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**31 July 2023**

2:00 pm - 3:00 pm | CEST, Berlin  
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# Achieving lower LCOS with liquid cooled ESS



**Marija Maisch**  
Editor  
pv magazine




**Hamza Al Smadi**  
ESS Technical Manager  
Jinko Solar



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Vice President of clean tech research  
Rystad Energy

# Welcome!

**Do you have any questions?** ? 

Send them in via the Q&A tab.  We aim to answer as many as we can today!

You can also let us know of any tech problems there.

**We are recording this webinar today.** 

We'll let you know by email where to find it and the slide deck, so you can re-watch it at your convenience.  



**RystadEnergy**

# Advancement in global utility-scale battery energy storage systems

**PV magazine webinars**

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July 2023

**pv magazine**

# Who are we?



## We are

a world-leading analysis and consultancy company, offering services and analysis across all energy sources globally



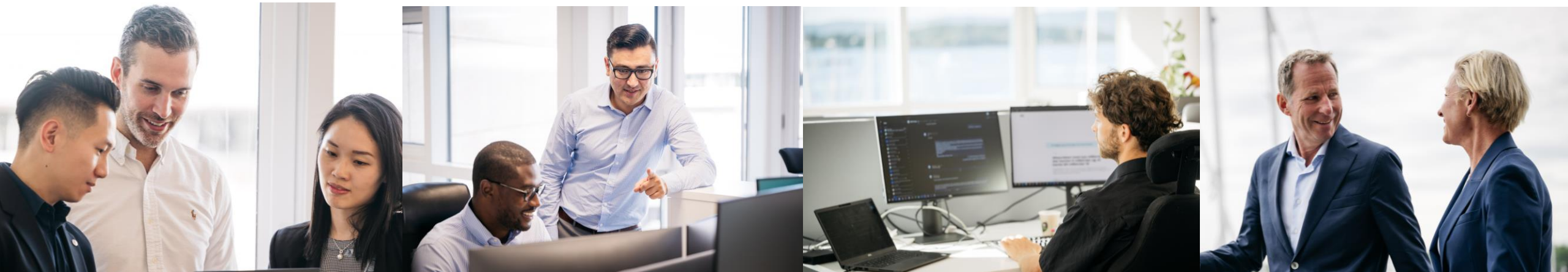
## We provide

reliable data, projections and advice to enable our clients to predict and plan for the future



## Our goal

is to provide transparency in the global energy markets and to contribute to a responsible energy transition





# Global presence



## Our locations

### EMEA

Aberdeen  
Brussels  
Copenhagen  
Dubai  
Istanbul  
London  
Madrid  
Oslo  
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### Americas

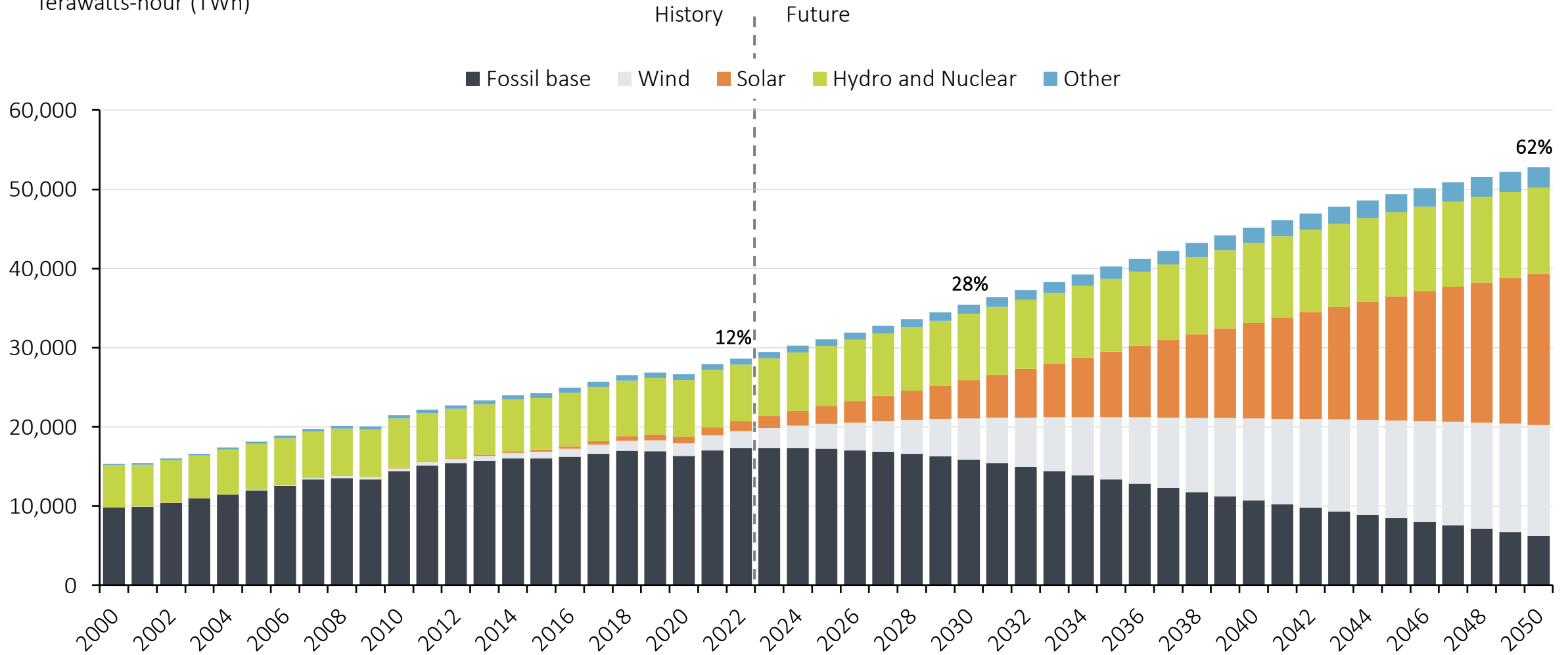
Buenos Aires  
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Denver  
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### APAC

Bangalore  
Beijing  
Jakarta  
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Perth  
Seoul  
Shanghai  
Singapore  
Sydney  
Tokyo

# Renewables will account for 70% of global energy generation by 2050

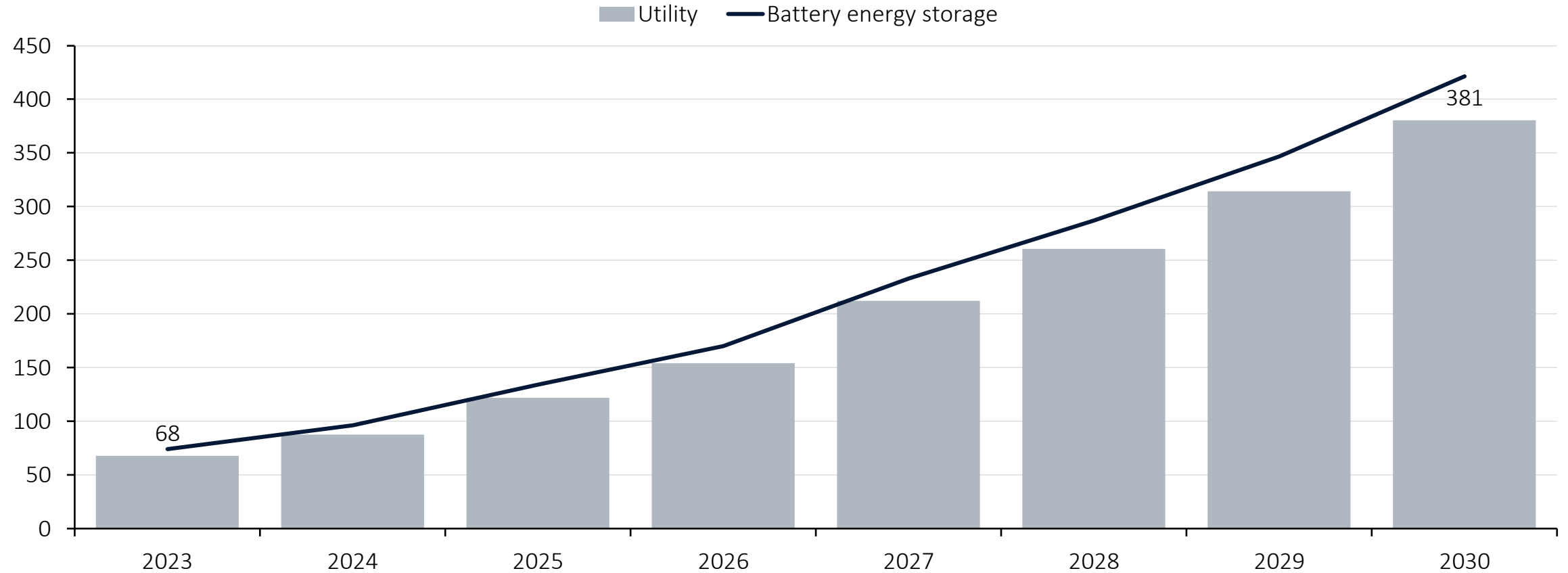
Global power generation mix  
Terawatts-hour (TWh)



Source: Rystad Energy Renewable and Power Cube

# Utility BESS demand accounts for 90% of total BESS demand

Global battery energy storage system outlook  
Annual installation, Gigawatts (GWh)

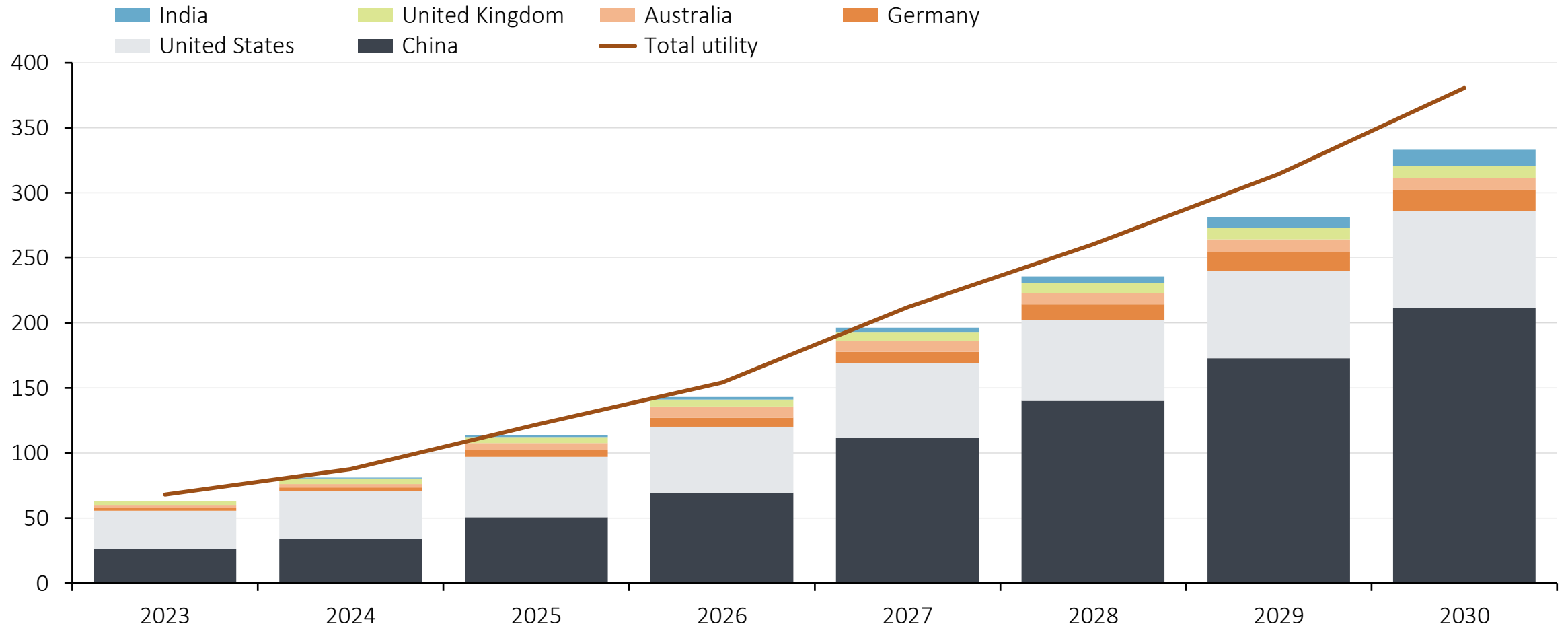


Source: Rystad Energy BatteryCube

# Top 6 countries accounts for ~90% of global utility BESS market

## Global utility battery energy storage system outlook

Annual installation, Gigawatts (GWh)

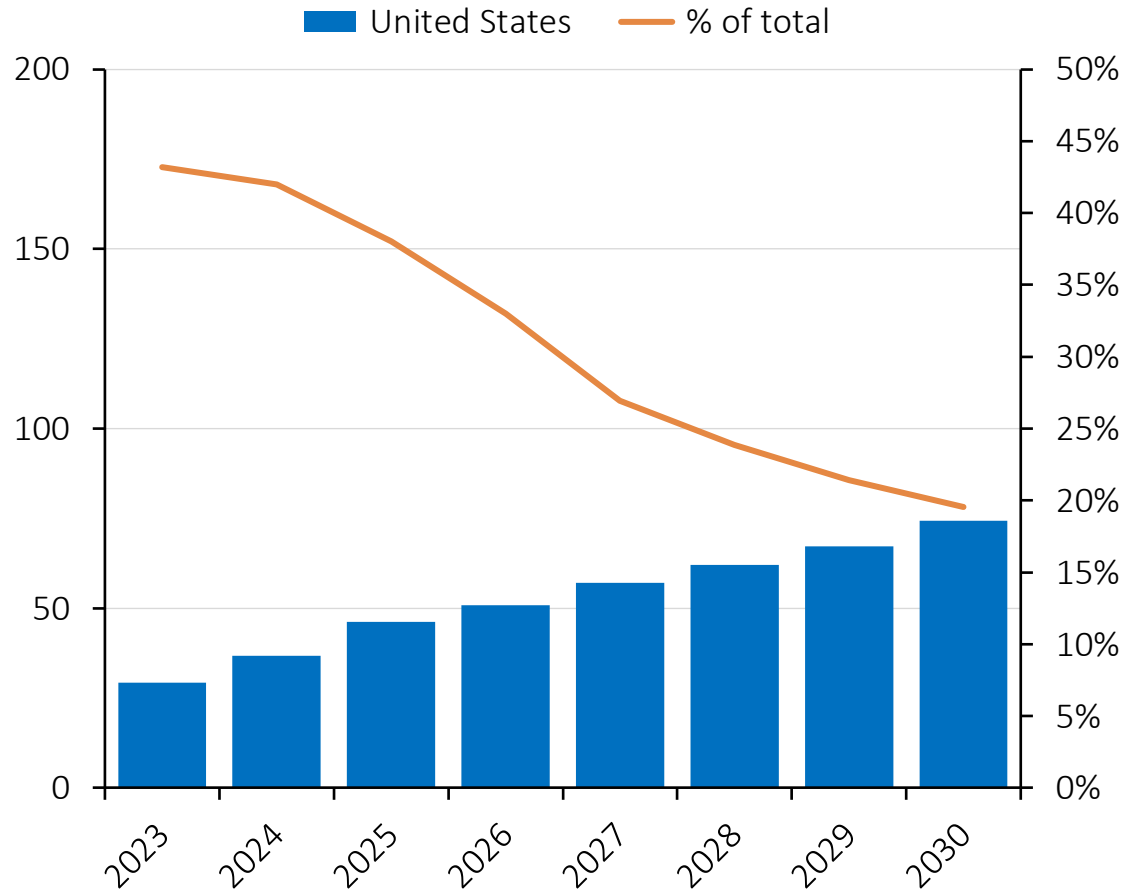


Source: Rystad Energy BatteryCube

# China and US is leading the growth in utility sector

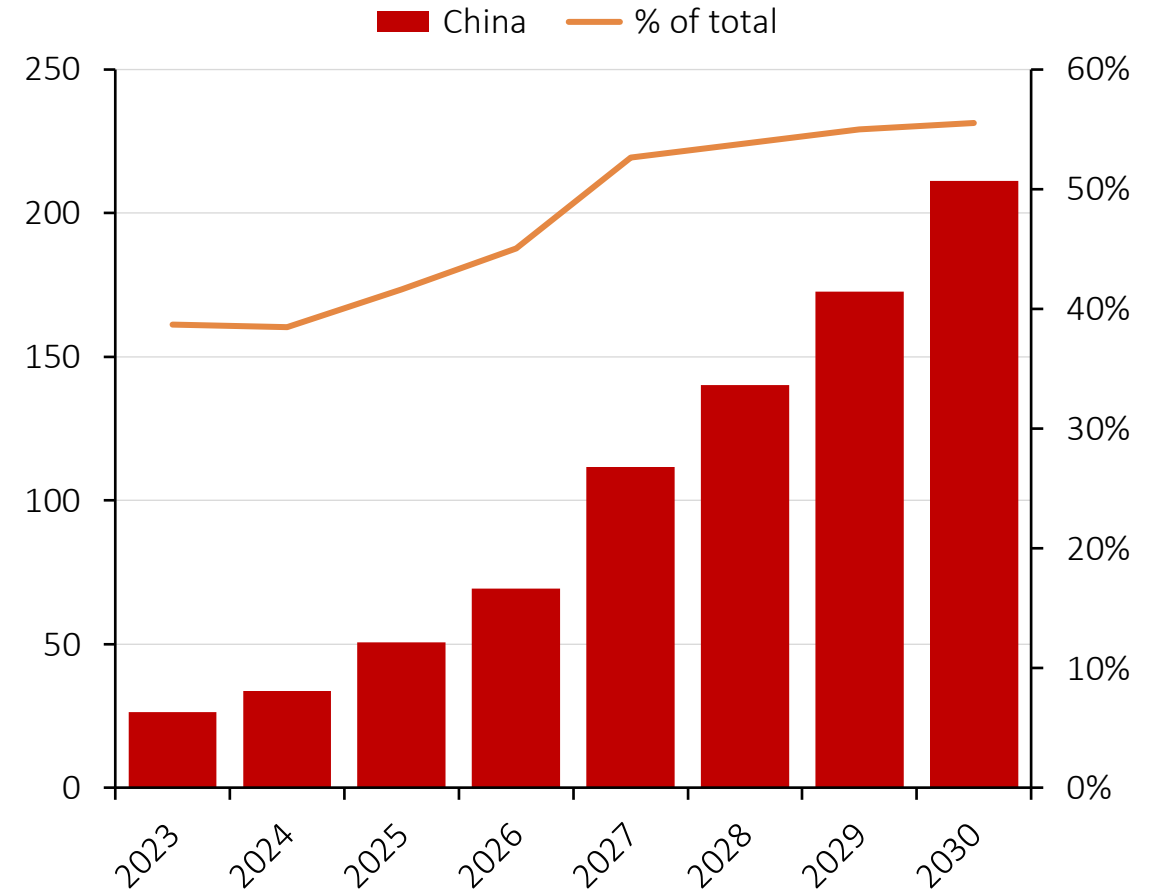
## Utility battery storage market outlook in the US

Annual installations, Gigawatts (GWh)



## Utility battery storage market outlook in the China

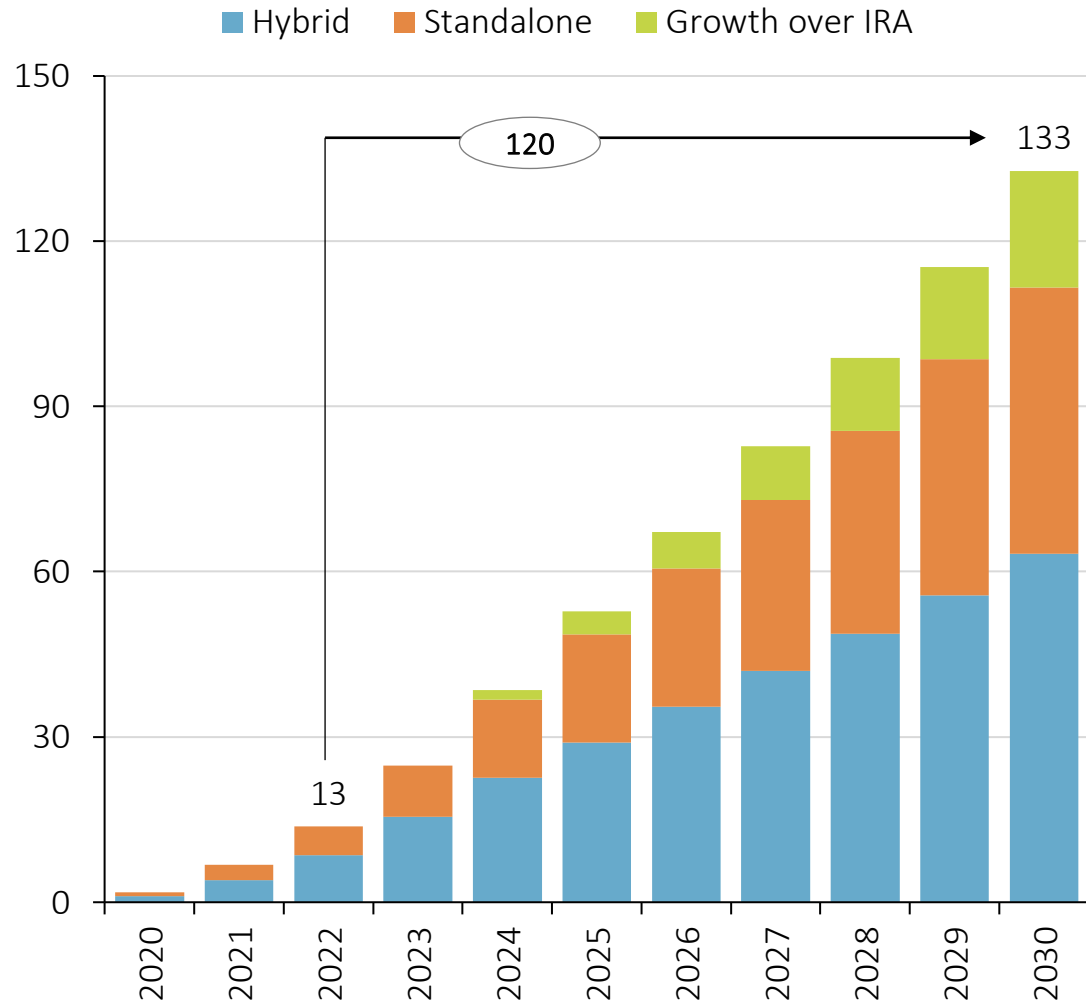
Annual installations, Gigawatts (GWh)



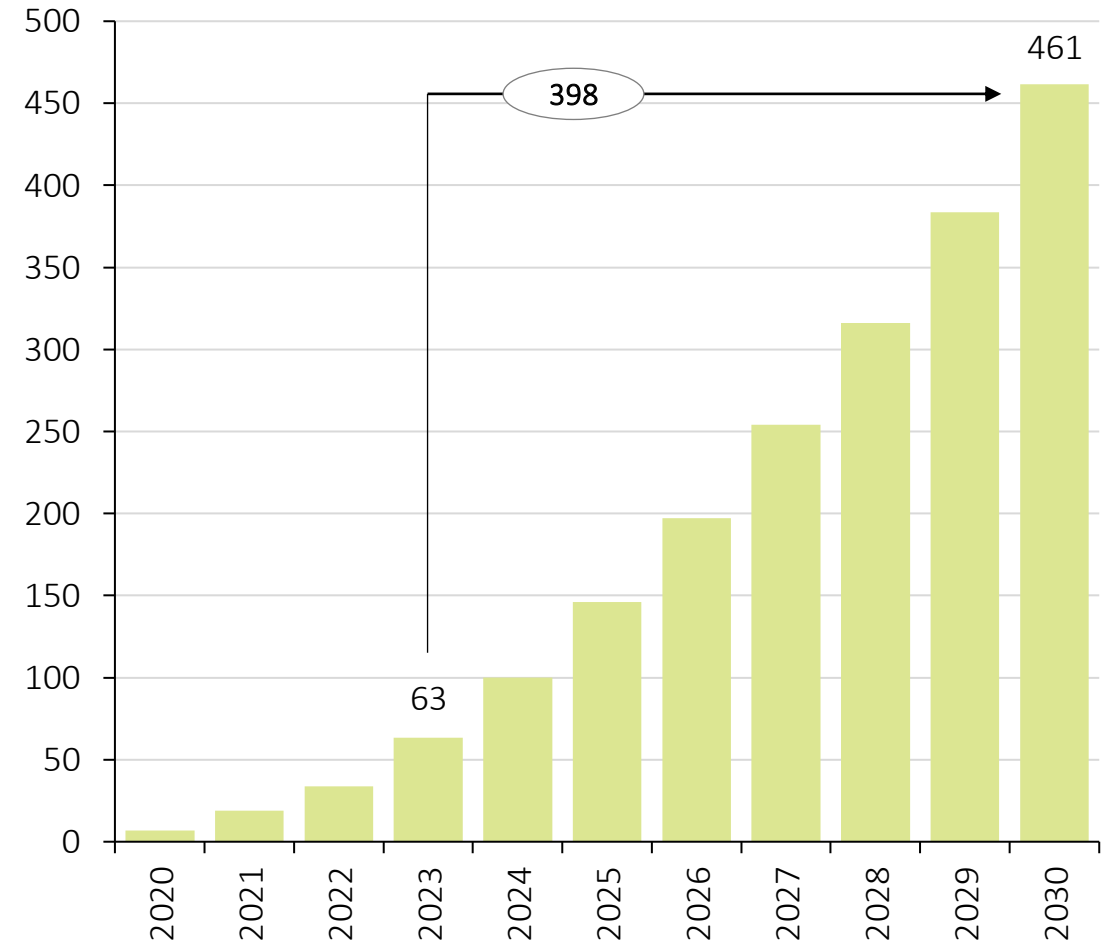
Source: Rystad Energy BatteryCube

# IRA to add 120 GW battery storage by 2030 resulting total battery storage to pass 490 GWh in US

Utility battery storage market outlook in the US  
Accumulated, Gigawatts (GW)



Utility Battery storage market outlook in the US  
Accumulated, Gigawatts-hour (GWh)



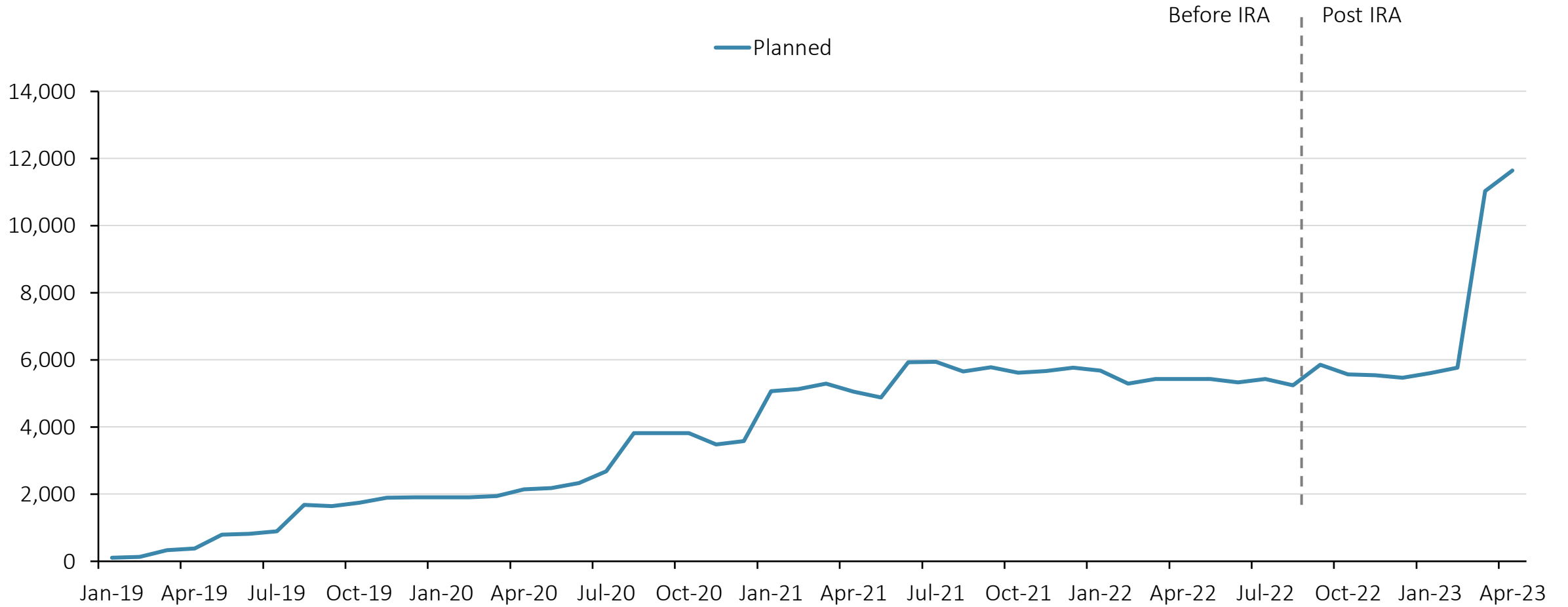
Source: Rystad Energy BatteryCube



# IRA is accelerating the Utility-scale BESS projects in US

## Battery energy storage projects in the US

Nameplate capacity, Megawatts (MW)

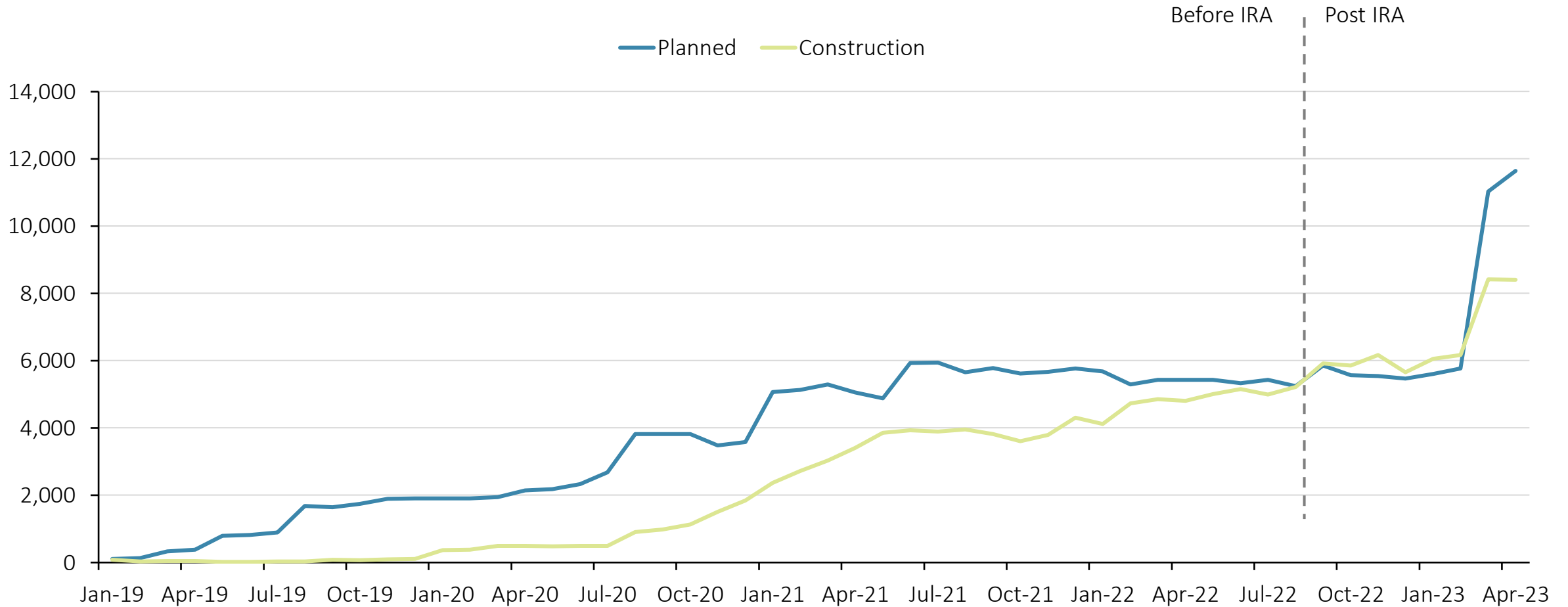


Source: EIA-860 report  
IPP: Independent Power Producer

# IRA is accelerating the Utility-scale BESS projects in US

## Battery energy storage projects in the US

Nameplate capacity, Megawatts (MW)

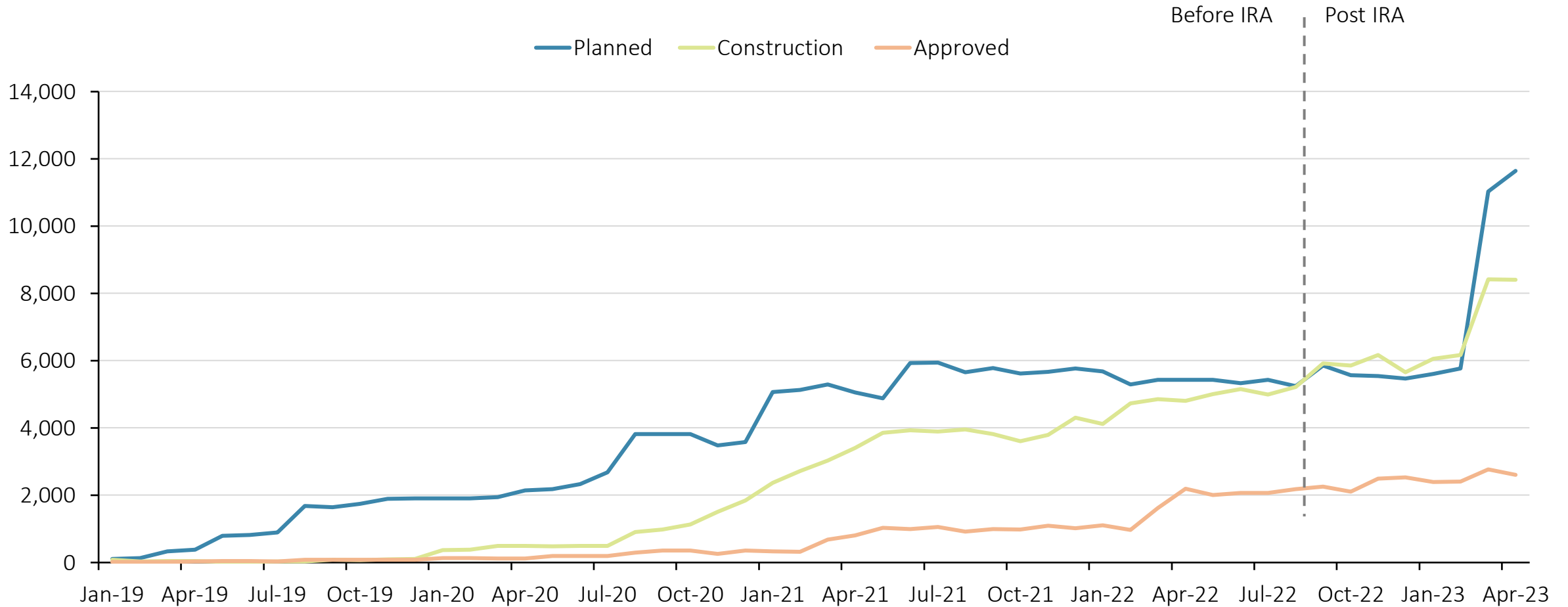


Source: EIA-860 report  
IPP: Independent Power Producer

# IRA is accelerating the Utility-scale BESS projects in US

## Battery energy storage projects in the US

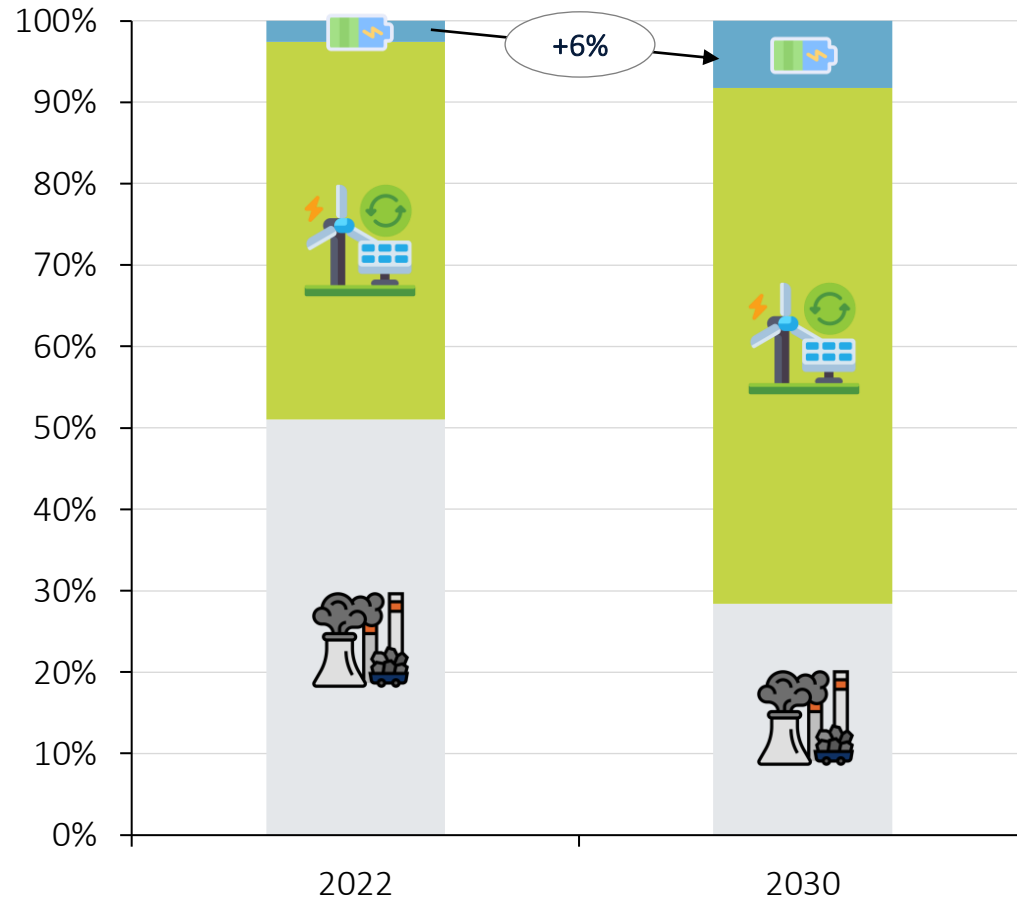
Nameplate capacity, Megawatts (MW)



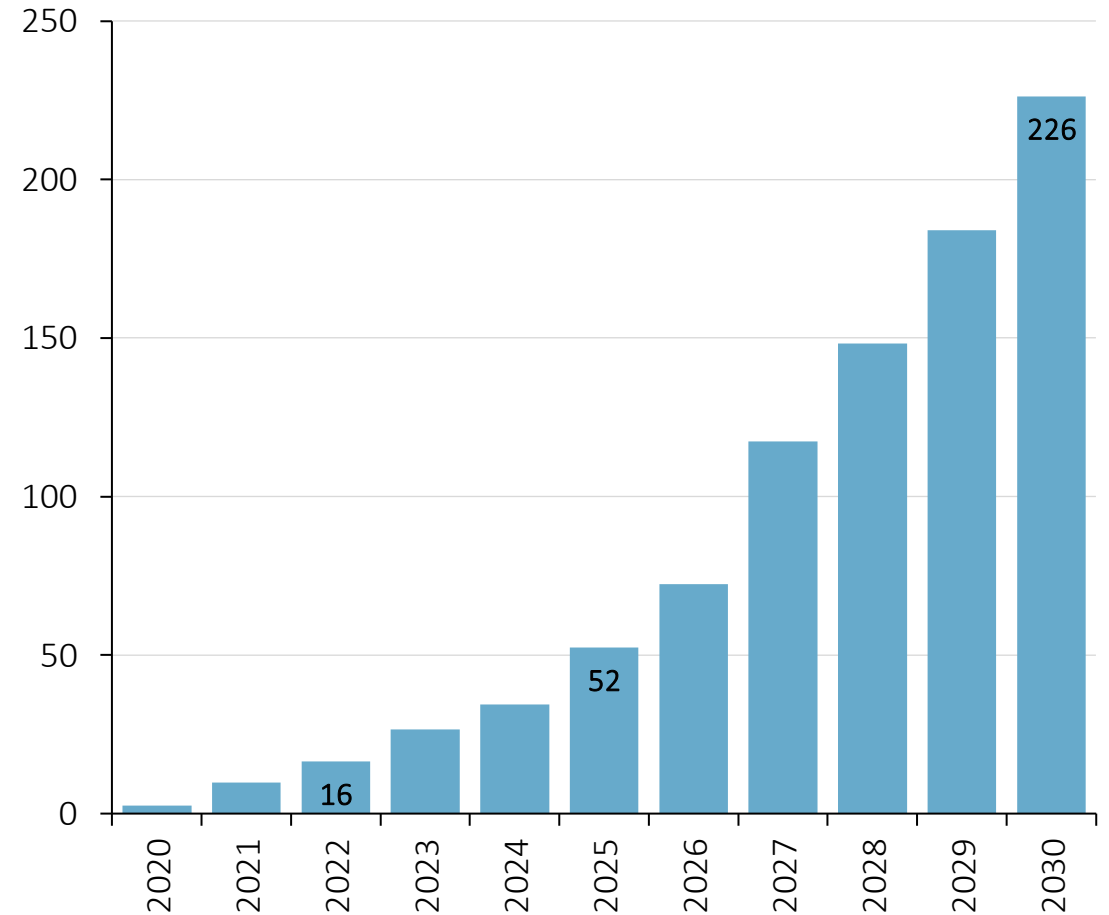
Source: EIA-860 report  
IPP: Independent Power Producer

# Massive battery installation in China to support the renewables adaptation

Share of power generator technology in China  
% of power generation capacity



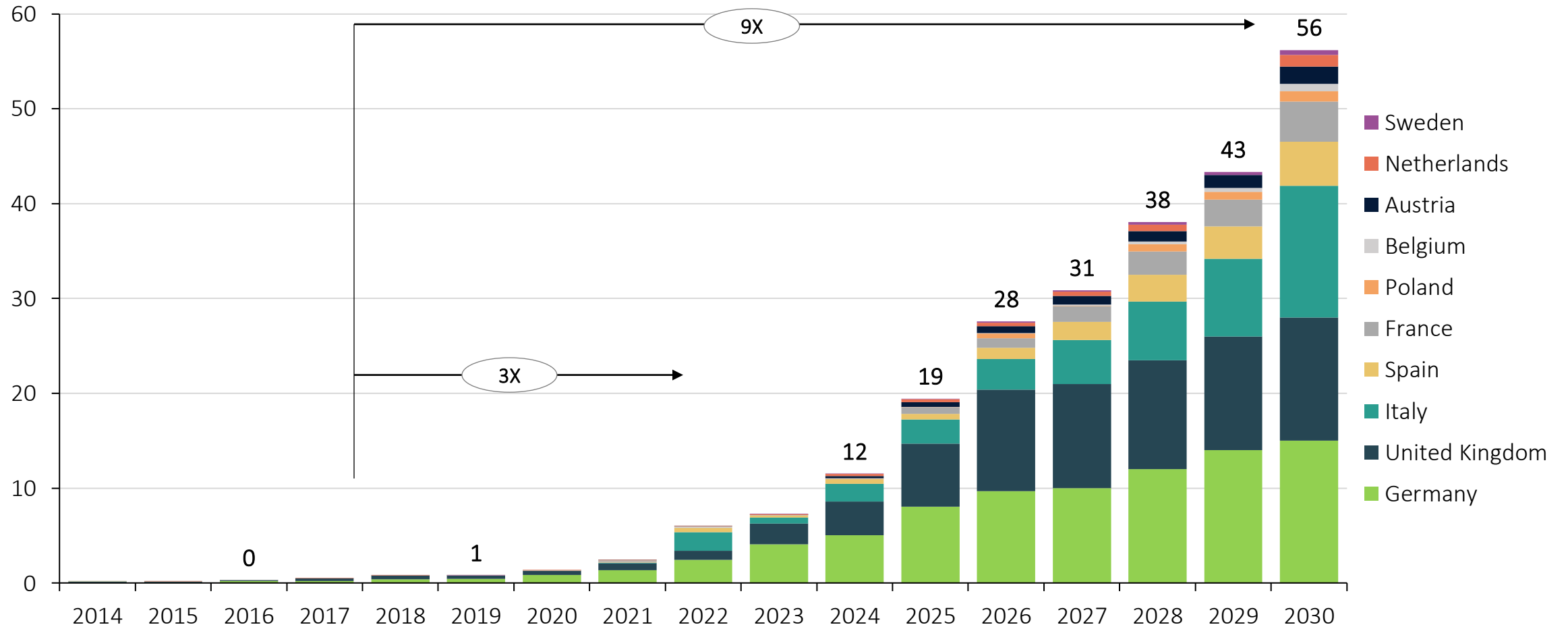
Forecasted annual battery storage added capacity in China  
Gigawatts-hour (GWh)



Source: Rystad Energy BatteryCube, Rystad Energy Renewable&PowerCube

# Utility market in Europe will be 9 times bigger by 2030 and Germany and UK are the pioneers

Annual utility battery storage installation in top 10 European market  
Gigawatts-hour (GWh)



Source: Rystad Energy BatteryCube

# Contact

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VP, Head of Battery Markets





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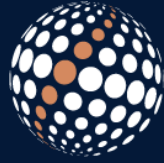
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Navigating the future of **energy**

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SunTera – Jinko Solar Utility Scale Liquid Cooled ESS  
A contribution towards a lower LCOS



# Presentation Topics:

1. Company Introduction
2. Major Application Scenarios
3. Liquid Cooled vs. Air Cooled ESS: Area Utilization
4. Liquid Cooled vs. Air Cooled ESS: Lifetime Assessment
5. SunTera ESS Solution

# Jinko Solar

## Company Introduction

SunTera - Jinko Solar Utility Scale Liquid Cooled ESS  
A contribution towards a lower LCOS



# Company Structure & Production Capacity

Jinko Solar is the first company to establish a "**vertically integrated**" production capacity from silicon material processing to wafer, cell and module production in the industry. It has a total of **14 global production** bases in China, the United States, Malaysia and Vietnam.

As of Q4 2022, the company's effective production capacity:

- ESS production capacity (3GWh - 2023 | 8GWh - 2024)
- Monocrystalline silicon wafers (65GW)
- Cells (55GW)
- Modules (70GW)





# ESS Factory

Our 3GWh ESS factory is located in Jianshan, Haining, Zhejiang Province with over 103 thousand square meters in area





# Jinko Solar ESS Solutions (C&I and Utility)



**JKS Microgrid Solutions**  
Air-Cooled  
From 50kWh - 8MWh  
DC & AC Coupled with PV



**SunGiga - Liquid Cooled**  
DC 1000V System — 215kWh  
DC 1500V System — 344kWh



**SunTera - Liquid Cooled**  
3.44MWh and higher  
DC & AC coupled with PV

SunTera - Jinko Solar Utility Scale Liquid Cooled ESS  
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# Application Scenarios

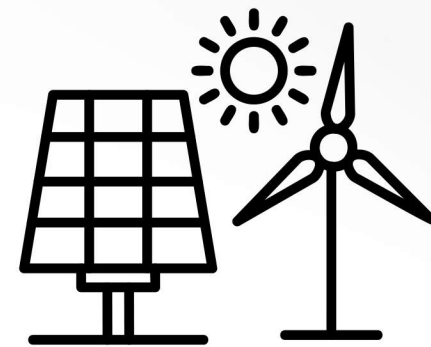
for

## Energy Storage Systems

# ESS Application Scenarios

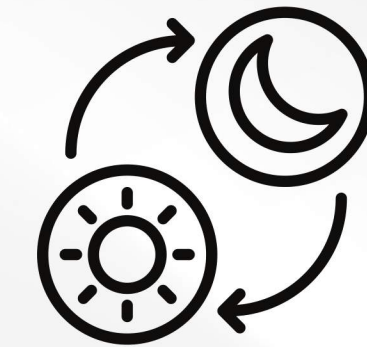
## Solar (PV) Peak-Shaving

Integrated with PV grid-connected energy systems



## Peak & Valley Arbitrage

Grid tariff fluctuating? Jinko Solar ESS solutions will help minimizing the energy bill on the consumers



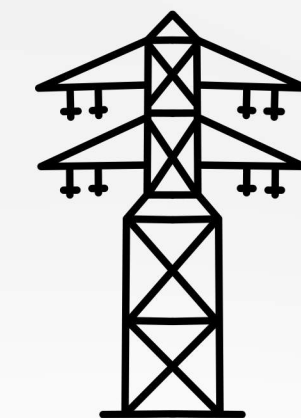
## Microgrid – Rural Electrification

Solar (PV)+ ESS + DG

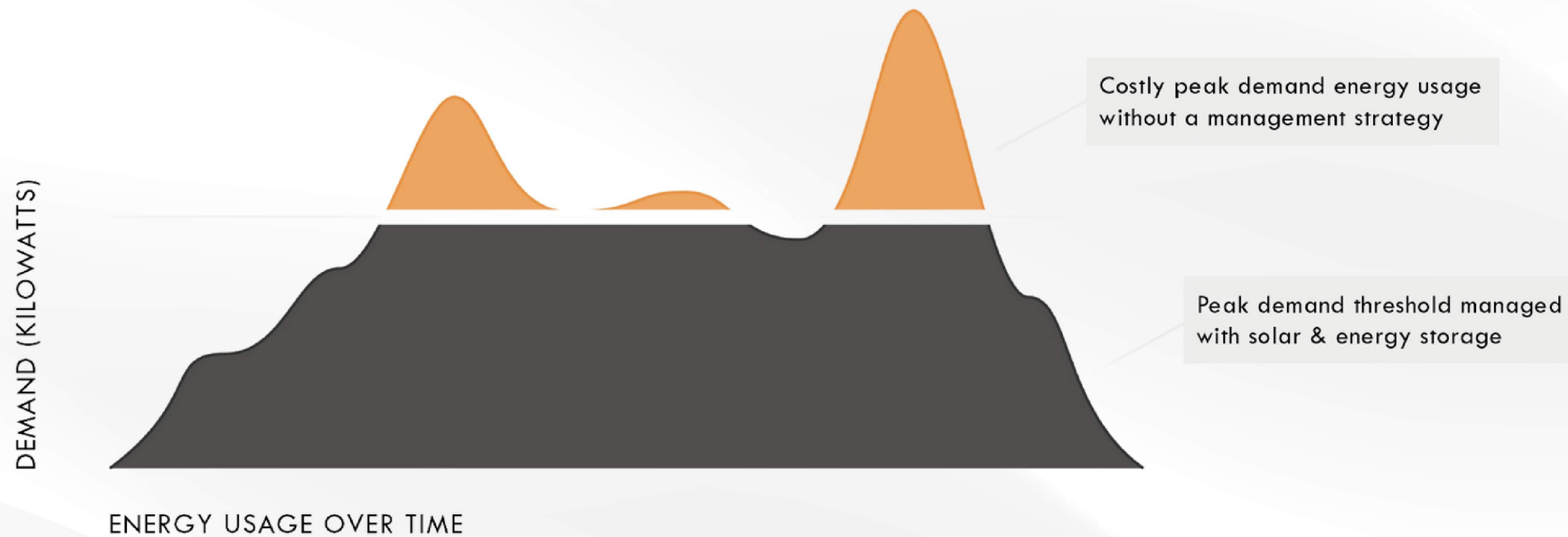


## Grid Support & Frequency Response

Utility-scale ESS solutions by Jinko Solar support the grid by smoothing out the net energy load demand



# Solar (PV) Peak-Shaving or Energy Shifting



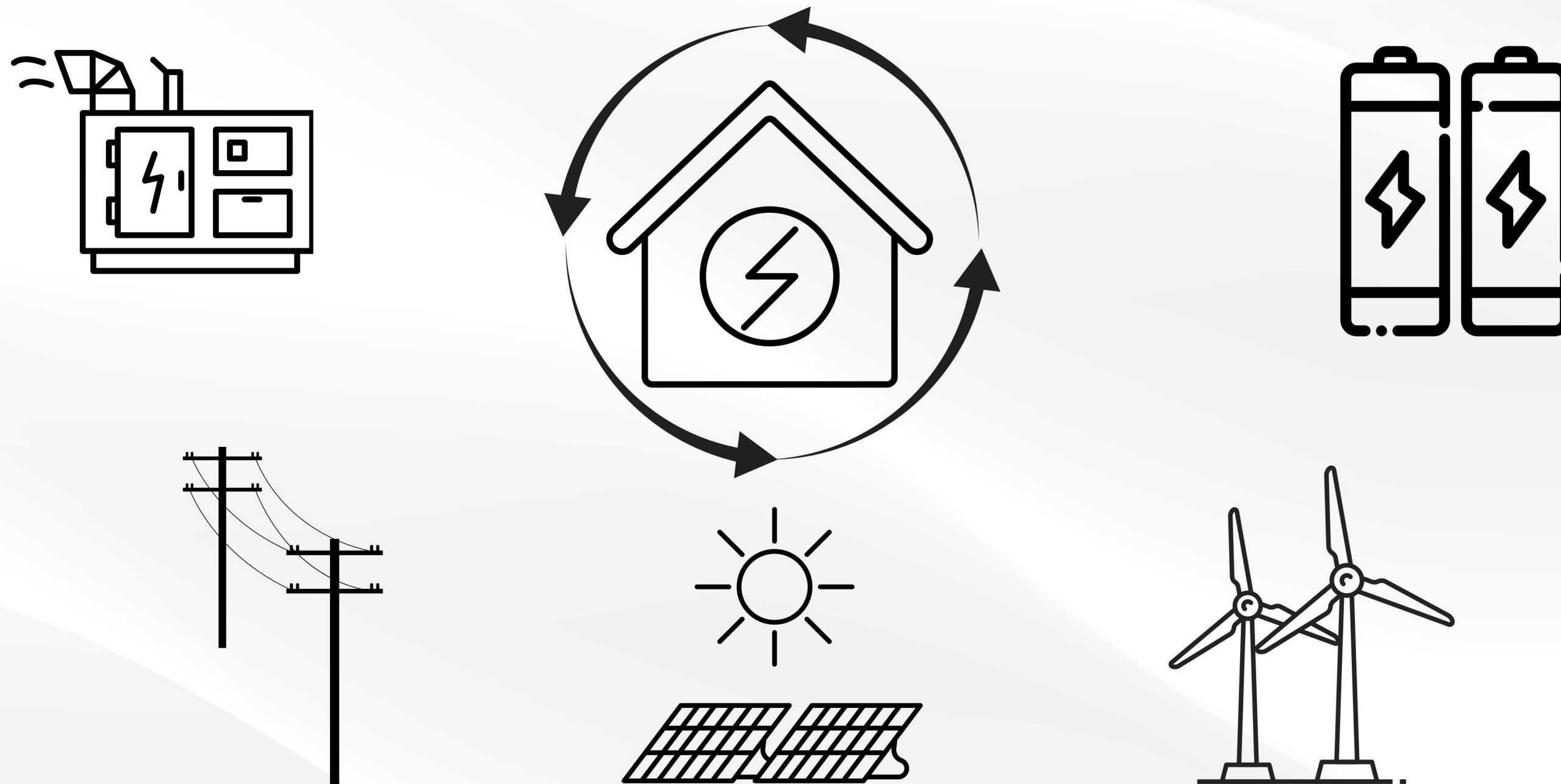
Extending the solar hours using an Energy Storage System (ESS)

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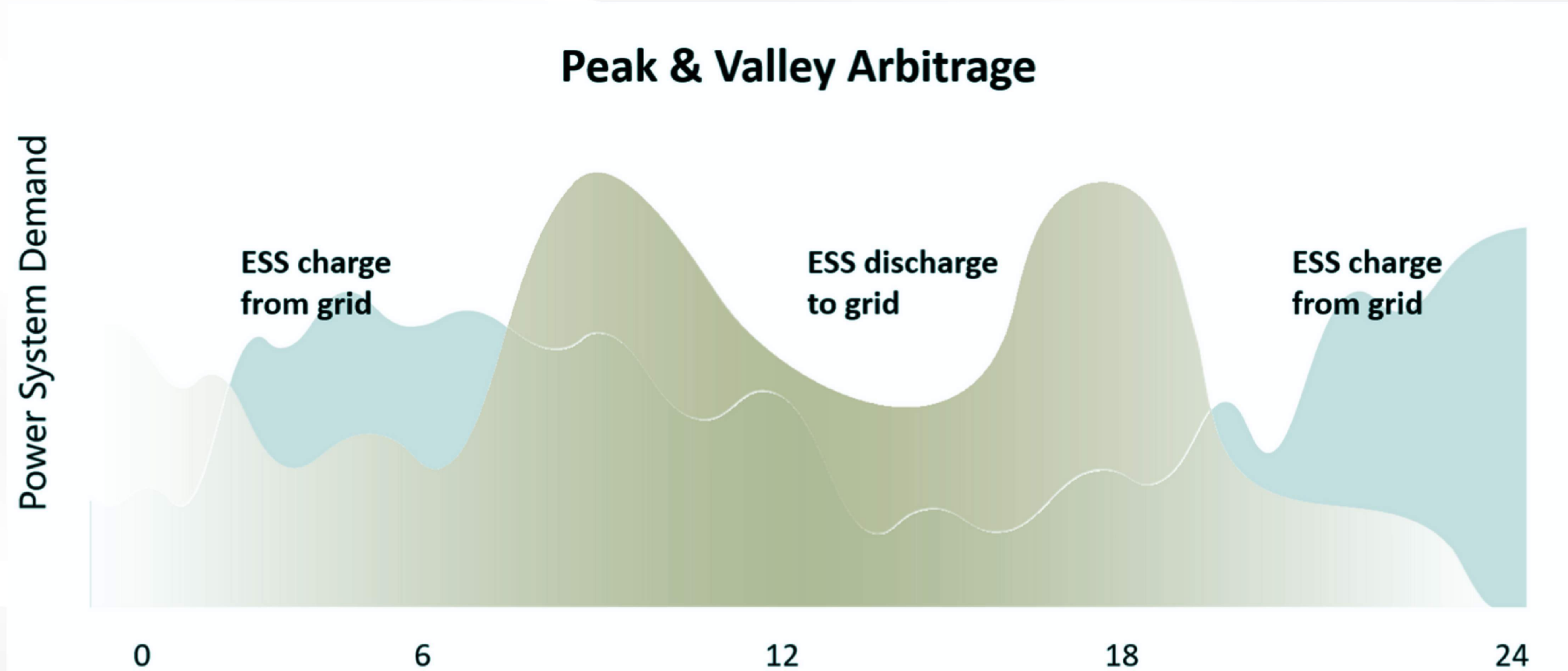
# Microgrid – Flexibility Matters



Flexible energy dispatching and generation sharing  
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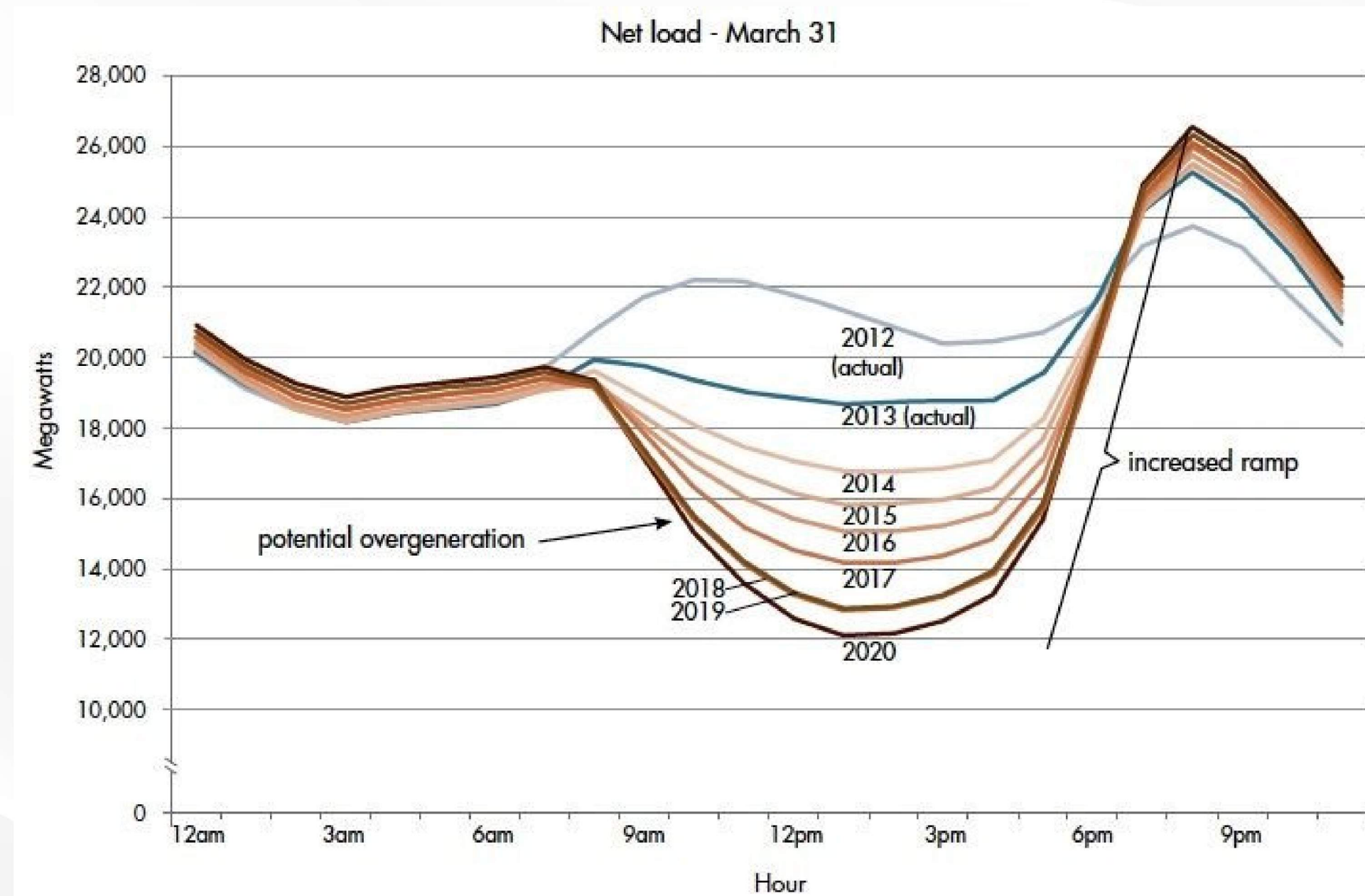


# Peak & Valley Arbitrage



Using ESS could be profitable in fluctuating grid tariff scenarios

# Grid Support & Frequency Response



CAISO DuckCurve - A great example on what major cities are facing.

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# Liquid Cooled Energy Storage Solutions

## Major Highlights



# 20% Lower Energy Consumption

## 1. 35% less consumption vs air cooling

Thermal management : **21.5X** thermal conductivity of the air

Thermal conductivity of the coolant:

**0.56**

Thermal conductivity of the air:

**0.026**

## 2. 20% less consumption vs conventional liquid cooling

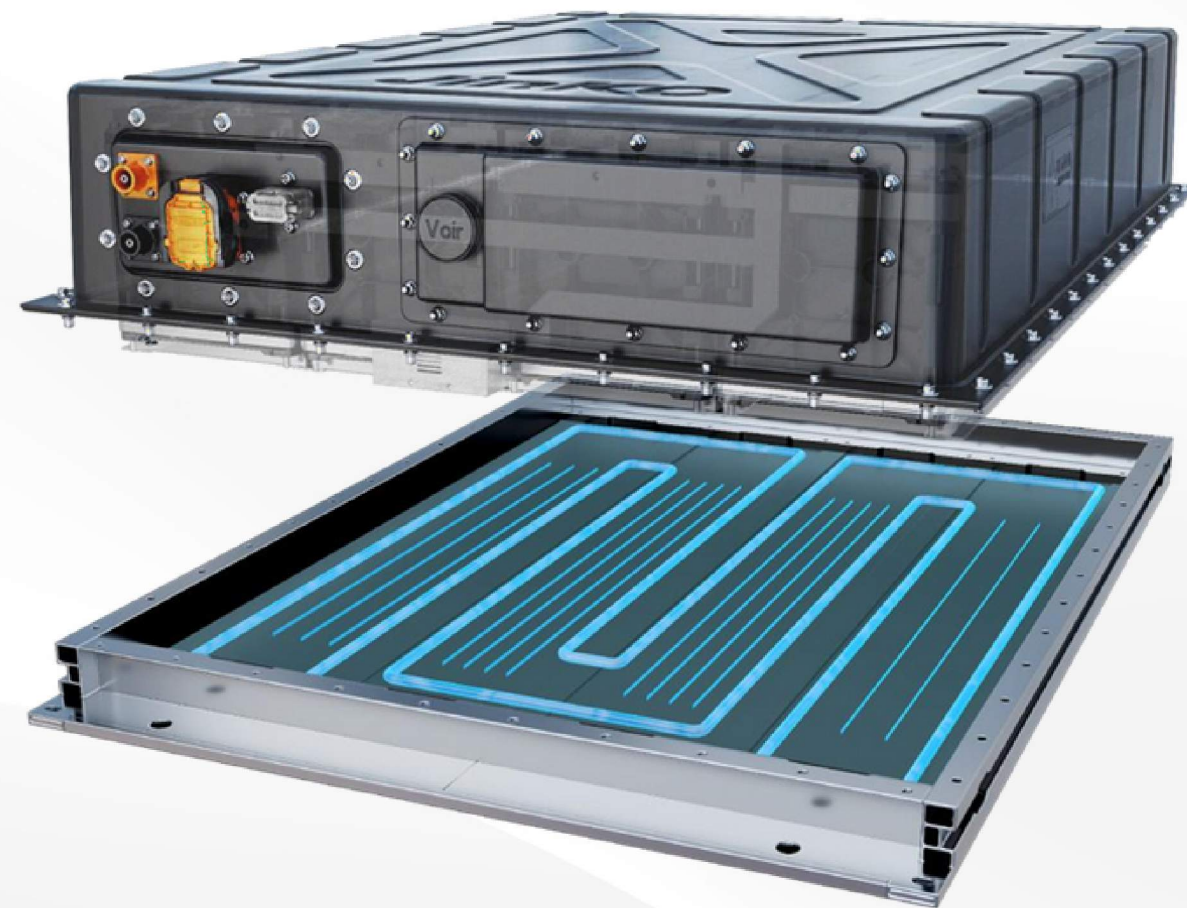
Multiple liquid cooling control modes, accurate liquid flow  
Monitor and control based on cell & operating temperatures





# 10% Longer Service Life

The advanced liquid-cooling technology allows the coolant flow through the pipes to evenly cooling the packs, adding 10% service life to the whole unit.



Non-uniform and refined pipeline design



Uniform heat dissipation of all packs,  
temperature difference  $\leq 2.5^{\circ}\text{C}$

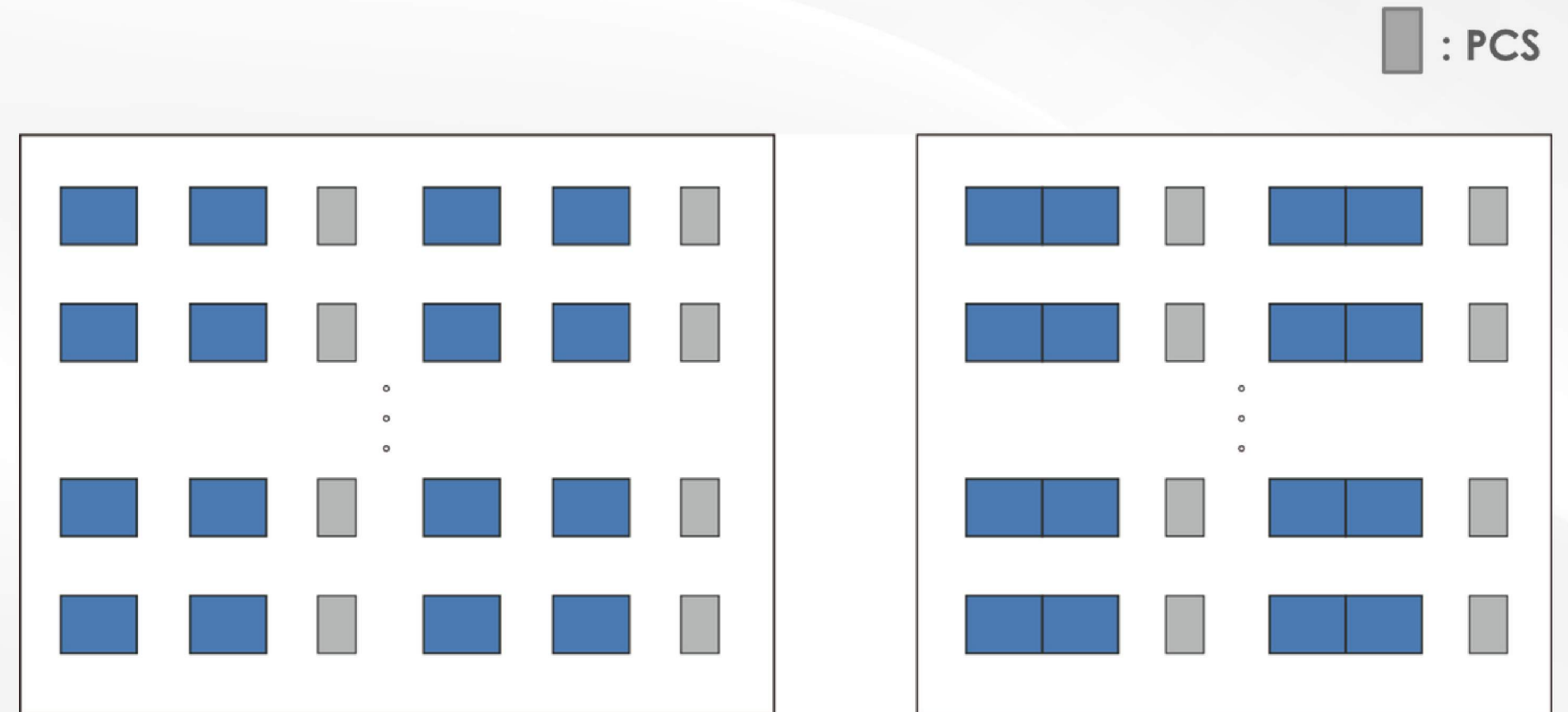
# Liquid Cooled vs. Air Cooled ESS: Area Utilization



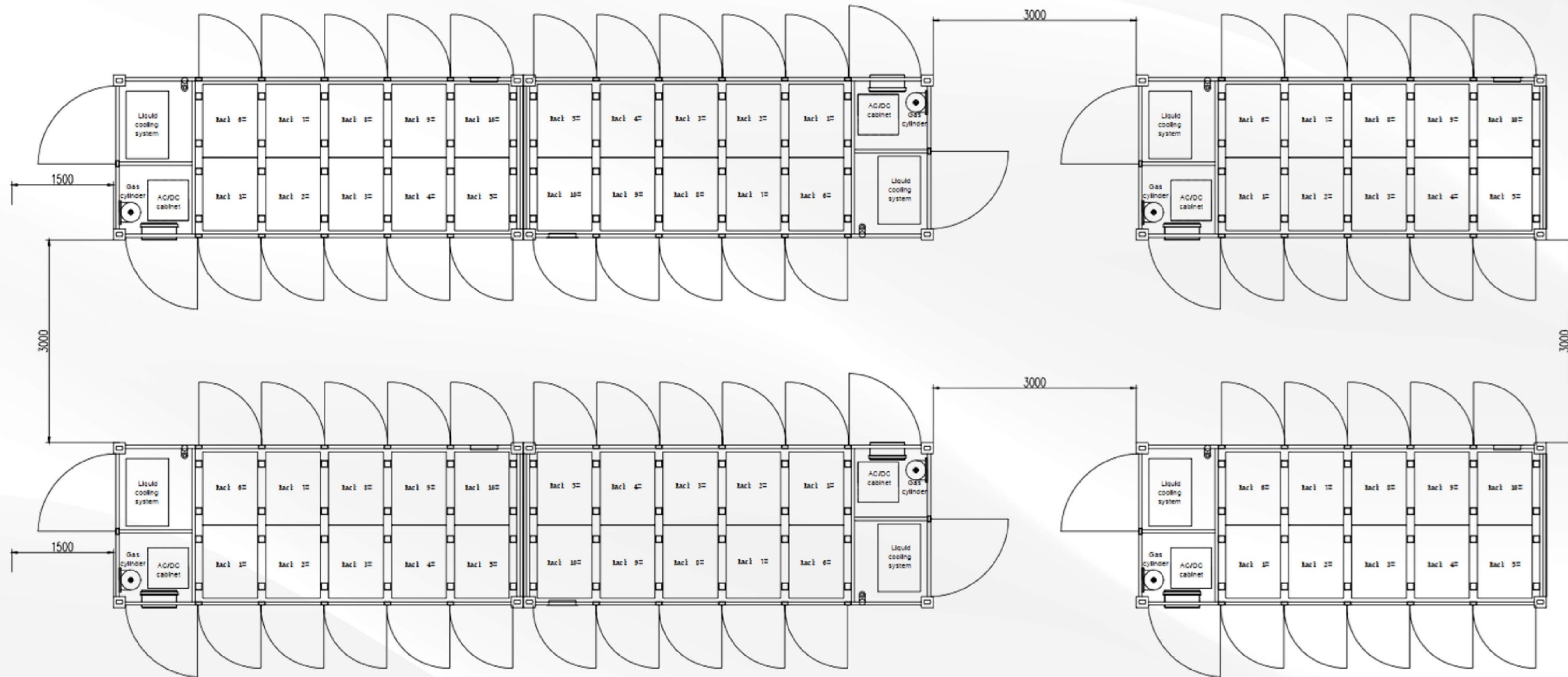
# 15% Higher Energy Density Compared to Air-Cooled ESS



Supporting Side by Side Layout



# Side by Side Configuration



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A contribution towards a lower LCOS



# 100MWh Project Example

## Jinko Solar SunTera

ESS Containers		PCS	ESS Containers	
1	9	1	17	24
2	10	2	18	25
3	11	3	19	26
4	12	4	20	27
5	13	5	21	28
6	14	6	22	29
7	15	7	23	30
8	16	8		

Total 100MWh Project Area	1715.26 Sqm
Total PCS Capacity	51.75 MW
Total ESS Capacity	103.20 MWh
C-Rate	0.50

## Other Liquid Cooled ESS in the Market

ESS Containers		PCS	ESS Containers		
1	2	1	6	21	22
3	4			23	24
5	6	2	7	25	26
7	8			27	28
9	10	3	8	29	30
11	12			31	32
13	14	4	9	33	34
15	16			35	36
17	18	5	10	37	
19	20				

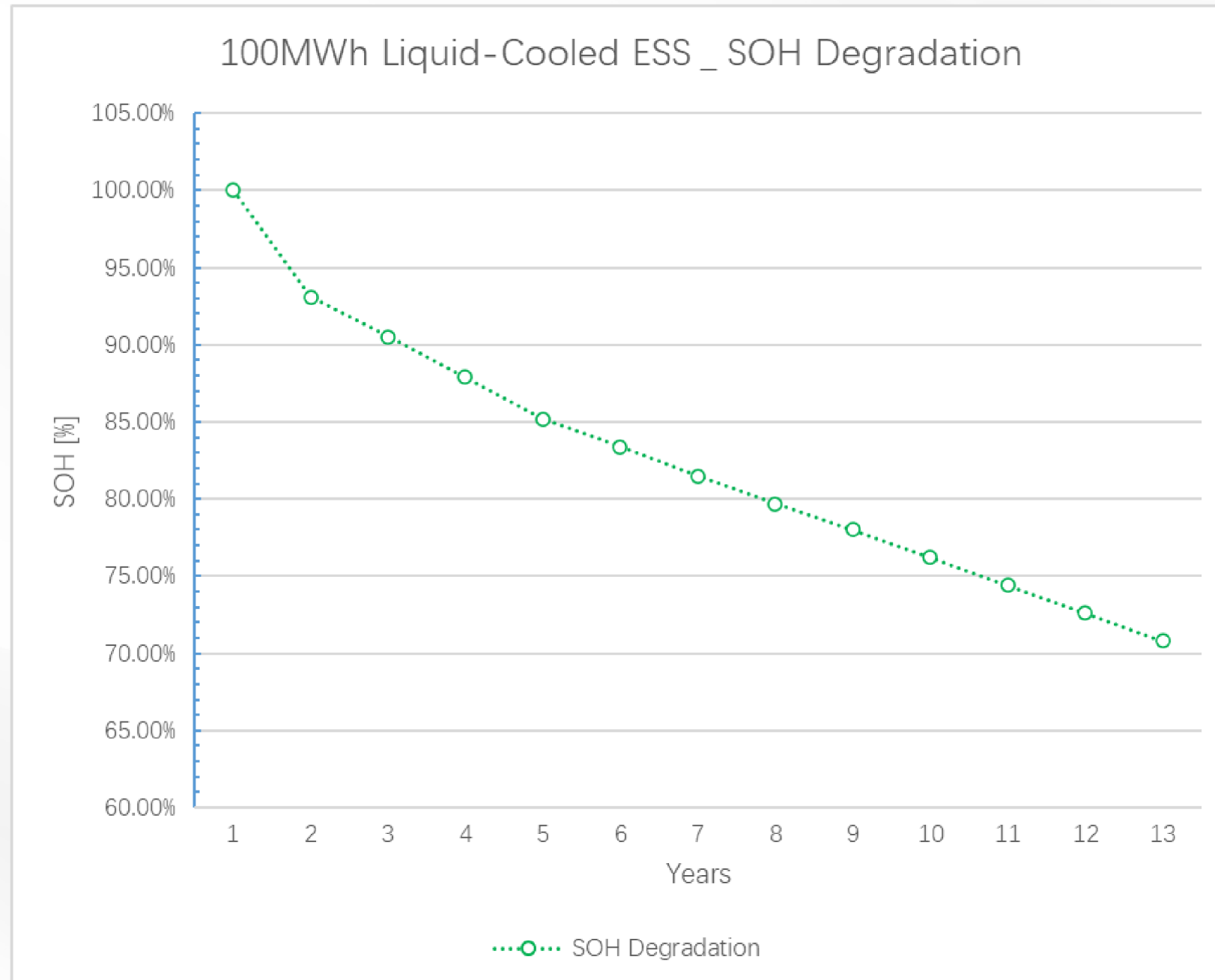
Total 100MWh Project Area	2095.06 Sqm
Total PCS Capacity	55.00 MW
Total ESS Capacity	101.82 MWh
C-Rate	0.54

# Liquid Cooled vs. Air Cooled ESS: Lifetime Assessment

# 100MWh Project Example

## Jinko Solar SunTera

## Air Cooled ESS



SunTera - Jinko Solar Utility Scale Liquid Cooled ESS  
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# SunTera 3.44MWh

Our Liquid Cooling System





# SunTera 3.44MWh

Our Liquid Cooling System

Items	Parameters
Type of battery	Lithium Iron Phosphate(LFP)
Cell parameters	3.2V/280Ah
Max. charge/discharge power	<b>0.5P</b>
Configuration of system	1P384S×10
Rated capacity	<b>3.44 MWh</b>
Rated voltage	1228.8V
Cooling method	Liquid Cooling
Environmental temperature	-20~50°C
Environmental humidity	≤95%RH, Non condensation
Altitude	≤ <b>2000m</b> / <4000m (optional, derating)
Noise level	< 80dB(A)@1m
IP Grade	<b>IP54</b>
Storage temperature	-20~45°C
Fire protection	Gas Sensors + Deflagration Venting+ FM200/Novac 1230/Aerosol + Water Dry Pipe
Corrosion-proof grade	<b>C3</b> (EN ISO 12944)/ <b>C4</b> (optional)/ <b>C5</b> (optional)
Dimensions (L×W×H)	6058×2438×2896mm
Weight	≈35000 kg
Design life	<b>20 Years</b>



SunTera - Jinko Solar Utility Scale Liquid Cooled ESS  
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# 30% Cost Saving on Shipping

Standard 20ft Container Design  
30% Shipping Cost Saving



Mass Density ▲

Volume Density ▲

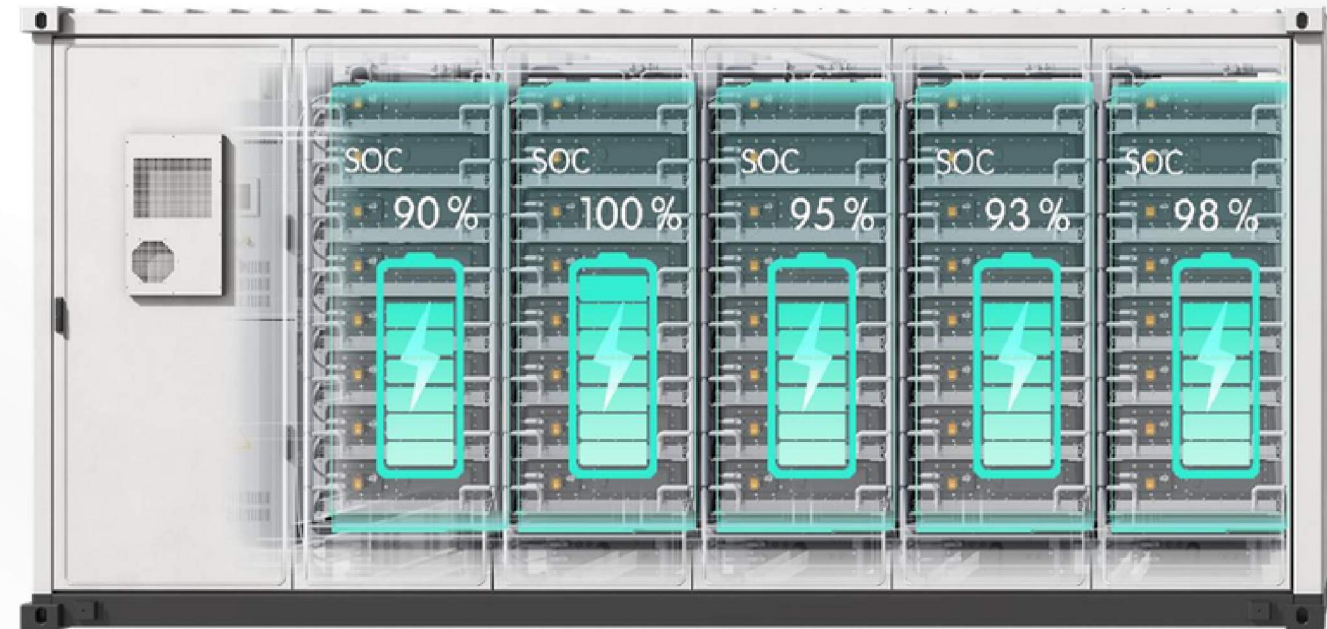
Area Density ▲

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# 1% Higher Round Trip Efficiency

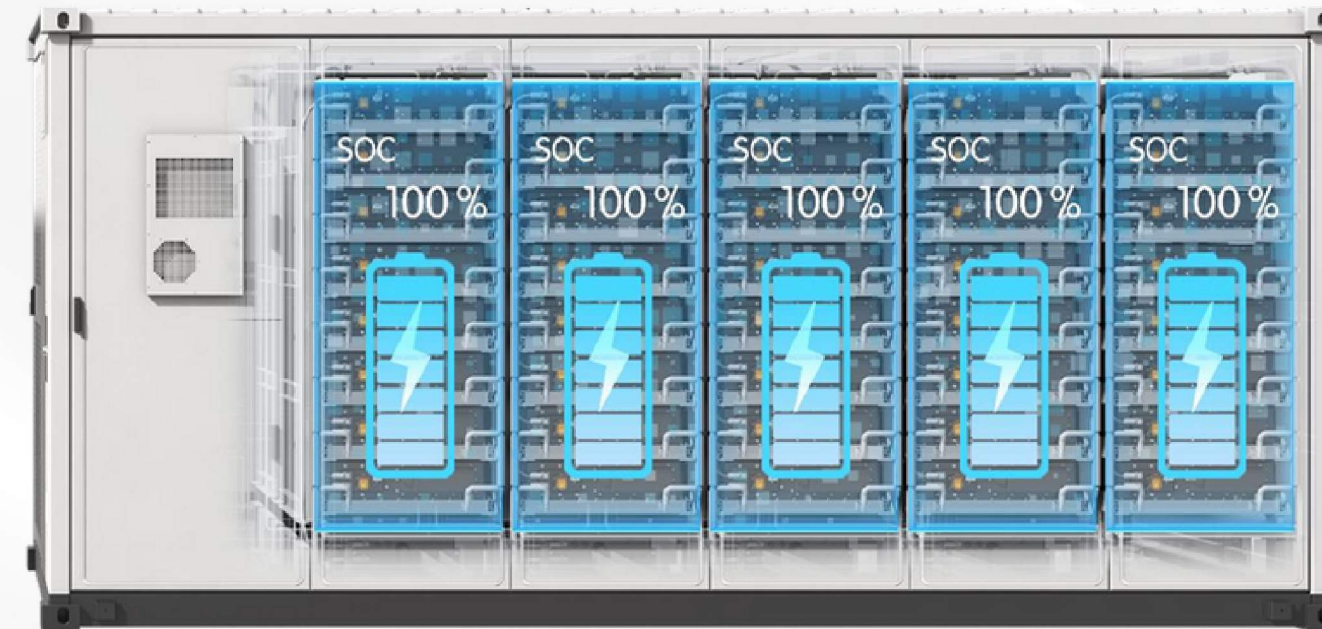
Conventional ESS without Cluster Management



**Traditional mode**

When a cluster is fully charged, the charging process will be stopped at the same time

Our SunTera with Smart Cluster Management



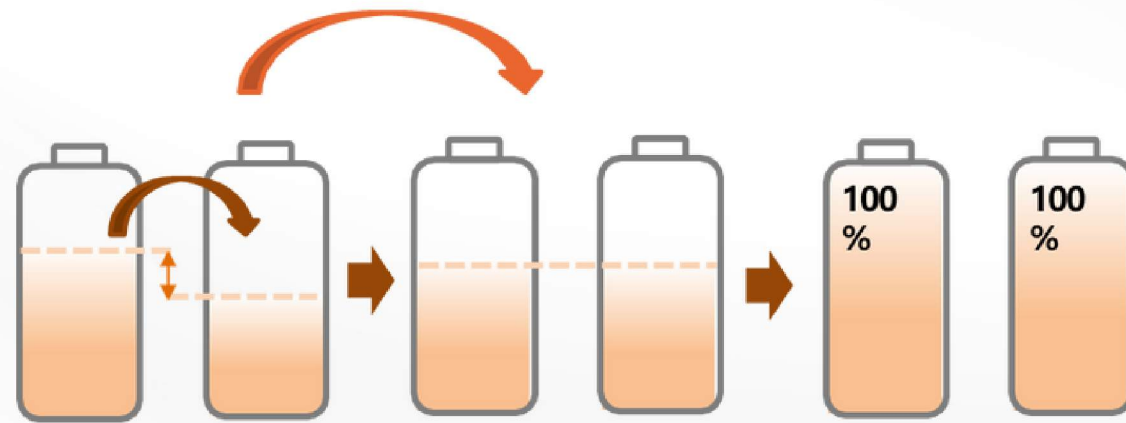
**Automatic drop out**

Fully charged/discharged cluster drops out automatically while the remains keep charging/discharging

# Operation & Maintenance Improvements

## SOC Auto Balancing - Passive & Active

No need for system shutdown or manual SOC calibration



## Dynamic Coolant Replenishment

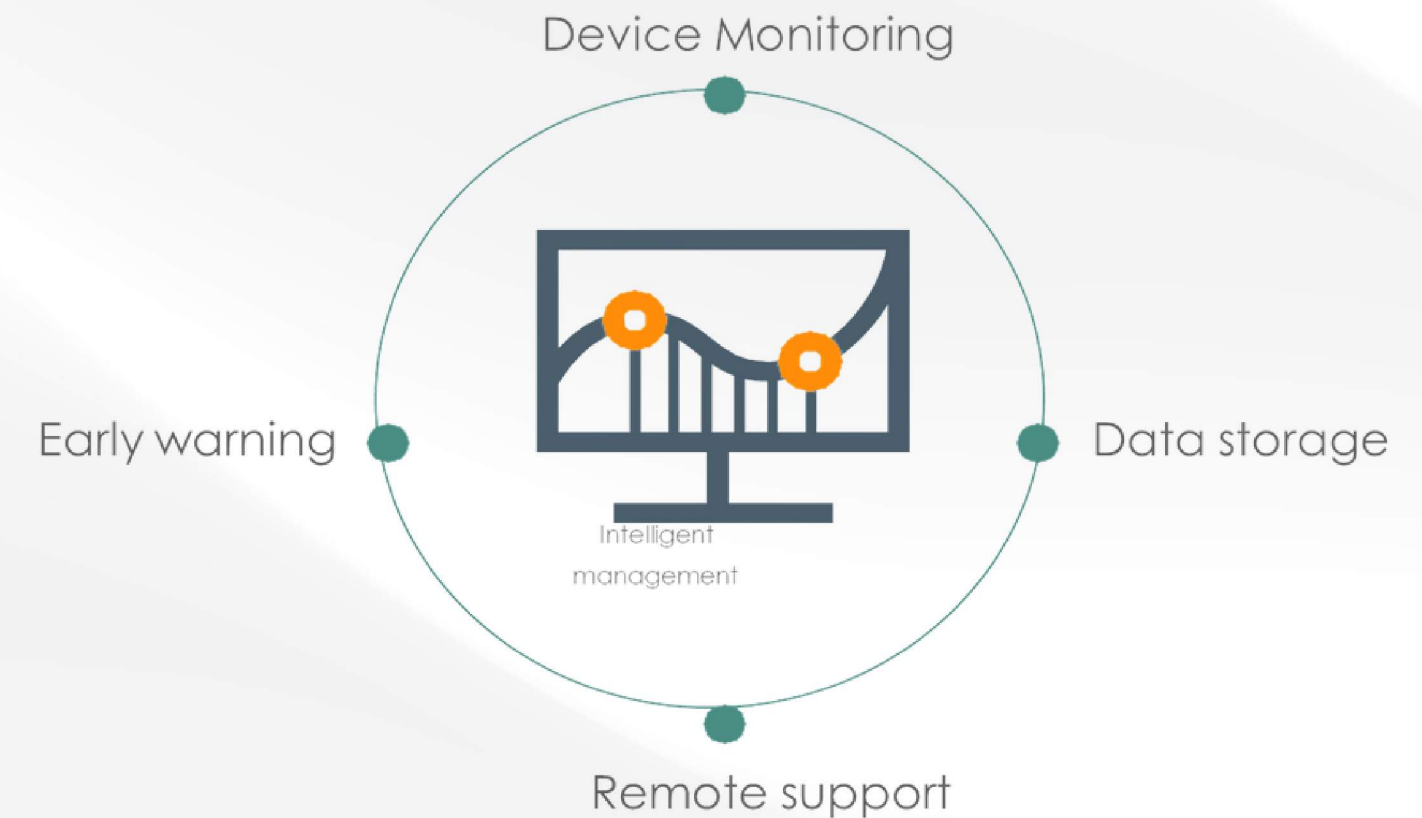
60% less replenishment workload

- No need for frequent manual coolant replenishment
- Keep the optimal heat dissipation

## Online Monitoring

30% less inspection

- Online Inspecting Check
- Battery Safety Monitoring
- Liquid Leakage Monitoring
- Devices Status Monitoring





# 50% Shorter On-site Installation Time & Least Labor Intervention

On-Site installation could be done in less than 8 hours, thanks to our systems which are delivered:

- Pre-wired
- Pre-configured
- Pre-assembled



Least Labor Intervention, this is achieved with the help of state of the art artificial intelligence; thanks to the:

- AI-Based BMS analysis of cycling curve bias, realizing online automatic calibration, remote O&M
- Automatic cooling liquid replenishment, 60% labor saving
- Cluster-level management, and easy software upgrade



Thank you for your attention!



# Contact Us:

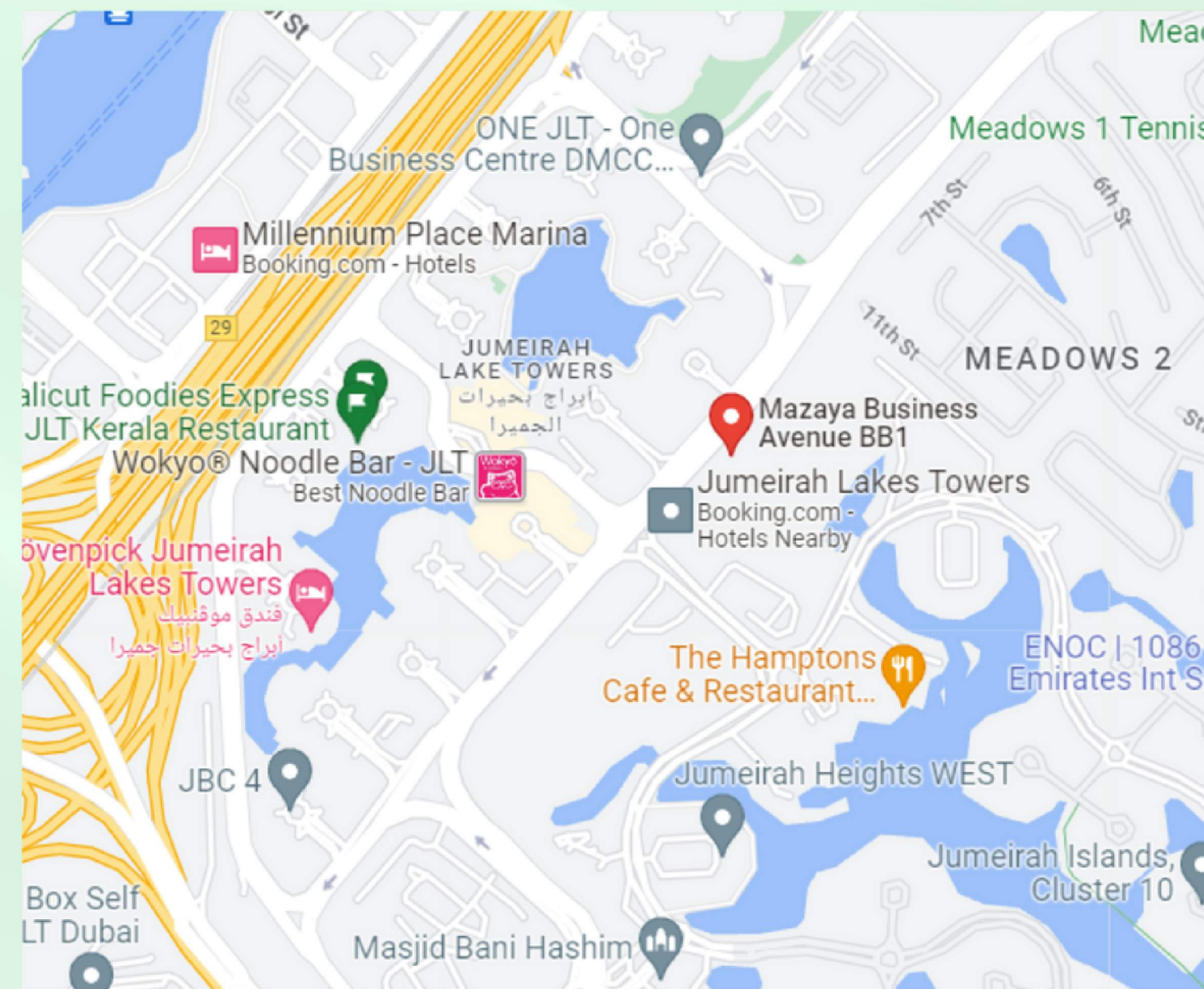
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# Achieving lower LCOS with liquid cooled ESS

## Q&A



**Marija Maisch**

Editor  
pv magazine



**Hamza Al Smadi**

ESS Technical Manager  
JinkoSolar



**Duo Fu**

Vice President of clean tech research  
Rystad Energy

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by David Carroll



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by Sergio Matalucci





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**Tuesday, 22 August 2023**

12:00 pm – 1:00 pm EDT, New York City  
6:00 pm – 7:00 pm CEST, Berlin

**Friday, 25 August 2023**

11:00 am – 12:00 pm CEST, Berlin

**Many more to come!**

**How drone data  
directs O&M crews  
to the right place,  
right time**

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**Marija Maisch**  
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**Thank you for  
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