FUTURE OF ENERGY STORAGE:
A DEVELOPMENT PERSPECTIVE

Energy Storage Financing Summit | October 9, 2024
United States Government, Department of Energy

WORLD BANK GROUP
Energy & Extractives

ESMAP
Energy Sector Management Assistance Program

OUTLINE

1. World Bank & ESMAP Storage Program

2. Future of Storage: Development Perspective

3. Select WB-financed Storage Projects

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ESMAP: ROLE AND FUNCTION AT THE WORLD BANK

ESMAP
Energy Sector Management
Assistance Program

Global
Think-Tank
& Forum

Integrated
Technical
Solution Hub

Fund
Mobilization
and
Channeling to
Client
Countries

STORAGE PROGRAM : SCALING UP ADOPTION AND DEPLOYMENT OF ESS GLOBALLY

Operation Support is informed by the global experience of partners, and by extension, informs it through lessons learned.

ESP **working groups produce** knowledge products and reports based on technical experience, exchanges, and collaborations.

Pillar I

Energy Storage Partnership (ESP)

Pillar II

Technical Assistance & Operational Support

Knowledge products and report builds on the operational experience of the World Bank, through its regional teams, and internal technical teams.

Knowledge Resources

ENERGY STORAGE PARTNERSHIP (ESP): CONVENING KNOWLEDGE & COLLABORATION

ESP Objective

To foster **international cooperation** to help ***develop*** and ***adapt*** energy storage solutions **tailored** to **the needs of developing countries**

Main Functions

- **Convene international cooperation** to increase **knowledge base in energy storage solutions** for developing countries
- **Build capacities** by following a global public goods approach
- Understanding of **emerging markets** and **technical requirements** for energy storage systems
- Opportunities to **inform innovation** and for **new technologies** to gain visibility
- Opportunities to **inform investments** and **policy dialogue** with countries
- Access to **country-** and **project-specific information**

ESP Stakeholder Forum and 11th Partners Meeting
(5th anniversary) in Morocco on Nov 4-7, 2024

STORAGE PROGRAM: TECHNICAL FOCUS AREAS

Program Technical Focus Areas

ESMAP Technical Assistance to World Bank energy teams and client government around 4 Priority Areas covering the overall ecosystem of unlocking the potential of storage for the energy transition

Strategy, policy, and legal advisory	Technical, economic analysis and studies
Investments, business models, and financing	Preparation and Implementation

35+ TA activities, and over 7 GWh informed investments through various mechanisms

Knowledge Resource

(external facing + client oriented)

ESMAP leads as a global energy think tank, advancing frontiers of applied knowledge resources and development-oriented research

- **Reports and Guidelines**
- **Storage Tools**
- **Storage Academy**

LANDSCAPE OF ESS INTERVENTIONS

	BESS only	Renewables-plus-storage (hybrid)	
Publicly Owned BESS	**Type A** Publicly owned BESS Stand-alone *(e.g South Africa)*	**Type B** Publicly owned BESS With publicly-owned VRE *(e.g India, CAR, West Africa)*	**Type C** Publicly owned BESS With IPP-owned VRE *(e.g Maldives)*
Privately Owned BESS	**Type D** Privately owned BESS Stand-alone	**Type E** Privately owned BESS With IPP-owned VRE	

unlocks flexibility and dispatchability for RE and accelerates decarbonization
(RTC/FDRE in India, South Africa, Uzbekistan, amongst others)

Higher criticality for the energy transition
Where long-duration energy storage with increased need for firmness and dispatchability

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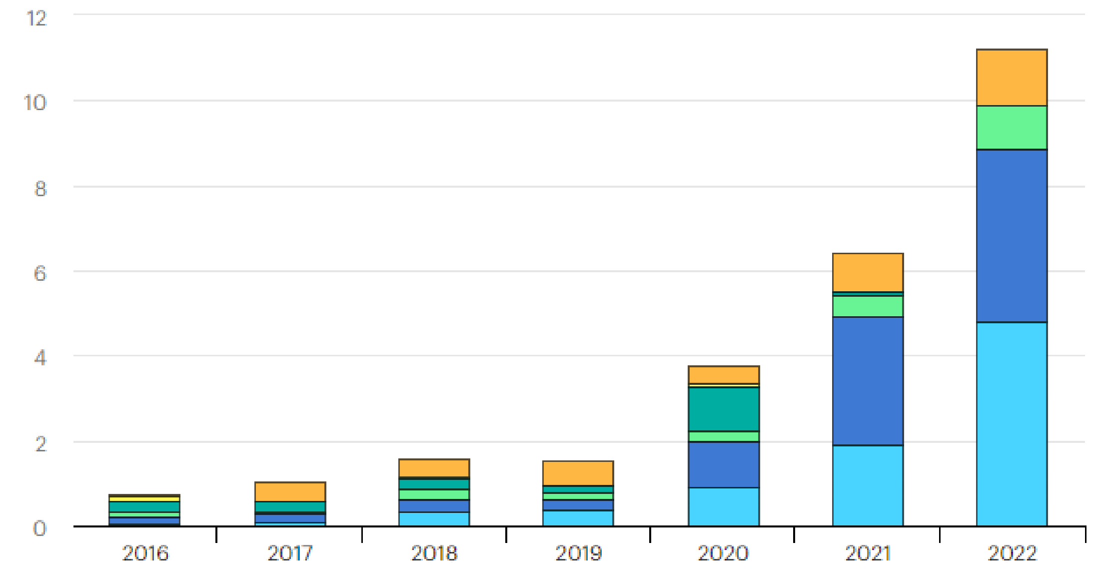
EXCITING DEVELOPMENT: DOMINO EFFECT OF ADOPTION FOR BATTERIES

- **Battery demand is growing on an S-curve**. Battery sales have been doubling every two to three years, and we are on track for a six to eight-times increase by 2030, with sales of 5.5-8 TWh per year.
- **A reinforcing feedback loop of scale, cost, and quality**. As the battery market grows, unit cost keeps falling and quality keeps rising. Both battery cost and energy density are on learning curves: for every doubling of battery production, costs fall by 19%-29% and the density of leading batteries rises by 7%-18%. At this rate, by 2030, battery cell costs will fall to $32-54 per kWh and top-tier batteries will have an energy density of 600-800 Wh/kg.
- **The largest clean tech market**. In 2022 more was spent on building battery factories ($45 billion) than on solar and wind factories combined; and by the end of the decade, the battery market will be larger than both solar panels and wind turbines.
- **Batteries put climate goals within reach.** As batteries help phase out fossil fuels, they reduce global emissions by 22 GtCO2 per year, which is over 60% of global energy-related emissions today. On the current S-curve trend, battery uptake is set to outpace net-zero scenarios

Source: https://rmi.org/insight/x-change-batteries/

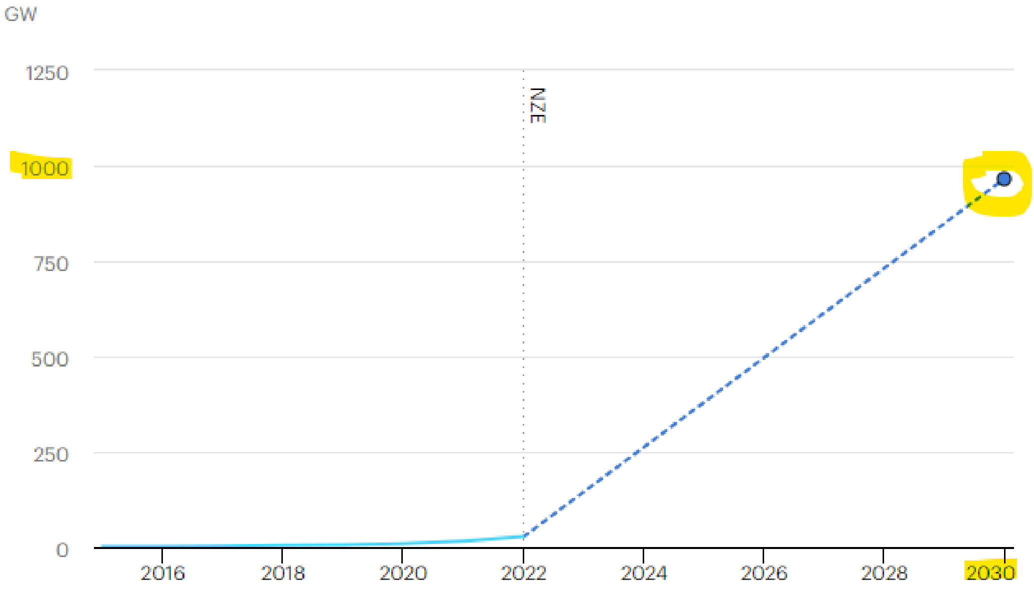
GLOBAL GRID-SCALE STORAGE DEMAND AND CONTEXT FOR NET-ZERO SCENARIO

Annual grid-scale battery storage additions, 2017-2022



China · United States · European Union · Korea · Japan · Rest of the world

Global installed grid-scale battery storage capacity in the Net Zero Scenario, 2015-2030

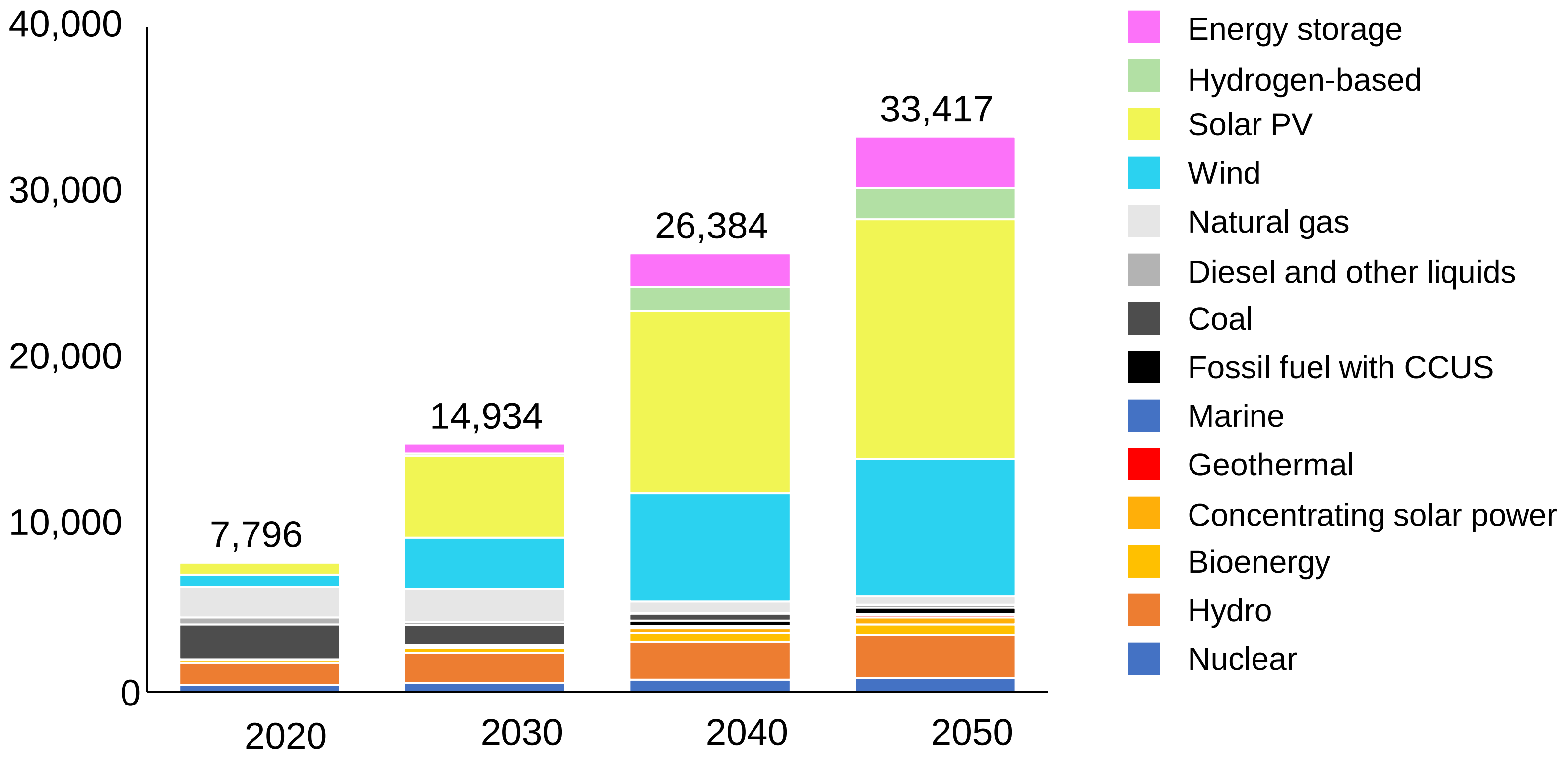


Historical · NZE

DECARBONIZATION OF POWER WILL CREATE A "FLEXIBILITY GAP", REQUIRING NEW RESOURCES TO BALANCE THE NET-ZERO GRID – LDES CAN DE-RISK THE TRANSITION

Power capacity especially of variable renewables – solar PV and wind – expected to increase significantly while conventional flexibility is phased out

Power capacity as modeled by IEA Net Zero by 2050 outlook (GW)



RES integration leads to new system challenges:

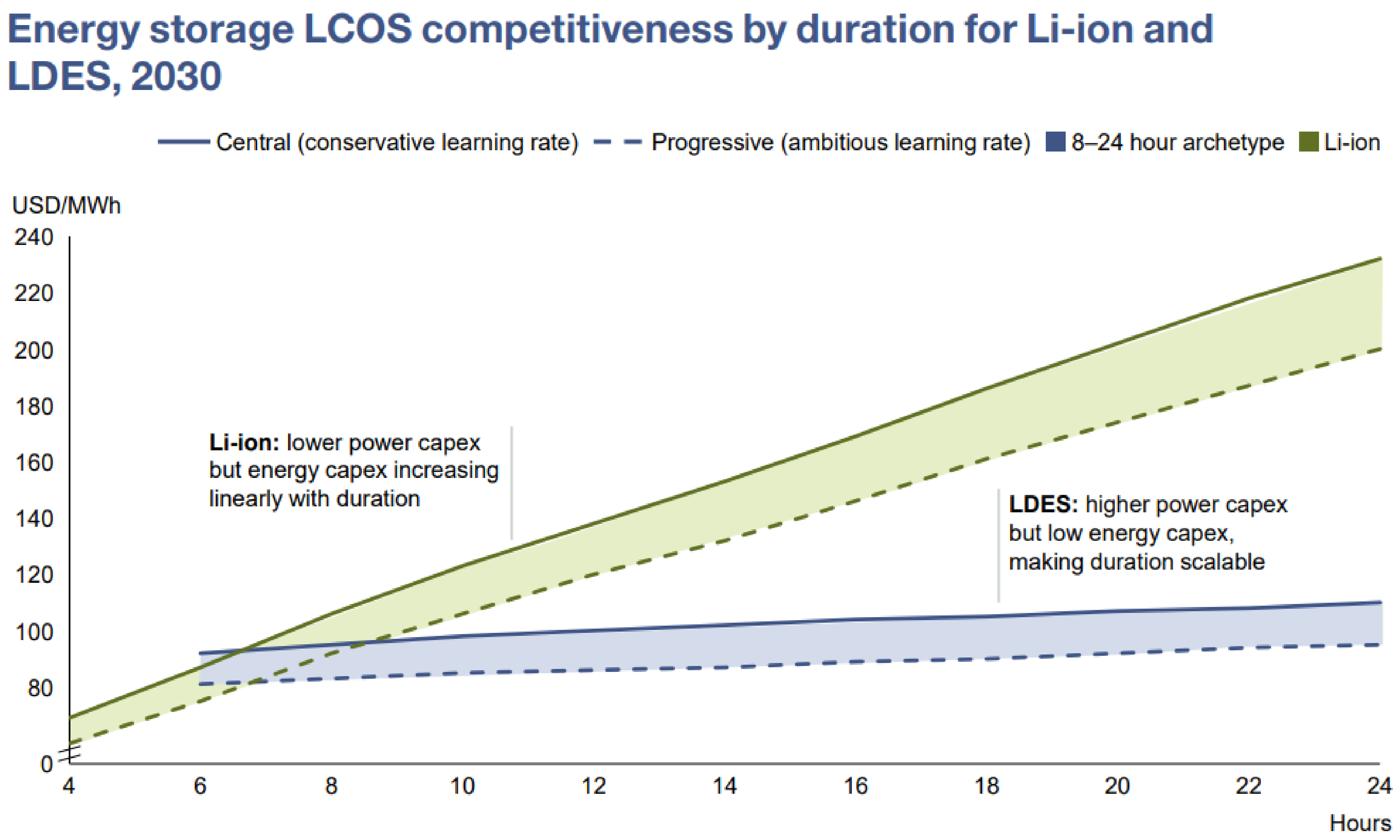
Power supply and demand not always in balance

Transmission flow changes potentially require costly and lengthy transmission upgrades

Retirement of conventional, synchronous generators creates need for new sources of grid support services, e.g., reactive power, inertia

Source: IEA

LDES: Cost effective for longer durations



Existing shorter duration technologies such as Lithium-ion batteries are cost effective for 0-4 hours

For longer durations LDES technologies become more cost effective.

DEMAND ON ENERGY STORAGE: DECENTRALIZED AND GRID-CONNECTED DEPLOYMENTS

Energy Storage is central for 3x Renewables & 300 million new connections

Climate goal to triple global renewable energy by 2030 within reach, IEA says

By Susanna Twidale

September 24, 2024 12:01 PM EDT · Updated 10 days ago

Aa

Global and national commitments in COP28 for tripling RE deployment by 2030 will only be fully enabled through energy storage. **Storage pledge expected in COP29: 6x times more capacity than in 2022.**

PRESS RELEASE | APRIL 17, 2024

New Partnership Aims to Connect 300 Million to Electricity by 2030

Realizing the **M300 Initiative** will require **scaled-up mini-grids** and **decentralized** deployment of RE, to **connect 300 million** people in Sub-Saharan Africa. **Energy storage** will be a critical element to achieving it.

1,500 GWh need to be online by 2030

How can this be realized?
Systemically addressing the interconnected deployment challenges

- **Grid upgrades** and networked-Infrastructure
- **Bankability** and Access to **Financing**
- **Enabling** policies and regulations
- **Capacity** for Planning and Deployment
- **Commercially viable** business models

CHALLENGS AHEAD: GRID-CONNECTED ENERGY STORAGE

- **Concessional financing is needed.** Climate financing needs to go beyond the viability of renewables, towards hybrid systems and BESS deployment to enable the bankability of storage assets. Public financing is limited and must be leveraged to unlock private capital investments.
- **Developing capabilities for deployment.** Capabilities in developing countries, at the government, utility, and private sectors is necessary for adequate integrated planning and deployment, and longevity of effective renewables and storage programs.
- **Viable and innovative business models**. With longer duration and increased demand for flexibility on the grid, new business models that leverage private capital will need to be developed locally and regionally with appropriate regulatory framework
- **Development of localized and regional markets.** Development of local markets that utilize different value streams of storage on the grid is necessary, in parallel to regional grids that would facilitate large-scale VRE park integration.
- **Integration with renewables in hybrid projects.** Evolving models of solar and wind IPP deployment to hybrid renewables-plus-storage, building on global experience in competitive and open IPP-led schemes, with established and bankable PPA frameworks.
- **LDES technology commercialization** is imperative.

ESMAP APPROACH TO STORAGE COMPLEMENTING TECHNICAL ASSISTANCE (INDEPENDENT ON TECHNOLOGY AND DURATION)

Proactive Stakeholder Engagement

De-risking & mobilization of support

Convening & Knowledge Sharing

In parallel to support developing and reforming local and regional energy markets to accommodate up-take of stationary storage capacity on the grid

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THANK YOU

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