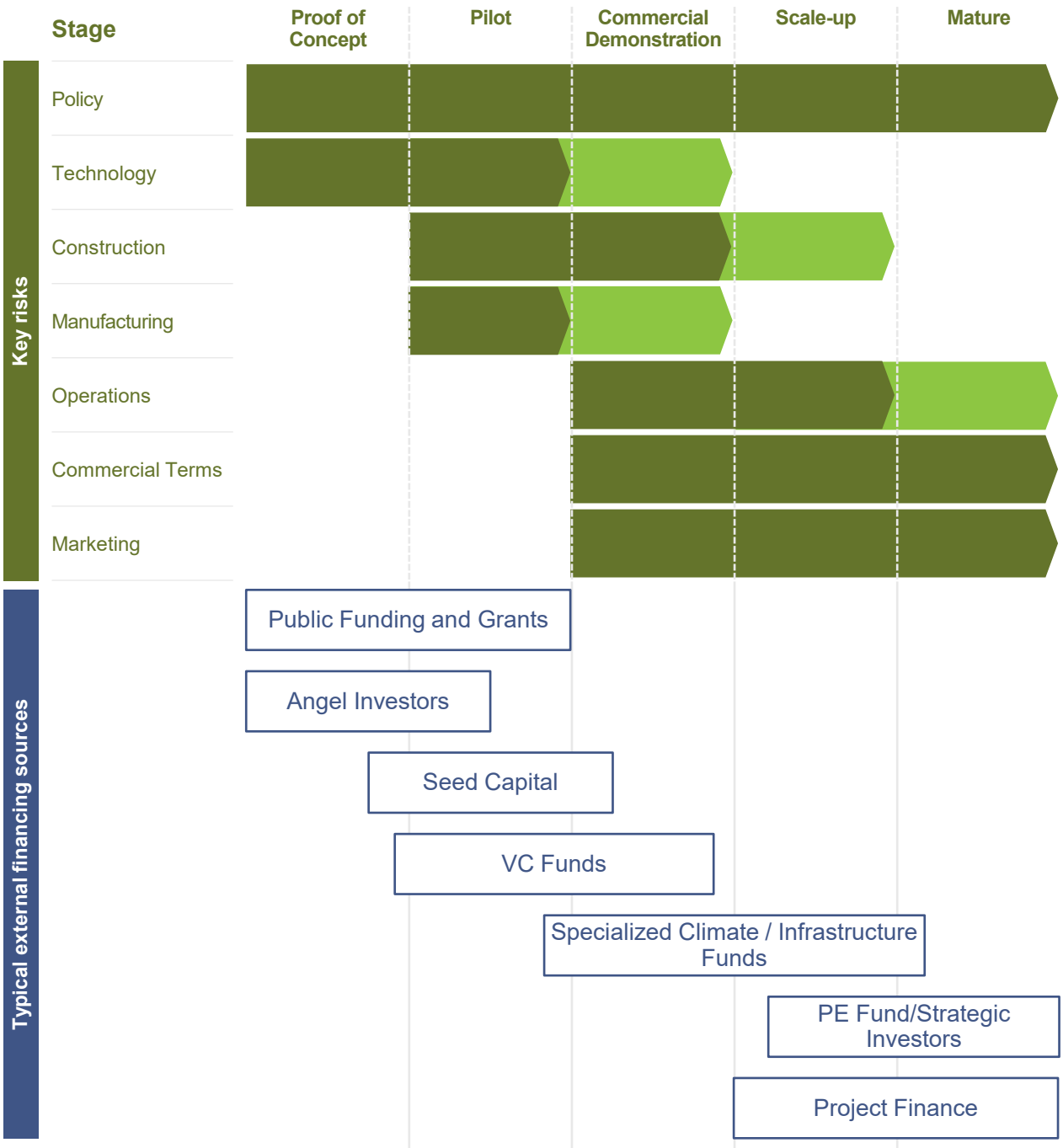
As technologies mature through several commercial projects, roles shift toward traditional power-project structures. Technology providers focus on more manufacturing and to a lesser extent, operations and maintenance, spare parts and licensing. They should generally exit project development and operation, which require different capabilities and capital. With commercial track records established, performance guarantees and insurance can be more economically priced. Project sponsors can employ non-recourse financing depending on revenue profiles.

LDES Financing Options

Selecting the right investor and instrument is critical for availability and affordability of financing. Most companies employ a blend of instruments at a given moment and over time, as they seek to minimise the cost of capital, maximise the net present value of residual cash flows to the owners, while accessing sufficient capital to achieve their growth objectives.

The mix of capital sources evolves with technology maturity, revenue mix and local capital market depth.

FIGURE 2
Technology Funding Lifecyle



Source: LDES Council, desk research, Pitchbook, Cleanteach Group i3

Earlier-Stage Capital

Lower-TRL LDES technologies rely heavily on grants and subsidies. Government-subsidised export financing is another common source for lower TRL LDES technologies. Outright grants, typically relatively small in size, usually target early-stage companies. Europe enjoys numerous, publicly supported funding sources available to LDES including EU-wide programmes for lower TRL technologies via the European Investment Council (EIC) Accelerator programme. There are also various programmes offering equity and quasi-equity support for early stage LDES technologies at regional (e.g., European Investment Bank) and country level.

In the United States, more sizeable loan guarantees provided by the US Department of Energy (DoE), along with investment tax credits, face policy uncertainty. However, many states like California offer a host of grants for early-stage energy technologies available to LDES.

Early-stage funding options also include family offices, foundations, venture capital investors and corporate venture groups. Venture credit providers have emerged for FOAK manufacturing or equipment financing, though they require easily monetised collateral and charge high interest rates.

LDES requires a distinctive set of investors to get enterprises and projects through the perilous valley of early-stage commercialisation. Like many energy technologies, LDES projects require heavy, hardware-driven capital investment and involve long timelines [typical of first-of-a-kind (FOAK) systems] and these challenges are often compounded by the slow approval processes common in utilities and other process industries. This profile doesn't align well with traditional venture capital, which favors fast-moving, capital-light bets that prove or fail quickly. It's also a poor fit for growth private equity, which generally prefers larger investments with low technology risk and near-term, positive EBITDA.

LDES technology sponsors thus need to tailor a very specific mix of different types of investors that appreciate the unique sources of value and risk represented by a given technology and use case. The resulting, quite heterogeneous mix of different classes of investors is seen in the capital tables of many leading LDES companies.

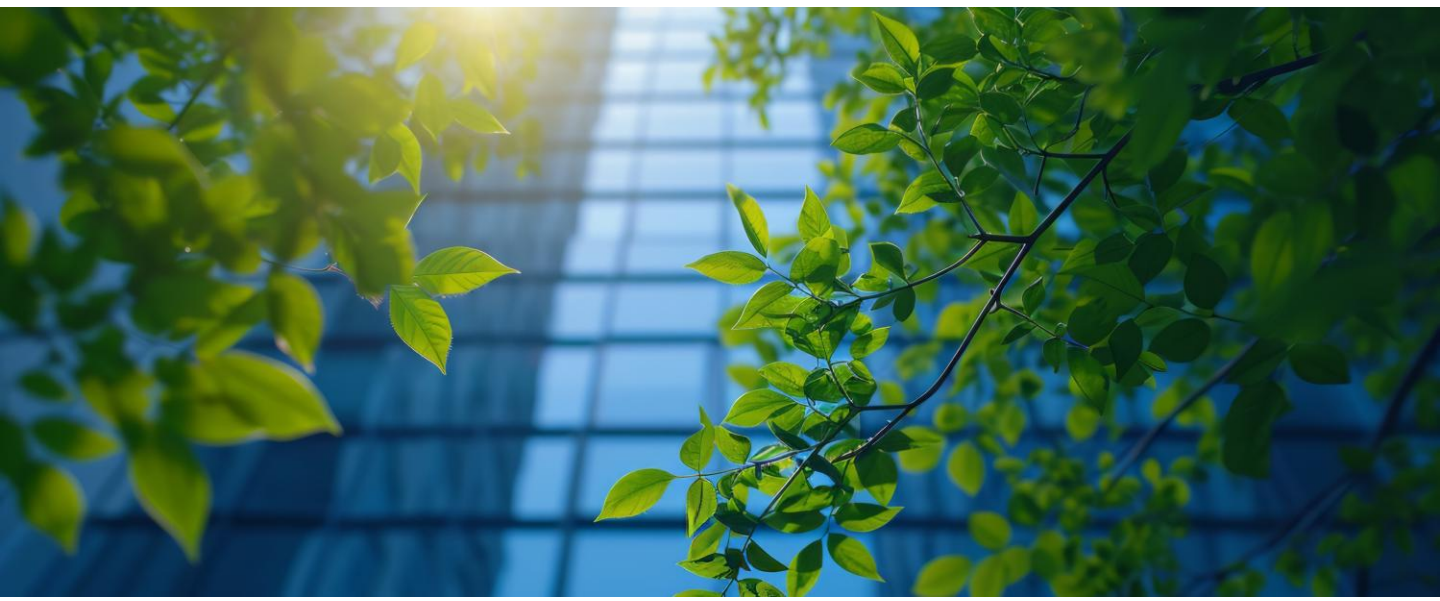


FIGURE 3
Investor Mix in Largest Recent Financial Raises of LDES Technology Providers[4]

Company	Description	Latest Round	Total Raised*	Funding Types	Key Investors
ANTORA	Developer of thermal batteries for industrial operations	2024	~$200M	VC / PE	Decarbonization Partners, Emerson Collective, GS Futures, Breakthrough Energy Ventures
ENERGY VAULT Enabling a Renewable World	Developer of gravity-based LDES and BESS	2025	~$788M	VC, SPAC / PIPE, Project Financing	SB Investment Advisers, SailingStone Capital, BlackRock
Form energy	Developer of iron-air battery up to 100 hours duration	2024	~$1.4B	Grants, VC / PE	Capricorn, Eni, Breakthrough, Macquarie, CPP Investments
Highview Power	Developer of liquid air energy storage	2024	~$580M	Grants, VC, Corporates	UK Infrastructure Bank, Centrica, Goldman
融科储能 RONGKE POWER	Developer of vanadium flow batteries	2023	~$145M	VC / PE	Legend Capital
HYDROSTOR	Developer of compressed air energy storage	2025	~$330M	VC / PE, Debt, Project Financing	Something Good Ventures, CPP, Goldman
MALTA	Developer of electro-thermal energy storage solutions	2024	~$100M	VC, Grants	Alfa Laval, Chevron Technology Ventures, Piva Capital

Strategic investors such as offtakers, utilities, data centres, industrial users and component suppliers are especially attractive. They often provide patient capital at favourable valuations and strong credibility signals.

4. Selection of companies was based on estimate of largest recent financings over the past three years. Desk research, including LDES Council, Pitchbook, S&P CapitalIQ, and Cleantech Group.

Later-Stage Capital

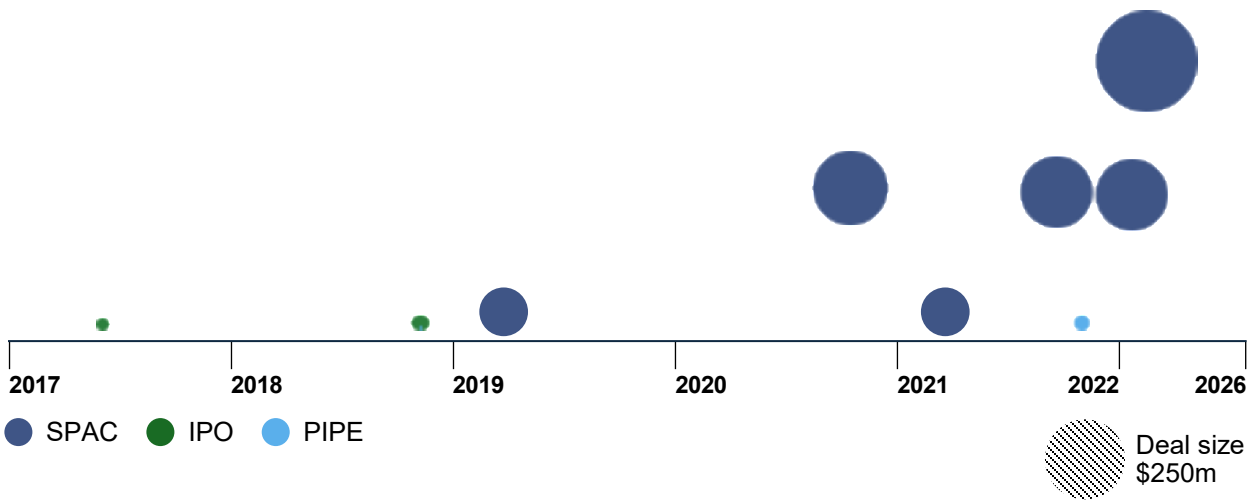
As developers move toward constructing commercial-scale projects and production facilities, a broader set of lower-cost capital providers becomes accessible. It is often at this stage that non-recourse project-level financing becomes available, including bank provided credit and, depending on the policy regime, tax equity investors. These investors are typically not willing to take technology risk and only varying degrees of operating and merchant risk, depending on their mandate and investors. On the other hand, they're often well equipped to:

- Provide access to best practice operational capabilities
- Leverage their sourcing power
- Make critical introductions to additional customers, investors, and key future employees

LDES investments also attract private equity and infrastructure investors, including pensions and insurers. Public market access through IPOs or Special Purchase Acquisition Companies (SPACs) has also been used. Public markets offer lower-cost, liquid capital but require regulatory scrutiny and dilute ownership.

It is also at this stage that LDES investments gain interest from large private equity and infrastructure investors, including pensions and insurance companies. Access to even larger pools of capital in public security markets – either through initial public offerings (IPO) or via SPACs – has been successfully pursued by a host of LDES companies over recent years. The trade-offs in participating in public equity markets are well known. They come down to the choice between often lower cost, more liquid, and practically unlimited capital on the one hand, versus expensive and time-consuming scrutiny by financial regulators and investor dilution.

FIGURE 4
Recent LDES IPO and SPAC transactions 2017-2025 ($M)[5]



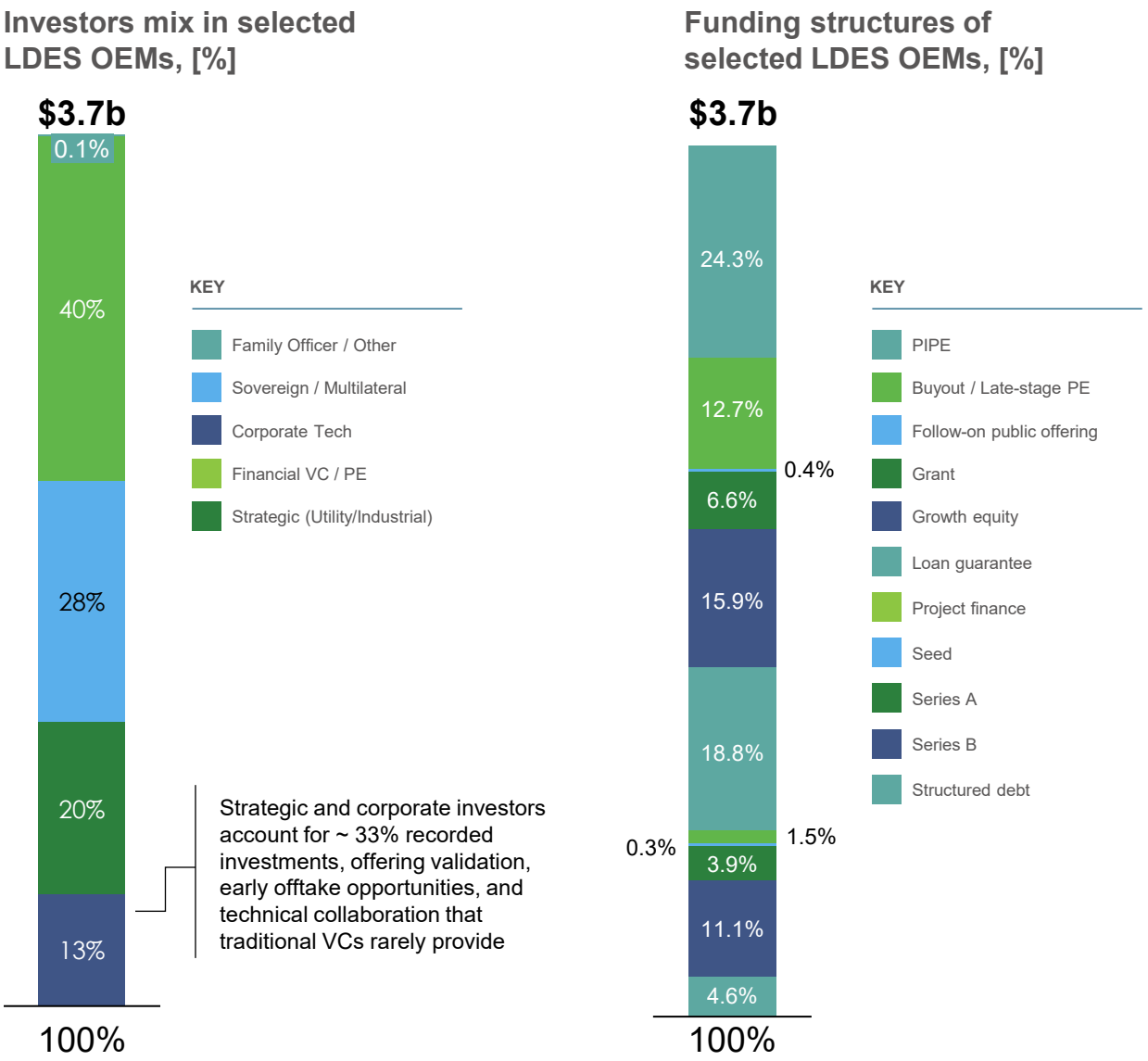
5. Desk research, LDES Council, including Pitchbook, S&P CapitalIQ, and Cleantech Group

Working capital and construction financing can provide liquidity before commercial operation, reducing the need for dilutive equity raises. Many LDES components are mature and “off the shelf,” enabling structured finance to collateralise equipment once risks are properly understood.

Emerging markets often present especially attractive use cases for LDES and oftentimes host highly ambitious conglomerates and regional champions willing to partially support LDES projects. It is important to note that emerging markets also present unique challenges for accessing capital given risks around legal, regulatory, and other typical emerging market risks. Combining sovereign guarantees with multilateral finance and local co-investment can reduce political and credit risk while enabling rapid deployment.

The funding mix among leading LDES companies shows a diverse investor base, with relatively low venture capital participation, significant sovereign and multilateral support and strong representation from private equity and PIPEs.

FIGURE 5
Investor Types and Funding Structures for Selected LDES Companies[6]



6. Strategic (Utility / Industrial) – Corporate investors such as utilities or manufacturers seeking technology access, offtake opportunities, and operational synergies, Financial VC / PE – Venture and private equity funds providing growth or buyout capital focused on financial return and scale-up, Sovereign / Multilateral – Government or international institutions offering grants, loans, or guarantees to advance energy-transition goals, Corporate Tech – Technology or industrial corporates investing to integrate innovation, secure supply chains, or meet sustainability targets, Family Office / Other High-net-worth, impact, or private investors funding early or niche opportunities with flexible mandates. Selected LDES technology providers: Form Energy, ESS Tech, Energy Vault, EOSE, HydroStor, Highview Power, Malta, Energy Dome, Invinity Energy Systems, Nostromo Energy, Ezinc. Source: Desk research, including Pitchbook, S&P CapitalIQ, Teneo and Cleantech Group

Recommendations to Achieve LDES Bankability

For Policymakers

1. **Develop targeted public financing instruments for LDES.** Policymakers should develop LDES-specific financing mechanisms taking into account the capital intensity, long development cycles, and uneven availability of commercial revenue sources for LDES, and avoiding exclusionary eligibility requirements e.g. overly rigid minimum project funding levels.[7] Public investment institutions focused on the energy transition should consider accepting sub-commercial returns to enhance bankability, and carving out a risk budget sufficient to absorb expected (first) losses and budget overruns typical of early stage technologies.

2. **Introduce public funding programmes that can play catalytic roles, by reducing risks and the levels of finance needed by investors** – such as the European Innovation Council Accelerator or Australian Renewable Energy Agency.

3. **Reform markets to reward flexibility and reliability, ensuring LDES is remunerated for the multiple benefits it provides to the system.** This includes the benefits of providing balancing, capacity, congestion management, system stability and reliability services over longer time periods.

4. **Drive demand by incentivising or supporting large energy users to adopt LDES.** Ensure transmission and distribution tariffs provide economically meaningful discounts for demand that avoids system peaks; accelerate grid connections for flexible demand including data centres; incorporate LDES in carbon reduction programmes (e.g., SDE++ in the Netherlands) and industrial heat decarbonisation strategies and grant programmes.

5. **Support LDES manufacturing with targeted subsidies rather than technology-agnostic measures that may favour already mature technologies.** Examples include carving out funds for LDES from traditional programmes focused on supply chain, manufacturing and initial capital expenditures, like production tax credits (PTC) for batteries.

6. **The development investment community should increase its focus on LDES and its financing needs.** Many emerging markets present distinctly attractive environments for LDES, but they often also require unique combinations of local (commercial and national development) banks, sovereign wealth funds, regional and local industrial groups, combined with multilateral and national development banks and foundations to make them investible.

7. See WG 3 ENERGY STORAGE (November 2023), WG Report N.8 – See this discussion for an analysis of the applicability of existing EU-based financial subsidy schemes for LDES.

For Investors

1. **Understand the nuances between novel and mature LDES technologies and components.** The TRL of different LDES technologies, but even more importantly that of their underlying components, is very diverse. In many cases, investors over-index on the technical and commercial maturity of the underlying LDES devices yet under-appreciate the more prosaic but still significant risks associated with construction and operating risk.

2. **Become part of a consortium.** While co-investment can complicate project or enterprise governance, LDES technologies often provide opportunities for a variety of strategic players (offtakers, component and service providers), along with investors seeking exposure to different types of risk, to come together in funding LDES companies over the different stages of their development.

3. **Collaborate with complementary capital providers.** LDES projects can feature multiple providers of capital and risk management, including insurance, reinsurance, and guarantors. A diverse set of investors can reduce overall enterprise and project risk by balancing risk tolerance, mitigation capabilities, and investment cadence, as long as governance complexity can be effectively managed.

4. **Work with the sponsor to structure a portfolio of risk management instruments to address potential gaps in coverage.** This could include backing up performance guarantees or liquidated damage clauses with insurance products or building in some tolerance/guardrails in performance specifications. This will evolve with technology maturity and vary by use case and geography. Investors can provide critical financial expertise to LDES technology providers.

5. **Ensure the investment financial plan allocates sufficient funds to support demonstration projects**. There really is no substitute for an operating, commercial scale project or manufacturing facility. Investors should be ready to underwrite obtaining a sufficient level of operating hours and performance data required to satisfy warranty/guarantees of the technology, including ample contingencies for operating delays.

For the Broader LDES Sector

1. **Establish technical and commercial standards.** Groups of industry LDES technology companies, service providers including EPCs, insurance companies, attorneys, governments, multilateral agencies and investors have an essential role in drafting and making available bodies of information critical for allocating capital. This information includes standardised approaches to activities or technical parameters that developers and potential investors will need to reduce transaction costs, risk, and delays. But as with many types of public network goods, it often takes intentional collective action or the intervention of public actors to provide them. The most critical items include:

- Technology – The availability of shared definitions, technical parameters, best practice procedures and designs saves time, enables coordination across nascent supply chains, and enables investors to better quantify risks so that they can confidently price insurance-like instruments. Some examples include:

- Technology Readiness Level (TRL) to Manufacturing Readiness Level metrics and stage gates tied to financing readiness (test hours, failure-mode coverage)
- "Play book" and performance standards for demonstrating TRLs
- Standardised factory and site acceptance testing protocols
- Shared actuarial datasets, jointly developed with insurers and independent evaluators to lower project "wrap" and insurance costs
- Standardised Balance of Plant and interface designs to reduce EPC variability and improve schedule confidence

- Commercial and financial – Just as in the case of technical standards and shared procedures, aligning on shared definitions and templates for legal and commercial agreements reduces uncertainty, legal and accounting fees, and delays. The development of specialised, detailed, and common contractual terms that clarify how risks associated with LDES project construction and operations should be addressed is especially critical to make it easier for LDES projects to provide the insurance-like protection that creditors often require. Some examples include:
  - Clause library covering performance metrics, test protocols, cure periods, liquidated damages caps and related specialised contractual terms aligned to LDES technologies
  - Back-to-back guarantee structures connecting technology provider warranties, EPC obligations, and insurance to close gaps over long service lives
  - Risk management products fit for purpose for typical LDES projects, preferably developed alongside insurance providers and underwriters
  - Modular guarantee menus (surety bonds, performance insurance, LD coverage) priced by risk layer and project phase
  - Publicly accessible, archetypal contracts for industrial heat PPAs, data centre Uninterrupted Power Supply replacement, and grid-connected resource adequacy services.

2. **Develop communication and education tools for investors and policymakers**. The highly technical and novel nature of LDES technologies makes it challenging for policymakers and investors to grasp the range of benefits it provides. The diversity of LDES technologies creates additional complexity. A clear, common message is important to gain the policy support and investor attention the sector needs and deserves.

3. **Facilitate connections** to reduce search costs for LDES technology providers, developers, investors (including credit, equity, grants, etc.), insurance providers and other relevant service providers.

For LDES Technology Providers

1. **Get the first-of-a-kind (FOAK) project built and rigorously tested.** There is no substitute for hard, empirical performance data from an actual project. Resist allocating management time and resources to non-critical engineering enhancements.

2. **Invest in and develop robust performance data.** Uncertainty over real-life cost and performance data is a critical barrier to accessing affordable capital and insurance for LDES. And the diversity of LDES technologies limits companies' ability to rely on industry-wide standards and actuarial data. So, LDES technology providers should plan on working with well-regarded third parties and focus on the most critical performance proof-points that future investors will require.

3. **Plan to invest significant time competing for and administering grants and concessional financing from public sources.** A wide variety of concessional state, provincial, federal, and multilateral financing is available, employing an increasingly diverse set of financial instruments (including non-dilutive quasi-equity and structured finance tools).

4. **Diversify finance sources, for example blending public grants, strategic investors and concessional debt.** Many LDES technologies' risks and capital needs are not ideally suited to traditional venture capital and private equity mandates. And total reliance on a single set of policy or strategic investors can expose LDES companies to potentially catastrophic binary risk or constrain future development options. This means LDES leadership teams need to proactively cultivate relationships with a variety of potential investors and creditors, not limiting themselves to opportunistic introductions. Expect to devote substantial time, and internal/external resources, to ongoing investor communication.

5. **Consider the investor's perspective.** Regardless of the stage of technical maturity or national setting, understanding and addressing investors' concerns is key. LDES technology companies and project developers must clearly describe the relevant revenue sources and viable paths to free cash flow generation and/or exits to public markets or private investors.

6. **Define milestones for the evolution of the operating model.** The operating model will likely need to change over the course of a company's development. Define clear metrics as to the circumstances when to start preparing for operating model changes to get a head start on accessing the required capabilities and expertise. Establishing these milestones can also provide sufficient lead time to raise new types of capital better suited to the new set of risks and rewards available to future investors.

7. **Align early with partners.** Projects advance faster when technology providers, EPCs, insurers, developers and off takers align early on roles, guarantees and risk allocation. Coordinating diligence efforts across all interested investors reduces transaction costs and timeline risk.

Bankability Assessment Checklist for Funders of LDES

We present a structured framework that reflects how investors, lenders and independent advisors evaluate the bankability of long duration energy storage (LDES) projects. The framework builds on the findings from two 2025 workshops (one in London, one in New York City) conducted by the LDES Council and consulting firm Teneo with investors, technology providers and LDES developers, and synthesises methodologies used by financial institutions, multilaterals and technical advisors (e.g., DNV, BloombergNEF, and IEA).

The framework can be grouped into five key pillars, each containing specific evaluation criteria and checklists that investors and lenders typically apply.

Technology and Technical Maturity 1

Sub-Criterion	What Investors Seek	Checklist Questions
Technology Readiness Level (TRL)	TRL 8–9 (commercially deployed, not just demonstrated)	• Has the technology achieved multi-year operational performance at commercial scale? • Are there multiple suppliers or is it single-source dependent?
Performance Validation	Independently verified performance metrics (round-trip efficiency, degradation, cycle life, response time, safety)	• Has the system undergone 3rd-party testing or independent engineer (IE) review? • Is there a performance warranty backed by the vendor?
Operational Track Record	Proven reliability and availability data	• Are there at least 2–3 years of operational data under similar duty cycles? • How many full-scale systems are currently in operation?
System Integration and Controls	Proven control systems and grid interface	• If grid-connected, is the energy management system (EMS) interoperable with grid standards? • Has the technology demonstrated safe and stable grid interaction?

Commercial Maturity and Vendor Strength 2

Sub-Criterion	What Investors Seek		Checklist Questions
Supplier Financial Strength	Vendor solvency and ability to honour warranties		• What is the supplier's credit rating or financial standing? • Does the supplier have a history of successful project (or product, if relevant) delivery?
Manufacturing Capacity and Supply Chain	Scalable, reliable manufacturing		• Are supply chains diversified and resilient? • Are critical components readily available?
Warranty and Service Agreements	Strong, enforceable warranties		• Is the performance warranty backed by a highly credit-worthy company's (technology provider, EPC) guarantee or insurance? • Does the O&M agreement cover spare parts and replacement cycles?

Market and Revenue Model 3

Sub-Criterion	What Investors Seek	Checklist Questions
Revenue Certainty	Predictable, long-term cash flows	• Are there long-term capacity, resource adequacy, tolling, Power or Steam Purchase Agreement (PPA, SPA), or equivalents? • Is the term of the revenue sources comparable to that of the project? • Are revenue streams relatively robust, predictable?
Market Access and Policy Stability	Clear regulatory frameworks for storage	• Does the market recognize LDES as a distinct asset class, with specific mandates, subsidies, guaranteed returns or revenue streams? • Are there transparent rules for participation in wholesale and capacity markets and revenue stacking across markets, if applicable?
Counterparty Risk	Creditworthiness of off takers	• Are offtakers investment-grade? • Are there take-or-pay or availability-based contracts in place?

Project Structure and Risk Allocation 4

Sub-Criterion	What Investors Seek	Checklist Questions
Project Contracting	Robust EPC and O&M contracts	• Is there a turnkey EPC contract with clear performance guarantees? If not, are there sufficient guarantees, insurance products, equity participation of highly creditworthy companies to serve as a substitute? • Are liquidated damages specified for delays or underperformance?
Risk Allocation	Clear assignment of technical, financial and operational risks	• Is the party that bears the technology performance risk able to make good on potential claims? • Is there adequate insurance coverage (construction, operation, business interruption)?
Independent Due Diligence	Independent Engineer (IE) reports and lender's technical advisor reviews	• Has an IE issued a positive opinion on technical readiness and financial viability? • Are environmental and permitting risks addressed?

Financial and Economic Viability 5

Sub-Criterion	What Investors Seek	Checklist Questions
Cost Competitiveness	Transparent, benchmarked costs	• Are CapEx and O&M costs aligned with market benchmarks for (use case) comparable technologies? • How do costs, availability and capacity evolve with cycles / age?
Levelized Cost of Storage (LCOS) **or Heat** (LCOH)	Competitive economics under realistic assumptions	• Is LCOS or LCOH below or near competing options for the use case? • How sensitive is LCOS or LCOH to utilisation, round trip efficiency, availability, CapEx and O&M variances?
Debt Service Coverage Ratio (DSCR)	Stable cash flows to cover debt obligations	Do financial models maintain DSCR >1.2–1.3x under base and downside cases for projects with fully contracted revenue, or 1.8 – 2.2 for merchant projects?
Sensitivity and Scenario Analyses	Resilience of project economics	Have stress tests been performed for low market prices, high maintenance or shorter life?

Supplementary Evaluation Tools

Tool / Source	Purpose
Independent Engineer (IE) **Report**	Technical validation, performance assumptions, degradation model review
Bankability Certification	Standardized technology risk assessment and data verification performed by companies like DNV, Black & Veatch, Technical Inspection Association (TÜV), etc.
Life-Cycle Assessment (LCA)	Environmental impact verification, ESG compliance
Insurance and Warranty Review	Verification of claims supportability and coverage scope
Financial Model Audit	Verification of modelling assumptions and sensitivities

Bankability Scoring or Rating (Indicative Example)

Category	Weight	Score Range
Technology Maturity	25%	1-5
Commercial Track Record	20%	1-5
Market & Revenue	25%	1-5
Project Structure	15%	1-5
Financial Viability	15%	1-5
Weighted Average ≥ 3.5 → Generally "Bankable"		

If a project going through this checklist process receives a score of 3.5 or greater, it can be considered "bankable."

Appendix

Glossary of Commercial and Technical Terms

Actuarial Data
Historical performance data used to price risk and determine warranty or insurance costs.

Availability Guarantee
A contractual assurance that an asset will be operational for a minimum percentage of time.

Bankability
The degree to which a project provides sufficiently predictable revenue and risk mitigation to attract investment.

Behind-the-Meter (BTM)
Energy assets located on the customer side of the meter that deliver on-site savings or operational benefits.

Cap-and-Floor Contract
A mechanism guaranteeing minimum and maximum revenue levels to limit downside and upside risk.

Capacity Payments
Revenue paid for ensuring availability of energy or grid services regardless of dispatch.

CFD (Contract for Difference)
A hedge that stabilizes revenues by settling differences between market and strike prices.

Collateral Warranty
A legal agreement giving lenders recourse to technology providers or equipment in case of failure.

Commercial Viability
The ability of a technology or project to generate sustainable, market-based revenues without subsidy.

Concessional Financing
Below-market-rate capital intended to catalyze early-stage or high-risk projects.

Construction Risk
The risk of delays, cost overruns or failures during the building of a project.

Credit Support
Financial protections such as letters of credit or guarantees to reduce counterparty default risk.

EPC (Engineering, Procurement & Construction)
A contract structure where a contractor designs, procures, and builds a project.

FOAK (First-of-a-Kind)
The initial commercial-scale implementation of a technology with elevated risk.

Insurance Wrap
A layered set of insurance instruments covering performance, construction and operational risks.

LDs (Liquidated Damages)
Pre-agreed penalties paid when performance or delivery obligations are not met.

Manufacturing Readiness Level
A measure of how prepared a technology is for scaled manufacturing.

Merchant Risk
Exposure to volatile, market-based revenues instead of contracted offtakes.

Non-Recourse Financing
A project financing method in which lenders rely primarily on project cash flows for repayment.

Offtake Agreement
A long-term contract committing a buyer to purchase the output of a project.

Operational Risk
The risk of performance degradation, failures or cost increases during ongoing operations.

Performance Guarantee
A contractual commitment that equipment will meet specified performance metrics.

Pipe (Private Investment in Public Equity)
An investment structure allowing institutions to buy shares of a public company at negotiated terms.

Project Finance
A financing method where a project's assets and cash flows serve as collateral.

Quasi-Equity
Hybrid instruments such as convertibles or subordinated debt used in early-stage financing.

Revenue Risk
Uncertainty regarding whether a project's revenues will be adequate and reliable.

Service Level Agreement (SLA)
A contract defining performance metrics, responsibilities and remedies.

Sovereign Guarantee
A government-backed commitment reducing political and credit risks in emerging markets.

Structured Finance
Customized financing combining debt, guarantees and insurance to allocate risk.

Technology Readiness Level (TRL)
A classification measuring technology maturity from concept to commercial deployment.

Tolling Agreement
A structure where an asset is operated for a fee while market participation is handled by another party.

Working Capital Financing
Short-term credit secured by receivables or inventory to support operations.

Additional Useful Resources

African Development Bank. (2023). *Energy Storage Finance and Risk Mitigation in African Markets.* AfDB.

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Workshop Participants

AEDENERGY
ECHOGEN power systems
MUBADALA
amazon
EXOWATT
NEOM نيوم
ANTORA
e-zinc
noon ENERGY
APRICUM
Generate.
Ørsted
ARA
GIIA Global Infrastructure Investor Association
PANTOKRATOR A better way
At One Ventures
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Gresham House Specialist investment
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