Energy storage

RPTCC meeting – 05-07-2022

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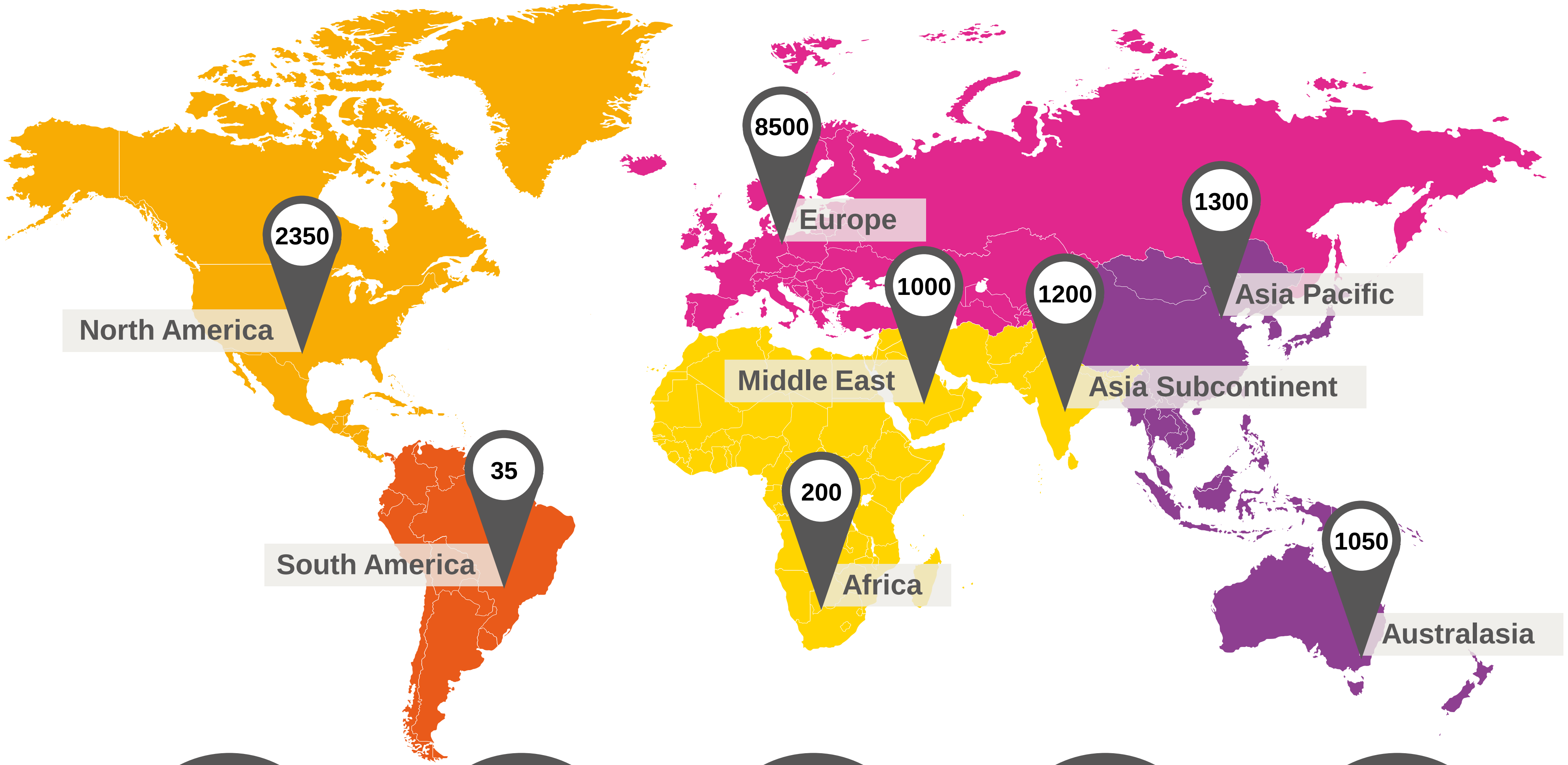
Agenda

1. Introduction
2. Global energy storge trends
3. Battery energy storage applications in the utility grid
4. Regional examples
5. Training programme – scope overview

Introduction

Robert de Groot
Integrated Energy Systems Practice Lead, APAC

- Electrical Engineer
- R&D, feasibility studies, project management and technical advisory for energy storage
- >6 years in Southeast Asia
- Involved in >GWh of energy storage projects



We work in 135 countries

170 permanent offices in 50 countries

16k staff

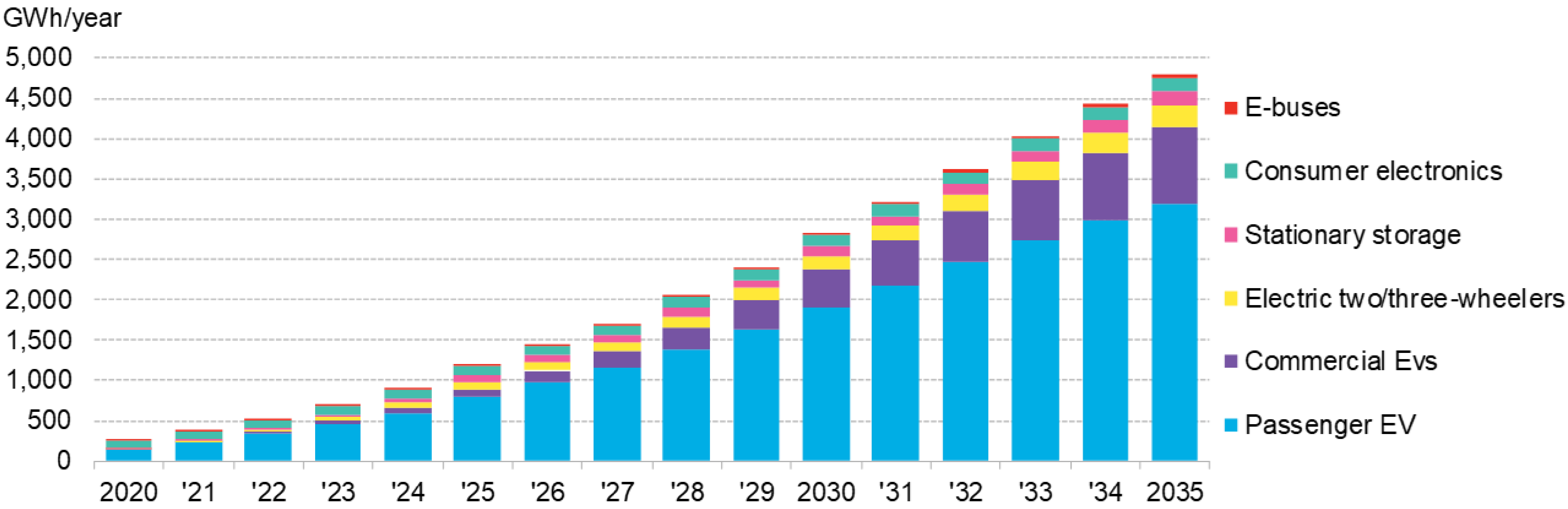
$2 billion turnover

Over 150 years' heritage

Global energy storage trends

Battery demand 2020-2035

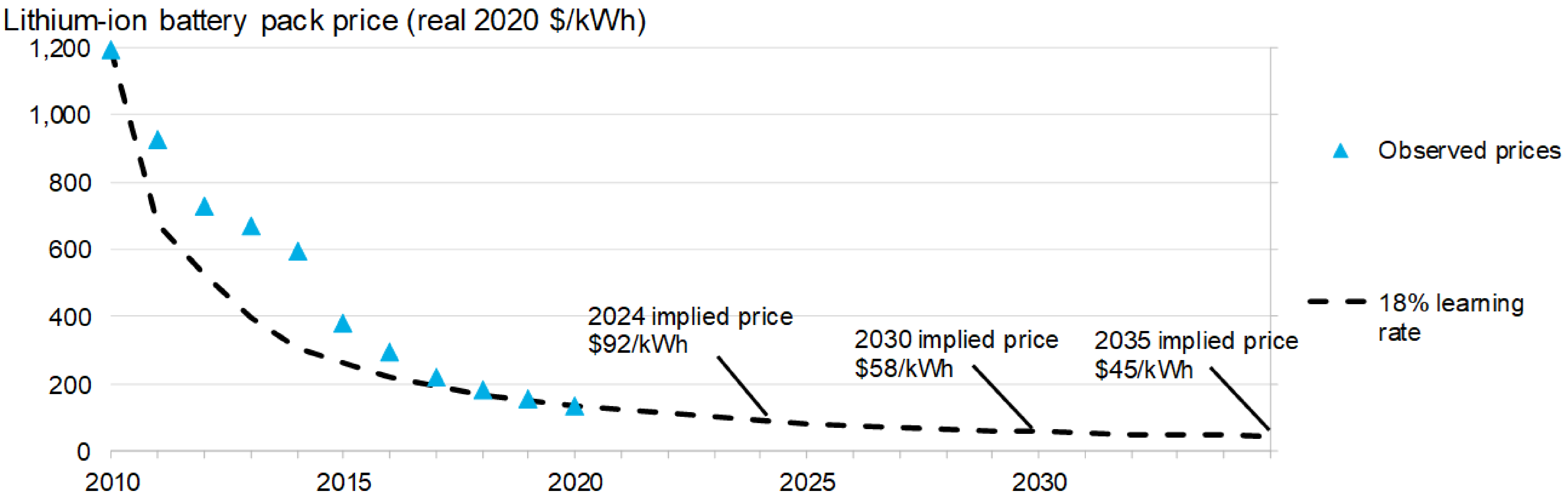
Li-ion



Source: BloombergNEF

Pack price forecast

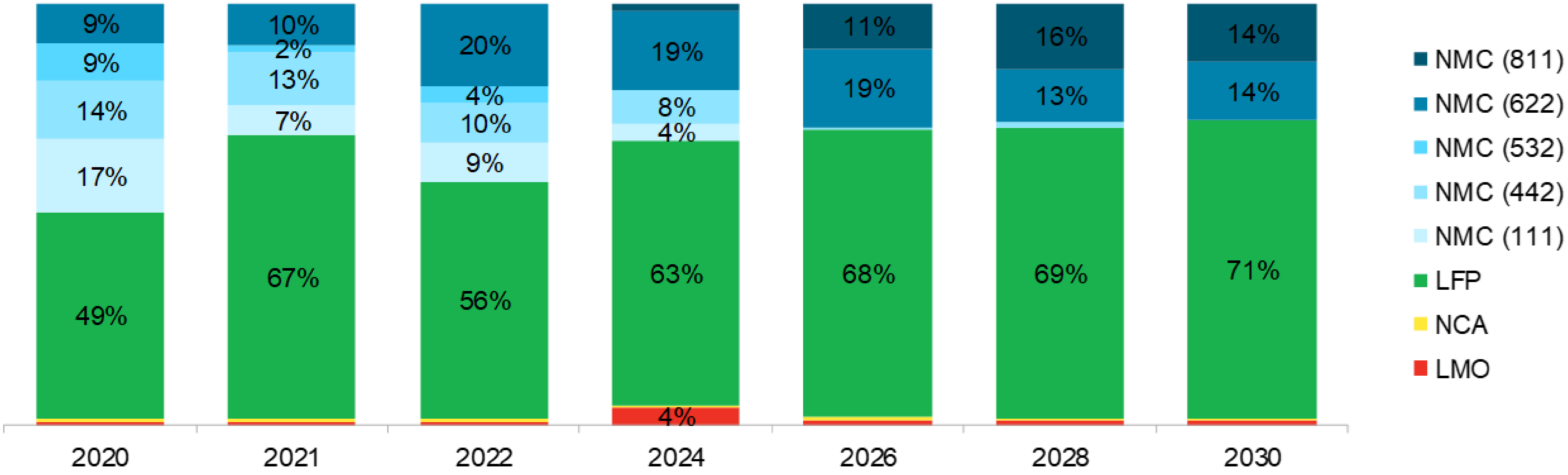
Volume-weighted



Source: BloombergNEF

Cell chemistry

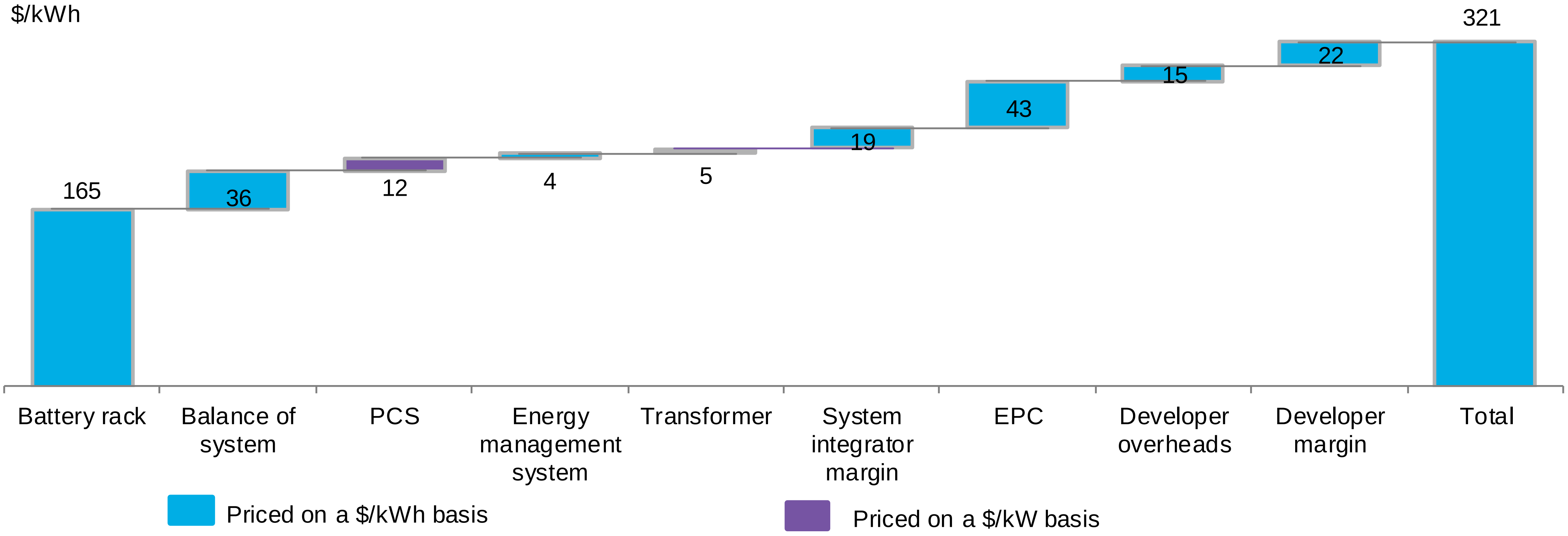
Stationary energy storage



Source: BloombergNEF

Build-up of system costs

Average survey costs for utility-scale storage (4-hour storage duration)

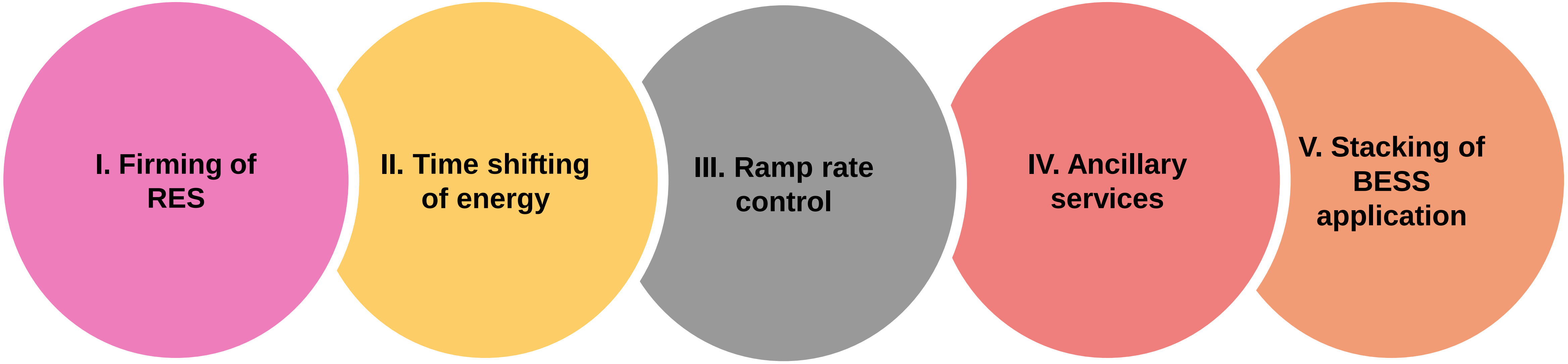


Source: BloombergNEF, survey participants. Note: Delivery year is 2020. Battery rack here is on a $/kWh of usable capacity. EMS was priced here on a $/kWh basis

Battery energy storage applications in the utility grid

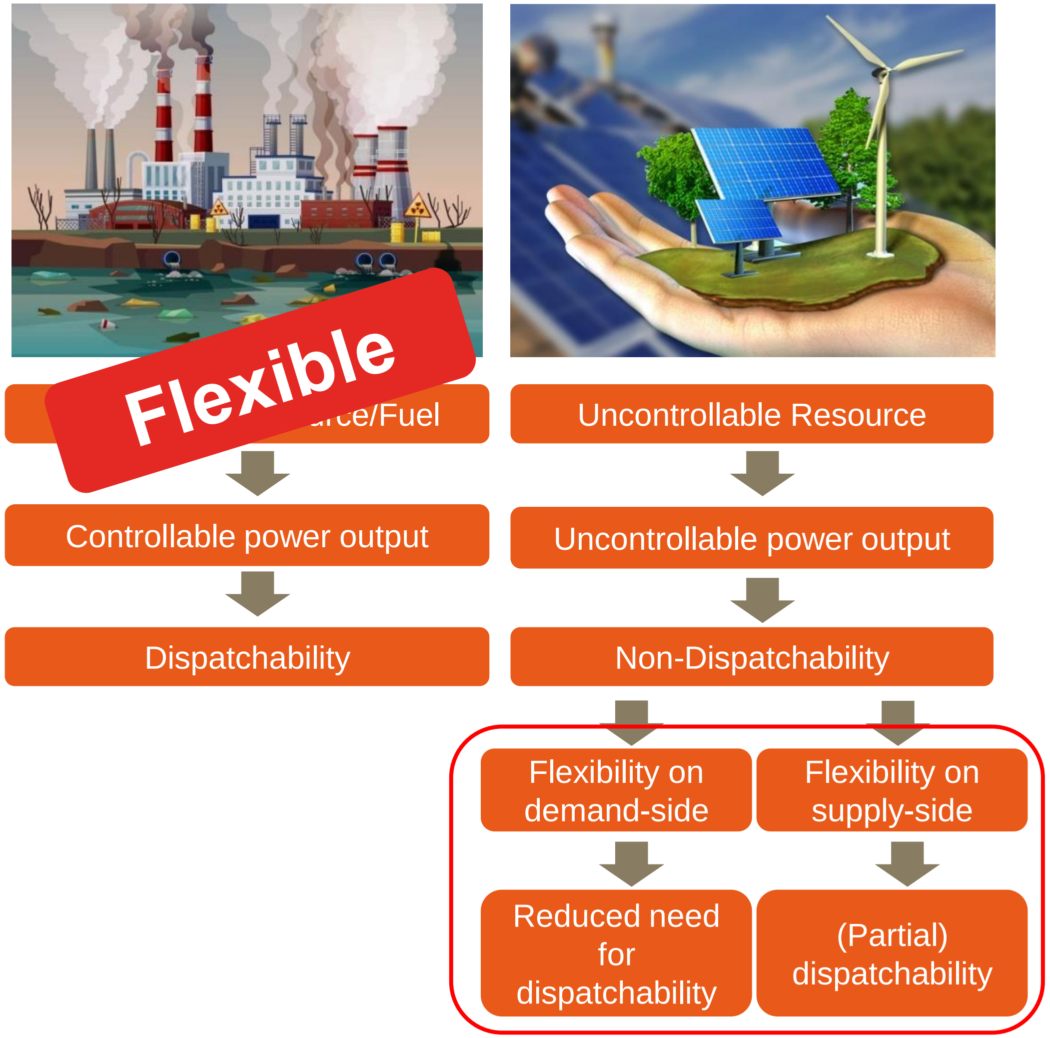
Common BESS Applications

Battery Energy Storage Systems (BESS) can be deployed in power systems for a range of applications. A single BESS can fulfil several applications simultaneously (stacking of applications) but would require a more complex assessment of technical and operational requirements to ensure stable and continuous operation while providing services.



BESS Applications for Renewable Integration

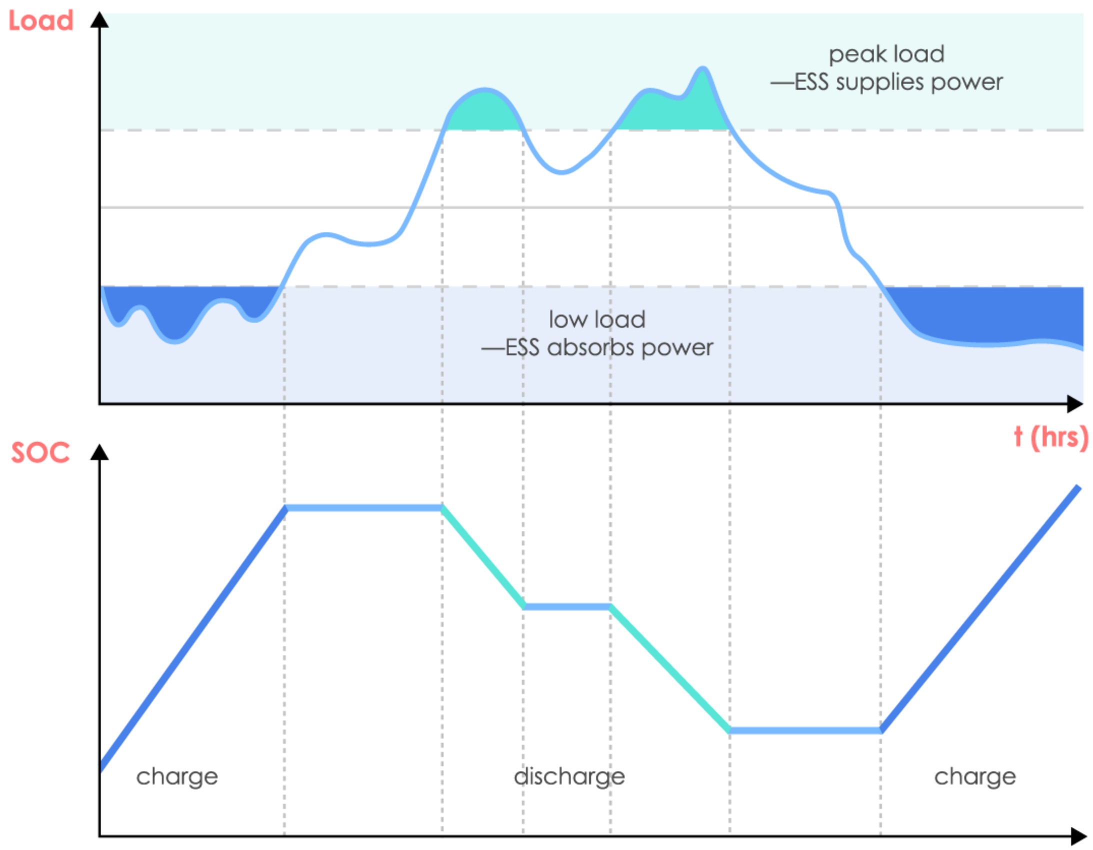
- Compared to conventional source of energy, variable renewable energy sources provide power intermittently, are often distributed across the grid and are (at best) only partially dispatchable.
- This leads to a reduction of "**flexibility**" on the supply side when adding renewable energy to the system.
- Supply can't always follow demand anymore, which leads to a mismatch in supply/demand and subsequent problems may occur.
- The integration of renewable energy sources into a distribution system can be supported by BESS in a couple of ways. The most direct way to support renewable energy integration is by co-locating a BESS with the variable renewable energy source to either **"firm"** or **"smooth"** its power output.



Firming of RES

Renewable energy firming

- The objective is to reduce the natural variability and/or intermittency of renewable energy sources
- Firming allows the renewable plant to provide a degree of dispatchability and/or supply some of the energy outside the typical generation hours or timeframes (e.g. solar power during the evening or night)
- The firming of renewables typically requires larger quantities of energy to be shifted over longer durations of time, thus, require larger BESS sizing
- The exact requirements for firming of VRE at a location are subject to type of project, region, utility service area and/or relevant jurisdiction



Source: PEC Technology (Thailand)

II. Time shifting of energy

Time shifting of energy is an application of energy storage in which electrical energy produced at one point in time is stored in a BESS and released back into the power system at a later point in time.

Value propositions for time shifting energy with BESS could be:

- **Energy Arbitrage**
- **Reduction of peak loads**
- **Deferral of transmission and distribution upgrades**
- **Avoidance of curtailment**

III. Ramp rate control

Ramp rate control is a reduction of the rate of change of power output of a generation source. In case of non-dispatchable variable renewable energy sources, one of the ways to reduce the ramp rate is to co-locate a BESS which purpose is to absorb or release power in a manner that the **combined power output of the VRE and BESS** stays within certain **pre-determined ramp rate limits**.

By reducing the ramp rate of VRE, their variability in power output is reduced, which in turn supports grid stability and allows for a higher penetration of renewables while reducing the need for (other) mitigations.

Application indicators

- A high penetration of variable renewable energy sources in the (local) grid
- A heavily loaded grid, or relatively weak grid
- Occurrence of grid instability, e.g. frequency or voltage deviations exceeding a certain threshold
- A high amount of additional variable renewable energy sources projected to come online in the (local) grid in the future

Design Considerations

- **Location**
- **Energy Capacity**
- **C-rate (Power Rating/ Energy Rating)**
- **Control system**

IV. Ancillary services

Ancillary services are the services necessary to support the transmission and distribution of electrical power from generators to consumers – they may support, maintain and enable the reliable operation of interconnected grids

The term "ancillary services" is used to refer to several operations, beyond generation and transmission, that are required to maintain grid stability and security of supply, these typically include:

- **Frequency control**
- **Reactive power and voltage control**
- **Provision of spinning reserve**

V. Stacking of BESS application

The capital costs of BESS are still expensive despite a steady cost reduction of batteries in recent years. Stacking of applications may be a way to achieve more investment returns as the BESS fulfils several functions at the same time.

Below are three examples of BESS with stacking applications:

Voltage control + Spinning reserve	**Energy arbitrage + Renewable energy firming**	**Peak Shaving + Deferral of T&D upgrades**

Regional examples

Thailand

Deployment of BESS alongside hydropower

- EGAT has been using pumped storage hydropower as a source of flexibility
- Total capacity 1,031 MW, to be increased to 2,100 MW

- With larger quantities of VRE entering the grid, battery energy storage becomes necessary
  - More flexibility, less space consuming
  - Can be installed closer to areas of supply and demand

- Applications:
  - Smoothing of RE
  - Energy shifting
  - Frequency regulation
  - Congestion management

Source: www.egat.co.th

Cambodia

Deployment of BESS together with solar PV

- Energy storage to be deployed near the 100 MW National Solar Park
- 16 MWh of capacity

- BESS applications:
  - RE integration
  - Transmission congestion relief
  - Balancing services

- Supported by ADB

MOTT MACDONALD

Training programme – scope overview

Training programme

Scope overview

Workshop 1

Introduction to BESS, BESS technologies and components

Face to face session, with a focus on establishing a basic understanding of BESS technology

Workshop 2

Overview and technical assessment of BESS applications

Online session, deep-dive into BESS applications and related benefits to grid operation

Workshop 3

BESS design considerations, sizing and siting

Face to face session, focusing on BESS design considerations and sizing and siting inputs for different applications

Workshop 4

Regulatory frameworks for BESS and identifying opportunities for BESS deployment

Online session with a strong focus on development of a favorable regulatory framework for BESS deployment

Thank you