ESMAP
Energy Sector Management Assistance Program

WORLD BANK GROUP

ESMAP WEBINAR
REPORT LAUNCH

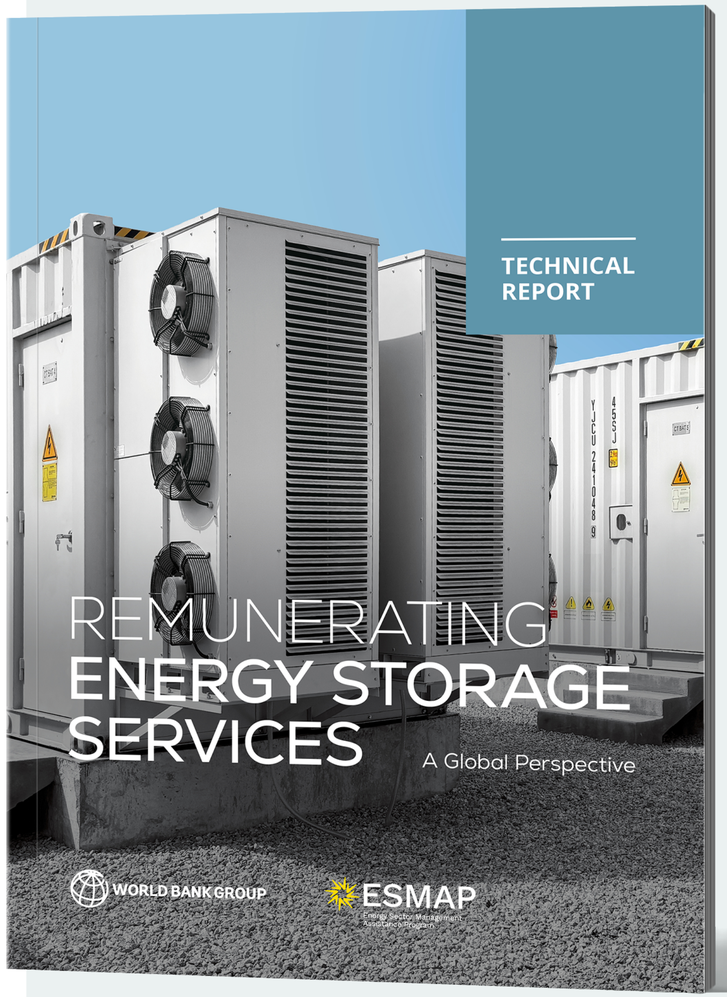
ENERGY STORAGE AT SCALE

Insights from Global Regulatory Practice and World Bank Group Operations

TIME 8:00 am – 9:30 pm EST

DATE October 22, 2026

PRESENTERS Xiaoping Wang and Huong Mai Nguyen


TECHNICAL REPORT
REMUNERATING ENERGY STORAGE SERVICES
A Global Perspective
WORLD BANK GROUP
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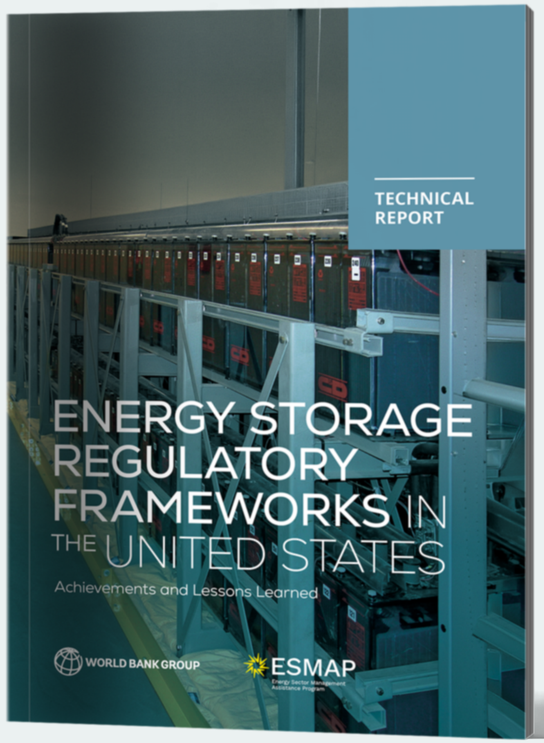
TECHNICAL REPORT
ENERGY STORAGE REGULATORY FRAMEWORKS IN THE UNITED STATES
Achievements and Lessons Learned
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ENERGY STORAG
REGULATORY FRAMEWORKS
Country Case Studies
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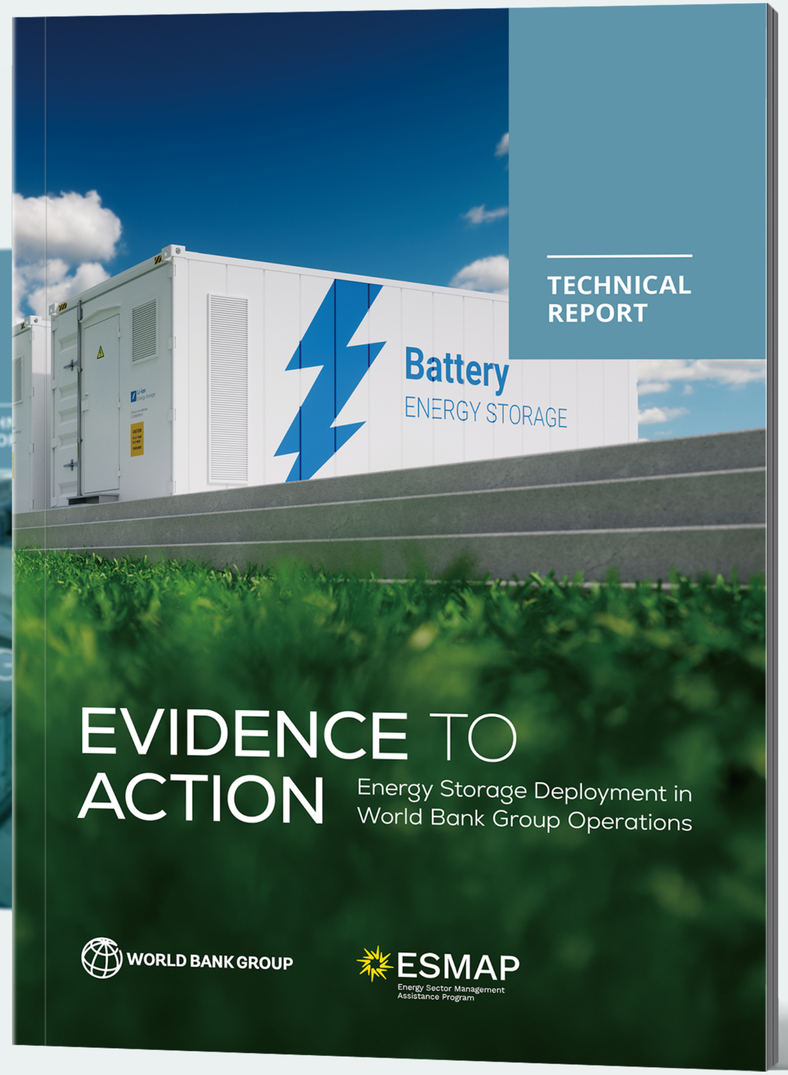
TECHNICAL REPORT
Battery
ENERGY STORAGE
EVIDENCE TO ACTION
Energy Storage Deployment in World Bank Group Operations
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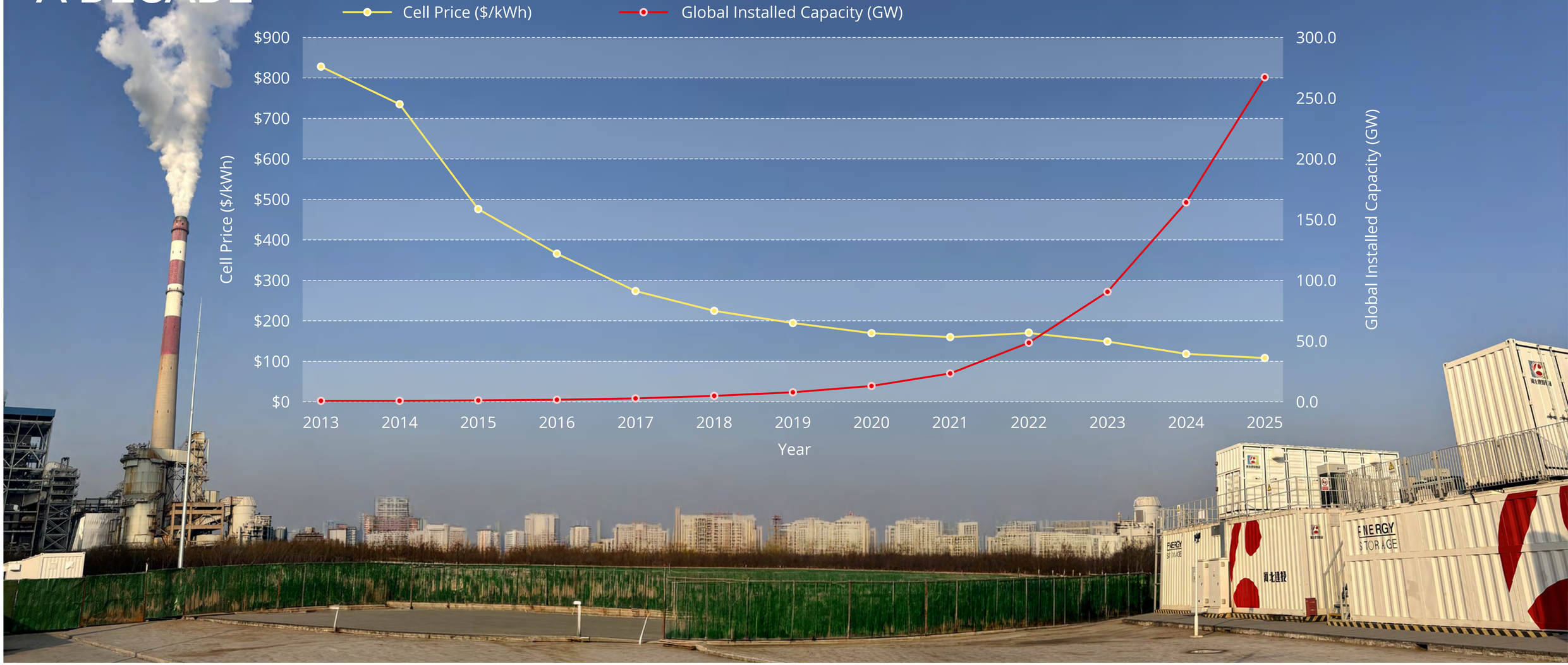
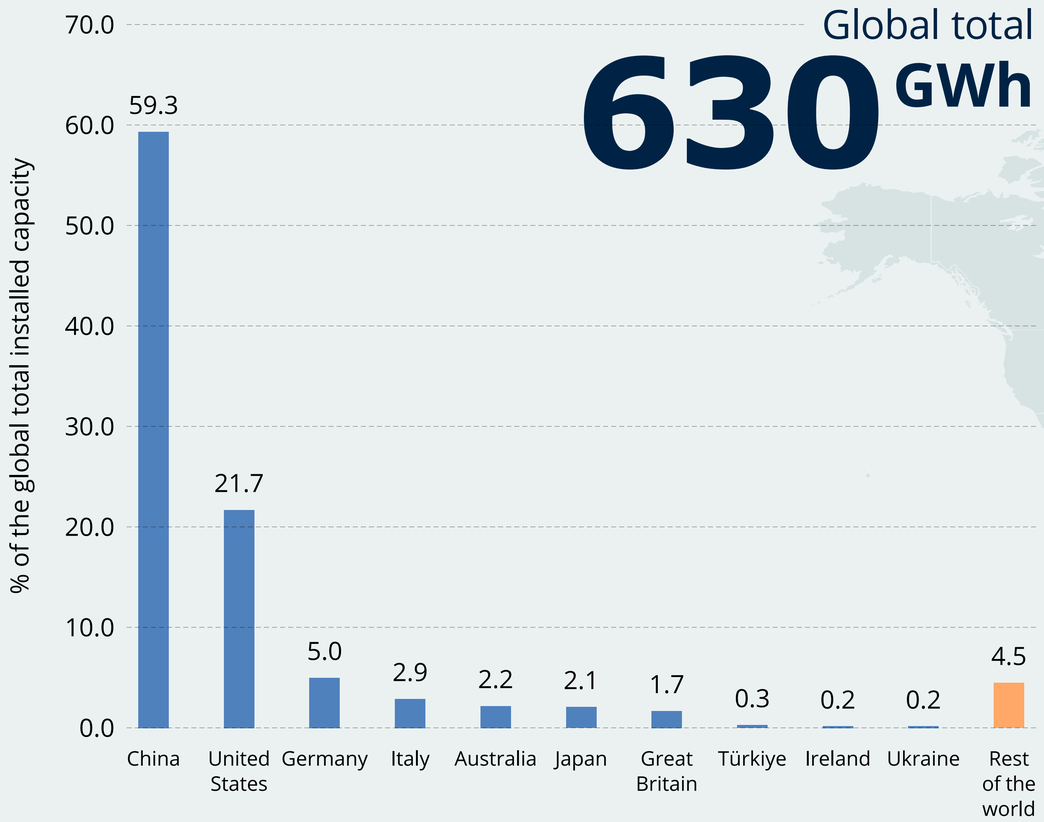
A 90% DROP IN BATTERY COSTS AND AN EXPONENTIAL GROWTH IN INSTALLATIONS IN A DECADE

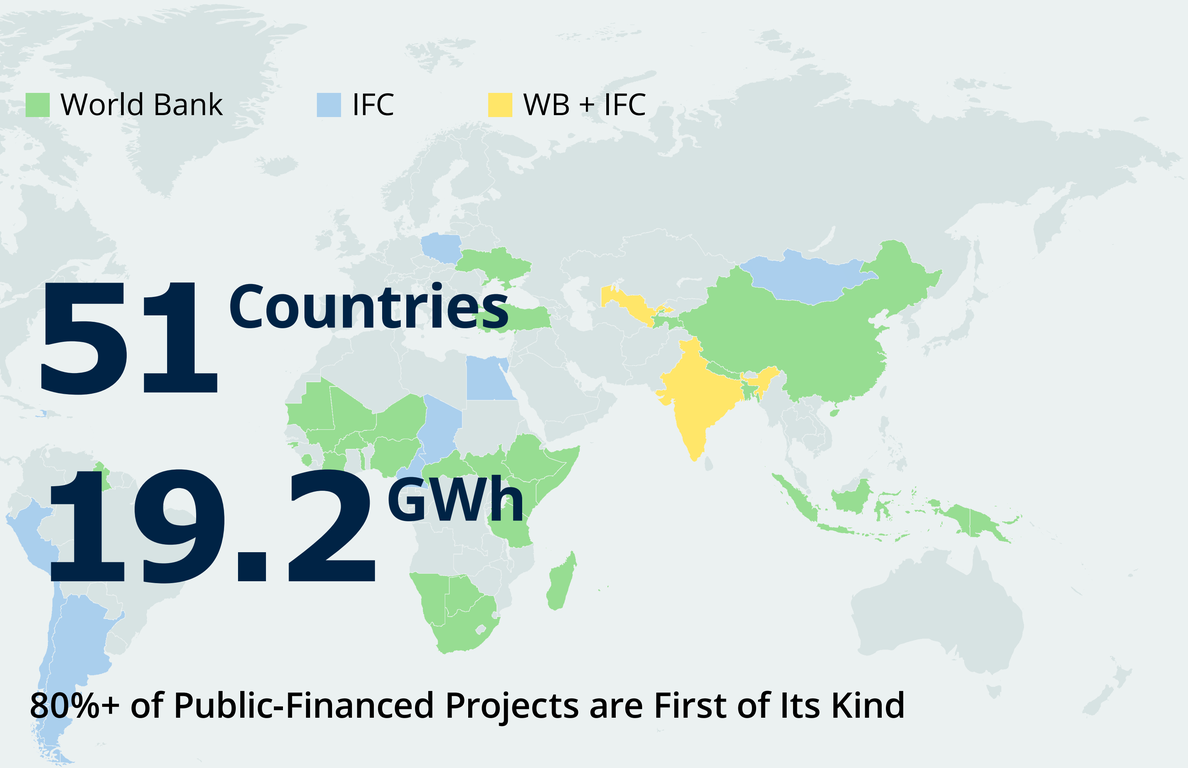


ENERGY STORGE COUNTRY LEADERS AND THE REST OF WORLD

% of Global Total Installed Capacity by Country



World Bank Group Investments in Energy Storage



80%+ of Public-Financed Projects are First of Its Kind

ENERGY STORAGE POLICY AND REGULATORY MEASURES IN SELECT COUNTRIES SURVEYED

		ITALY	AUSTRALIA	GREAT BRITAIN	IRELAND	JAPAN	UKRAINE	GERMANY	TÜRKİYE
Market	**Day-Ahead market exists**	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
	Intra-Day market exists	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes /
	Real-Time/Balancing market exists	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Ancillary services market	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Storage eligible for ancillary market	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Procurement	**Capacity/Adequacy mechanism**	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
	Local/DSO flexibility procurement	Limited	Trials	Individual Markets	Yes	No	Limited	No	No
Policy	**Storage legal status**	Dual-use	Dual-use	Generation	Dual-use	Generation	Sui generis	Sui generis	Sui generis
	Double-charging (network/use-of-system)	No	No	No	Partially removed	No	No	Partially removed	Exists
	Aggregation/VPP access	Allowed	Allowed	Allowed	Allowed	Allowed	Allowed	Allowed	Allowed
	Long-Duration Energy Storage (>8h) policy instrument	Tender	Tenders and grants	Cap & Floor Scheme	Tender	Tender / LTDA	None	Tender	None

REMUNERATION MECHANISMS

KEY SUCCESS FACTOR #1

Adequate remuneration is key to the sustainability of energy storage investments

In COMPETITIVE MARKETS

- Enable storage to earn energy, capacity and ancillary-service revenues.
- Allow compatible revenue stacking, with coordinated dispatch and metering to avoid double compensation.
- Use long-term underwriting where needed to reduce revenue risk.

Australia

The Capacity Investment Scheme underwrites revenues for 10–15 years.

In VERTICALLY INTEGRATED SYSTEMS

- Benchmark compensation to avoided system costs, such as deferred network investment or reduced curtailment.
- Use regulated cost recovery or competitive, long-term service contracts.
- Specify capacity, duration, availability and performance obligations.

Brazil

Regulated auction purchase costs pass through to distribution tariffs.

INTEGRATED RESOURCE PLANNING

KEY SUCCESS FACTOR #2

A quantified storage need gives investors a credible demand signal

SYSTEM NEEDS

Evaluate storage against generation and network alternatives. Quantify flexibility and firm capacity needs by duration.

LEAST-COST DESIGN

Optimize storage location, size and quantity through system studies, including frequency support, reserves and congestion relief.

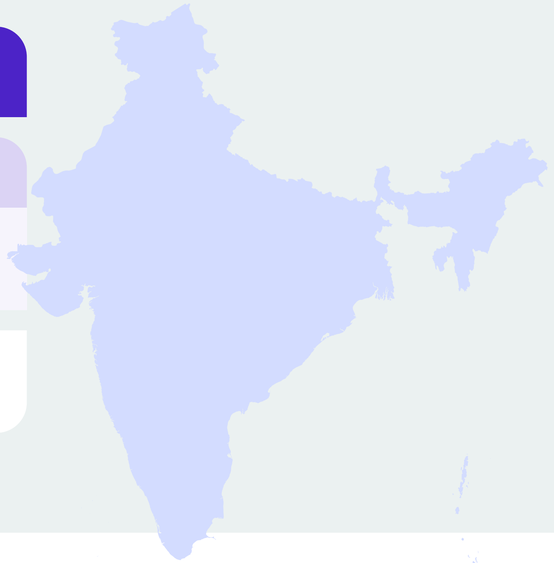
ROADMAP AND PROCUREMENT

Translate the results into national targets and competitive procurement that specify the required storage capability.

EXAMPLES

California	India
Storage forms part of integrated resource planning.	Energy storage obligations create predictable demand for utilities.

Design caution
Targets need compensation rules to support actual utilization.



CLEAR LEGAL DEFINITION OF STORAGE

KEY SUCCESS FACTOR #3

Storage needs rules that recognize both charging and discharging

BARRIER	REGULATORY RESPONSE
Legacy asset categories	Define storage's dual role and clarify licensing and ownership rules.
Double charging of cycled energy	Treat charging for resale as wholesale use and remove duplicative network charges and final-consumption levies.
Restricted participation	Align market eligibility and tariffs so storage can provide compatible services without discriminatory treatment.

EXAMPLES

EU rules address duplicative network charges.

UK reforms remove final-consumption levies on storage imports.

INTERCONNECTION, PERMITTING, SAFETY AND TARGETED FISCAL INCENTIVES

KEY SUCCESS FACTOR #4

Clear approval rules and targeted support reduce early-project risks

CONNECTION, PERMITTING AND SAFETY

- Standardize connection requirements, queue milestones and transparent curtailment rules.
- Set storage-specific siting, fire safety and emergency response requirements.
- Include cybersecurity, environmental safeguards and decommissioning plans.

EXAMPLES

UK queue reforms and US NFPA 855 safety requirements

TARGETED FISCAL INCENTIVES

- Use duty or VAT relief, tax credits, accelerated depreciation and targeted grants to reduce upfront costs.
- Pair early-project support with concessional finance where needed.
- Apply performance conditions, competitive allocation and sunset clauses.

EXAMPLES

India's Viability Gap Funding and Brazil's tax relief for BESS

ALL STAKEHOLDERS MUST BE AT THE TABLE

KEY STAKEHOLDERS

SYSTEM PLANNERS

Assess different use cases in which energy storage can reduce overall system costs

ENERGY MINISTRIES

Articulate an overall national energy storage strategy within broader energy policy goals

PERMITTING ENTITIES

Learn from best practice; consolidate required permits into a ‘one-stop shop’ approach

REGULATORS

Proactively update regulations to remove barriers and enable fair remuneration of all storage services

SYSTEM OPERATORS

Balance security-of-supply obligations with recognition of storage’s future contribution to meeting system needs

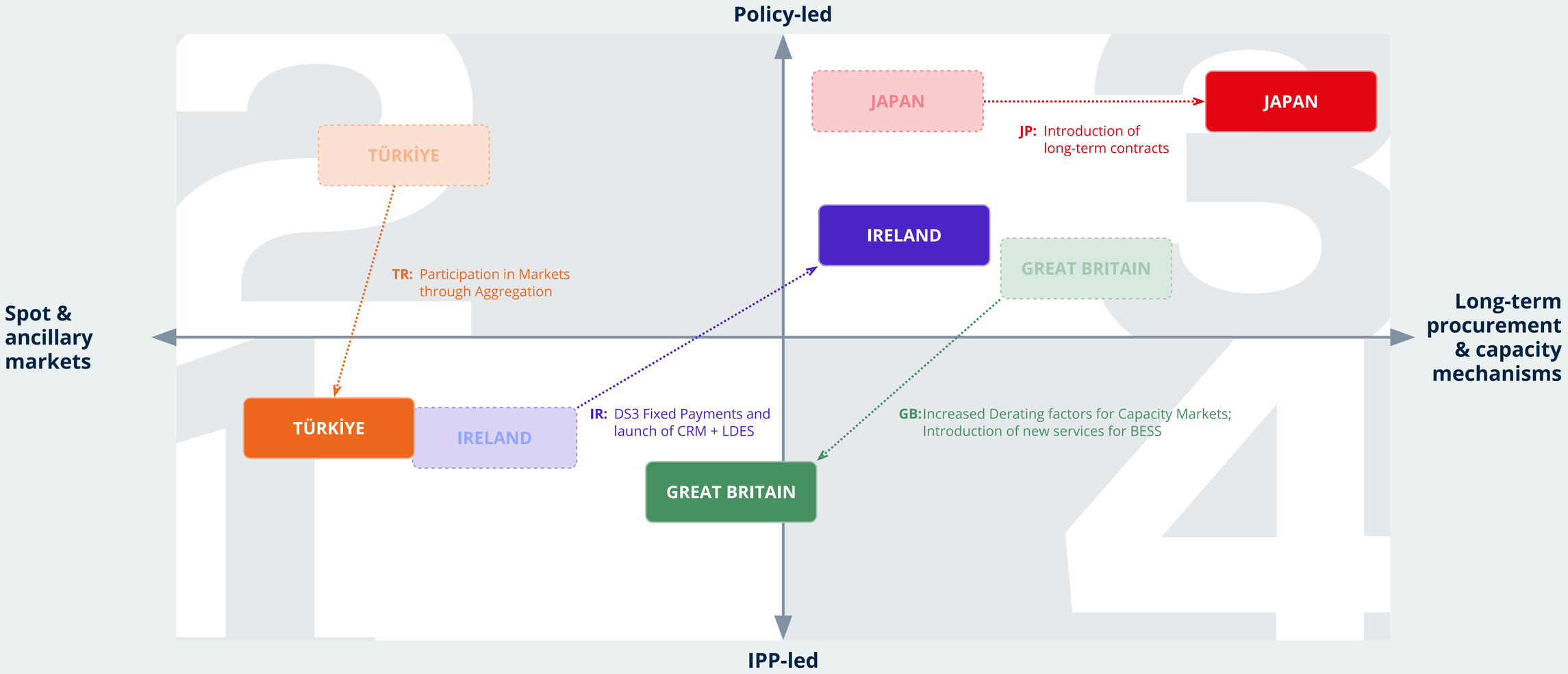
MANUFACTURERS

Adapt product specifications to the specific requirements of developing country contexts

FINANCIERS

Provide feedback on what makes a project ‘bankable’ and highlight the need for stable, long-term contracts

POLICY EVOLVES ALONG WITH SYSTEM NEEDS AND TECHNOLOGY DEVELOPMENT



MAIN USE CASES IN WORLD BANK GROUP'S ACTIVE ENERGY STORAGE SYSTEM PORTFOLIO SINCE 2018

World Bank use cases

Grid services

Ancillary services, peak shaving and VRE integration

Island/Diesel-based power systems

Diesel displacement and improved power quality

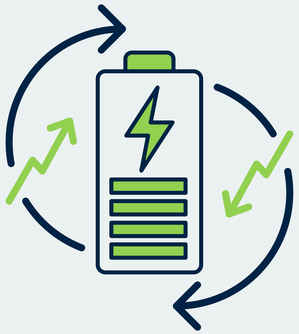
Energy access

Storage to support electricity access

IFC investment

Capacity-backed infrastructure

Regulated markets or crisis contexts



Merchant arbitrage

Merchant or quasi-merchant models in liberalized markets

Commercial hybrids

Distributed behind-the-meter systems for commercial clients electricity access

PRIVATE SECTOR ENGAGEMENT

The Solar and Renewable Energy Storage Project is a significant milestone in Uzbekistan's clean energy transition.

- A 250 MW solar power plant and a 63 MW/126 MWh BESS in the Bukhara region
- Implemented by Abu Dhabi Future Energy Company PJSC - Masdar

Project Highlights

» Private sector-led IPP

» First utility-scale BESS in Central Asia, tackling RE intermittency

» An innovative two-part PPA contract in line with the technical and risk profiles of the technologies: energy generated ($/kWh) and storage capacity availability ($/kWac)

» World Bank Group's IBRD payment guarantee to lower perceived risk for investors

PUBLIC SECTOR ENGAGEMENT

The Regional Emergency Solar Power Intervention (RESPITE) Project responded to acute supply shortage, reduced reliance on expensive fossil fuels, help rapidly expand grid-connected renewable energy capacity in West Africa (Chad, Liberia, Sierra Leone, and Togo).

- Installation of 106–150 MWp of solar photovoltaic (PV) capacity paired with battery energy storage systems (BESS)

Project Highlights

- Public utilities in each country own the BESS. The project is financed by about $332 million in IDA grants and credits, plus CTF grants.
- A single EPC contractor supplies the BESS across all three countries and provides 1 to 3 years of O&M, with capacity-building clauses to train utility engineers before handover to the utilities.
- Risk mitigation: Implementation risk is handled through embedded Owner's Engineers, HEINS and support from ESMAP and the Energy Storage Partnership.

LESSONS LEARNED

PLAN

» Start with quantified use and **power system studies** before locking in technology, size, site, or business model.

» Establish **enabling framework**, including grid codes, remuneration, cost recovery, and asset ownership.

DESIGN

» Match **business models** to markets using utility-owned models where markets are nascent and PPP/IPP structures where bankable.

» Use **concessional resources** selectively for first-of-kind or fragile contexts, paired with guarantees and value-for-money tests.

IMPLEMENT

» Strengthen **procurement** by bundling capacity, standardizing documents, and deploying experienced procurement support.

» Embed **capacity building** early with Owner's Engineers, PIU/utility training, market consultation, and stakeholder workshops.

SUSTAIN

» Plan **O&M** from the outset through long-tenor service agreements, KPIs, warranties, spares, and handover plans.

» Maintain **post-commissioning** support to optimize dispatch, integrate EMS/SCADA, manage warranties, and sustain performance.

WBG / ESMAP ENERGY STORAGE PROGRAM AND PARTNERSHIP

The objective is to significantly scale up support to energy storage projects and mobilize concessional finance as needed.

Horizon Scanning

Pillar 1

Curating frontier technology trends for investment decisions

- "conveyor belt" of knowledge from researchers and industry R&D to practitioners
- knowledge platform for agile scanning, curation, and dissemination
- Inform procurement and technology choices for programs on a 3–4 year horizon

Operational Support

Pillar 2

Shaping the design of and sharing lessons from investment operations

- Curate lessons of implementation from large energy storage programs and technical assistance
- Leverage the WBG and partner portfolio for peer-to-peer learning, data, and fast-cycle co-creation
- Provide technical backstopping, study tours, and networking for TTLs, partners, and clients

Capacity Building

Pillar 3

*Scaling capacity through the **Energy Storage Academy***

- Serve the full client spectrum, from "Storage 101" to advanced policy and procurement
- Expand the Storage Academy, Global Virtual Community, and resource library
- Grow peer-to-peer learning through study tours and practitioner exchanges
- Build on the Women in Storage mentoring program

External Facing: Energy Storage Partnership; Global Energy Storage Virtual Community.

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THANK YOU

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Join us at

https://www.esmap.org/

Global Energy Storage Virtual Community

https://connect4impact.worldbank.org/organization/global-energy-storage-community