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CYBPHYS

Development of practically-oriented student-centred education in the field of modelling of Cyber-Physical Systems – CybPhys

609557-EPP-1-2019-1-LV-EPPKA2-CBHE-JP – ERASMUS+ CBHE

MC and WS meeting
March 16-18th 2023

Rīgas Tehniskā universitāte
Institute of Industrial Electronics and Electrical Engineering
Faculty of Electrical Engineering and Environmental Engineering,
Department of Industrial Electronics and Electrical Engineering

Martins Bisenieks

(Energy storage technologies, its challenges and opportunities)

1862
RTU
ENERĢĒTIKAS UN
ELEKTROTEHNIKAS
FAKULTĀTE

Todays plans

Objective: Understand what is battery erergy storage system (BESS)

Tasks:

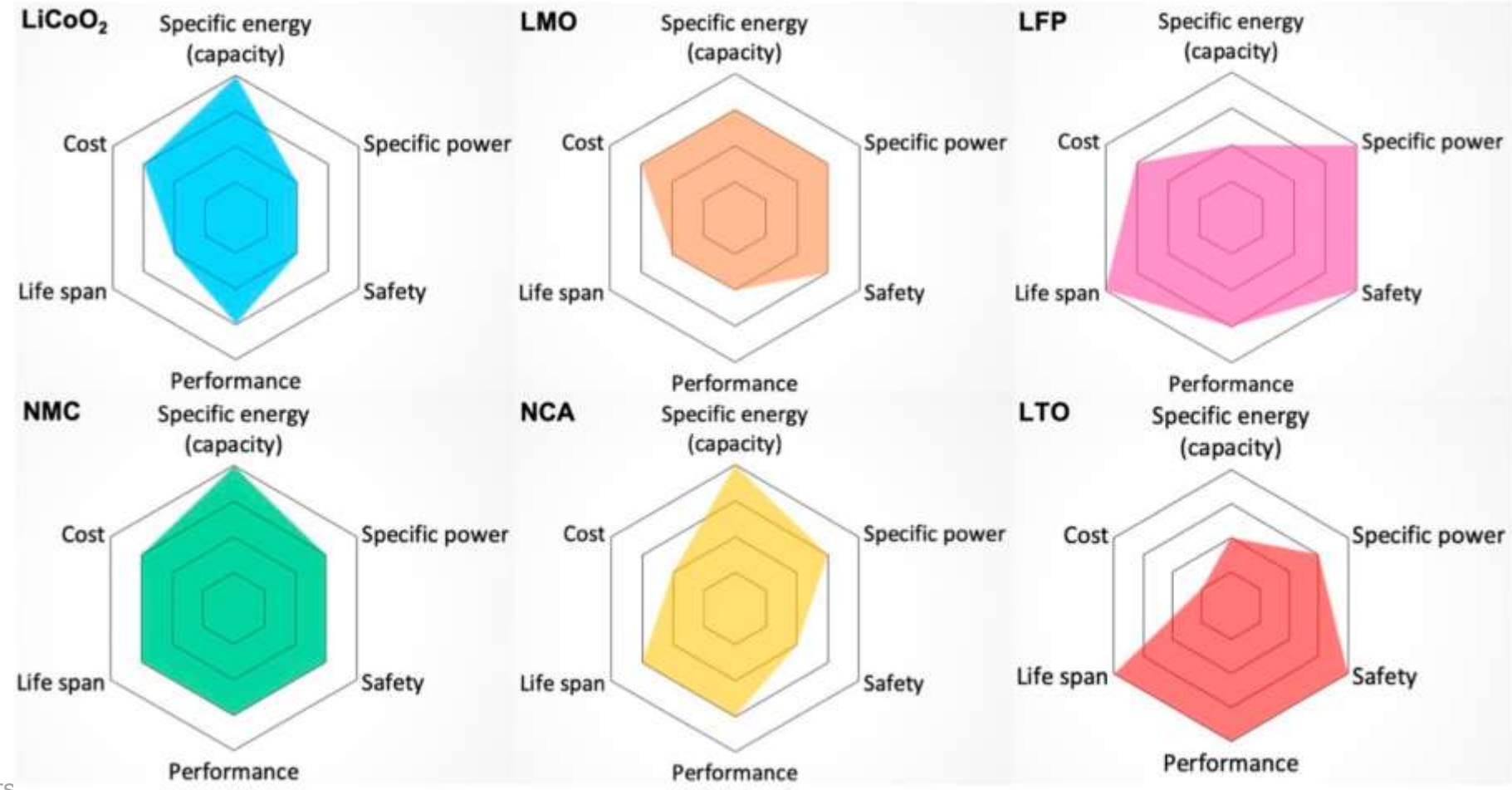
Introduction

Usage examples

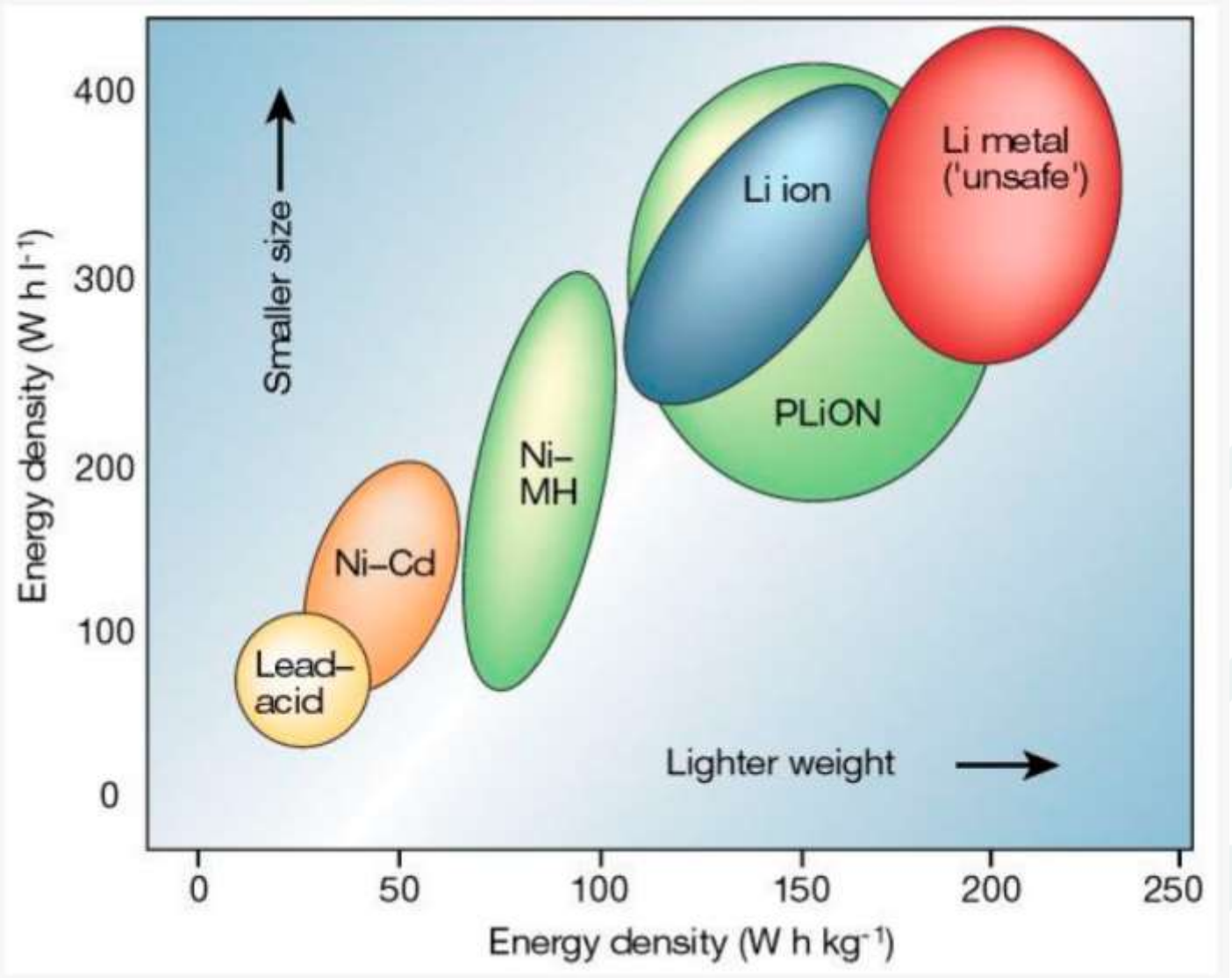
History

- “Baghdad Batteries”
  - ~1000-2000 years ago.
  - Terracotta jars containing a copper cylinder separated from an iron rod by a non-conductive stopper, and filled with an electrolyte.

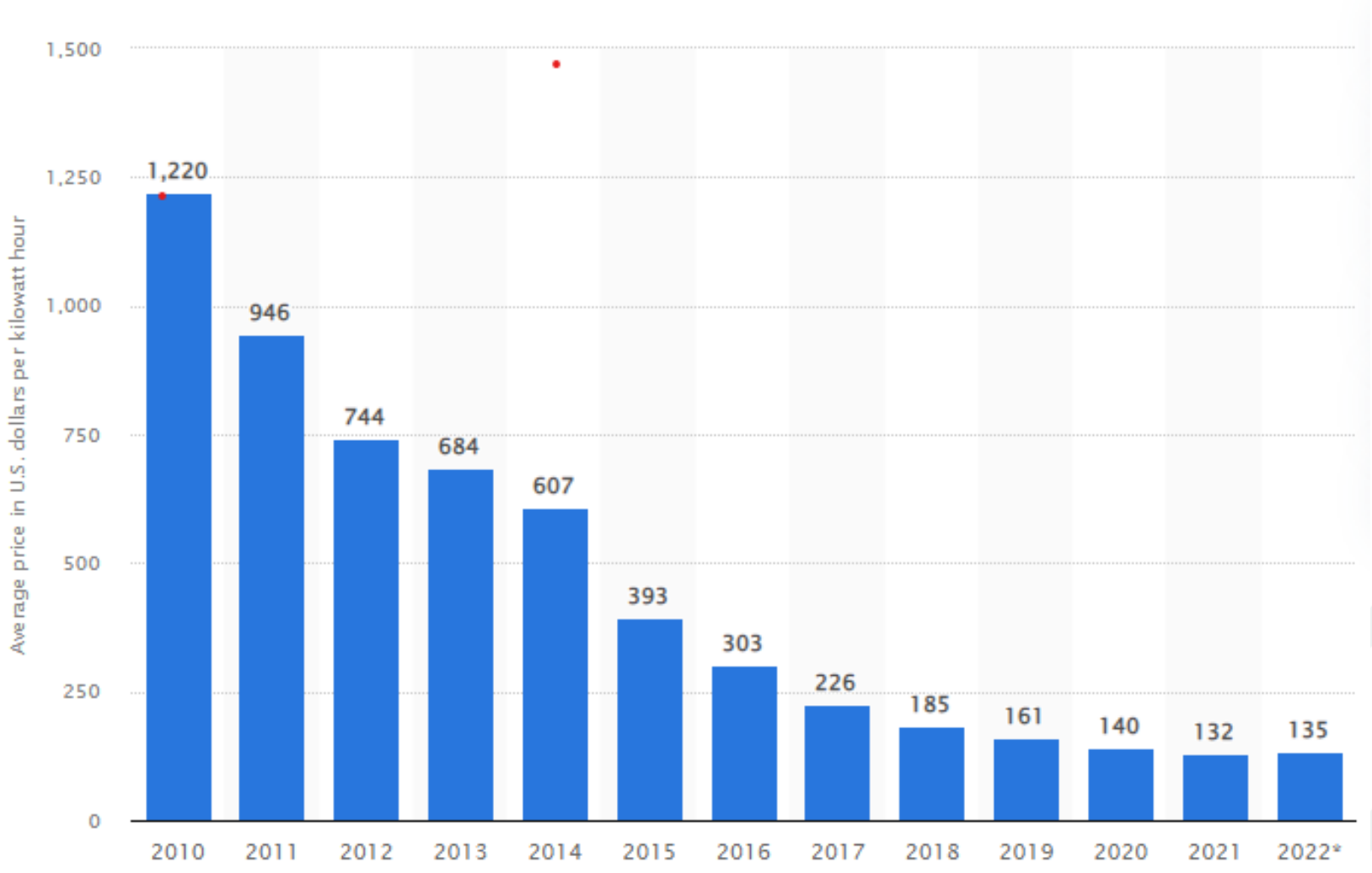
The difference between lithium ion and lithium polymer batteries



The difference between lithium ion and lithium polymer batteries

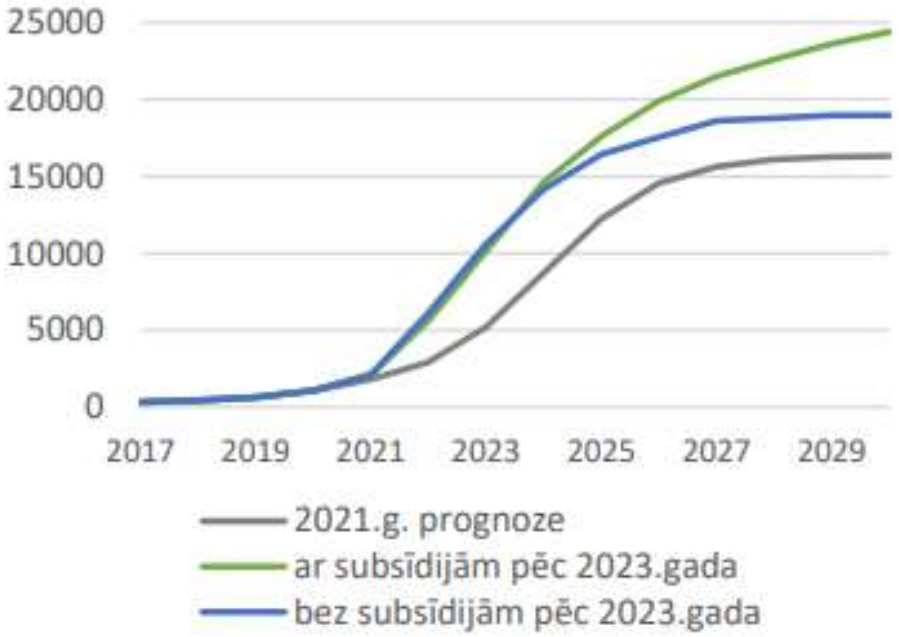


Battery costs



Actualities

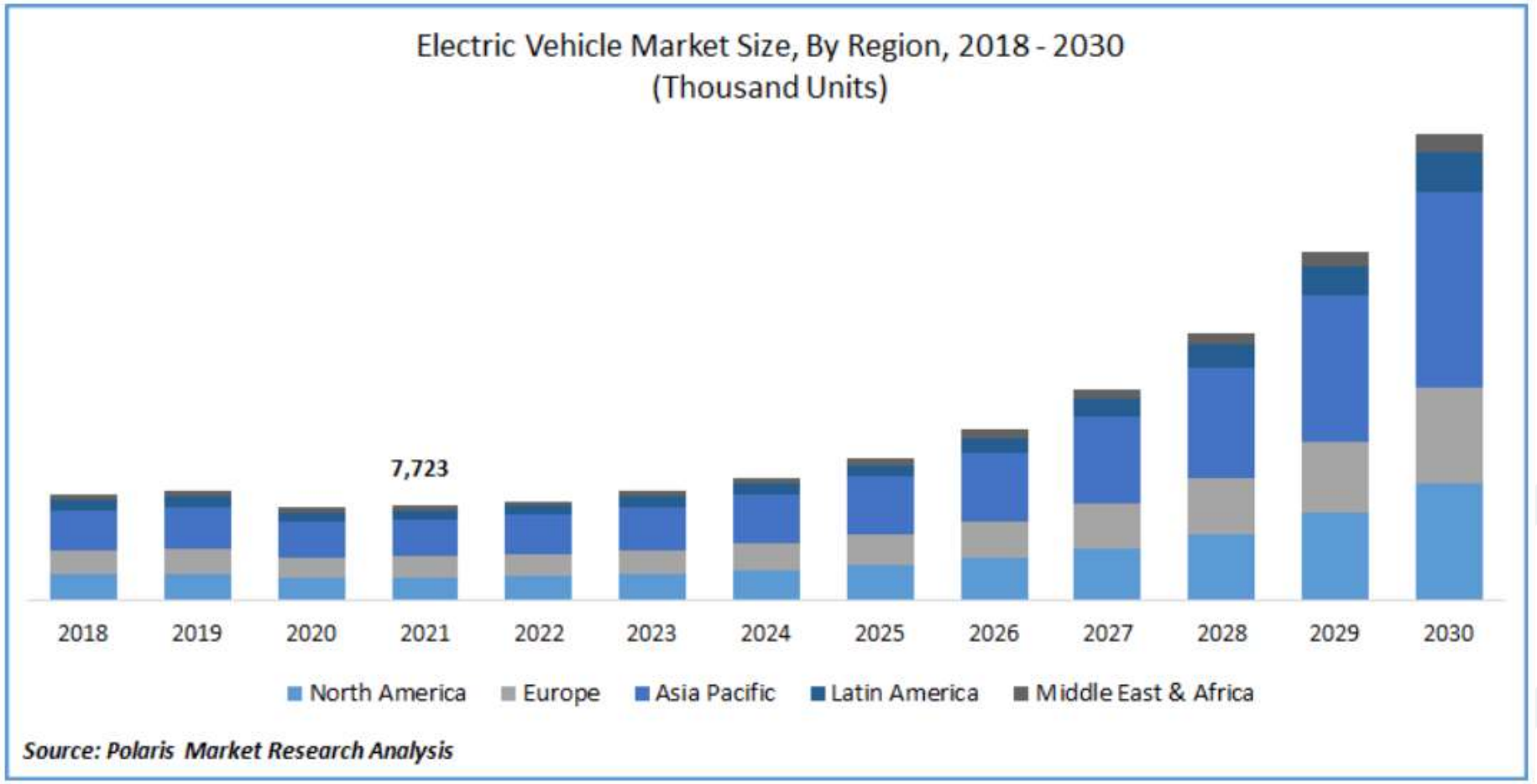
Attēls 20. Rezervētā un uzstādītā SES jauda.



Attēls 18. Kumulatīvais MĢ skaits.

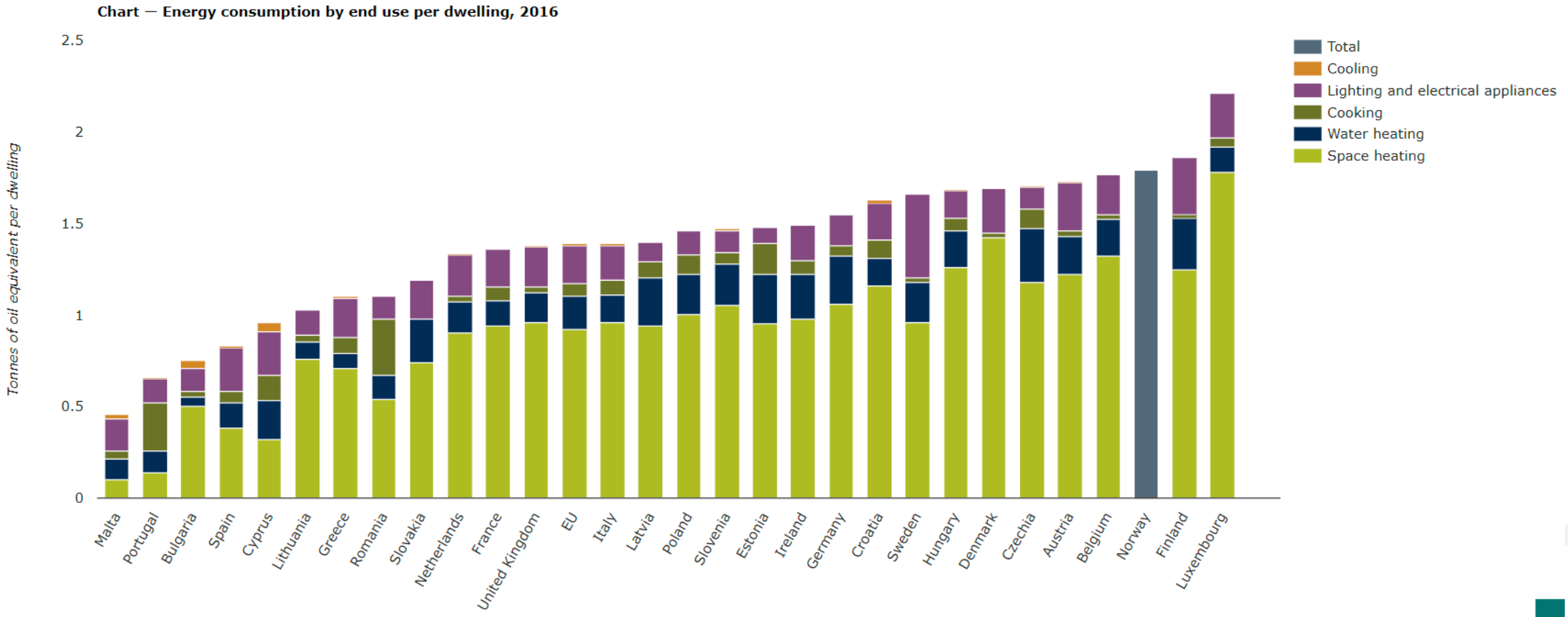
By the end of 2023, the number of micro-generators in the system of JSC Sadales tīkls will most likely exceed already 10,000 with a total capacity of more than 75MW.

Actualities



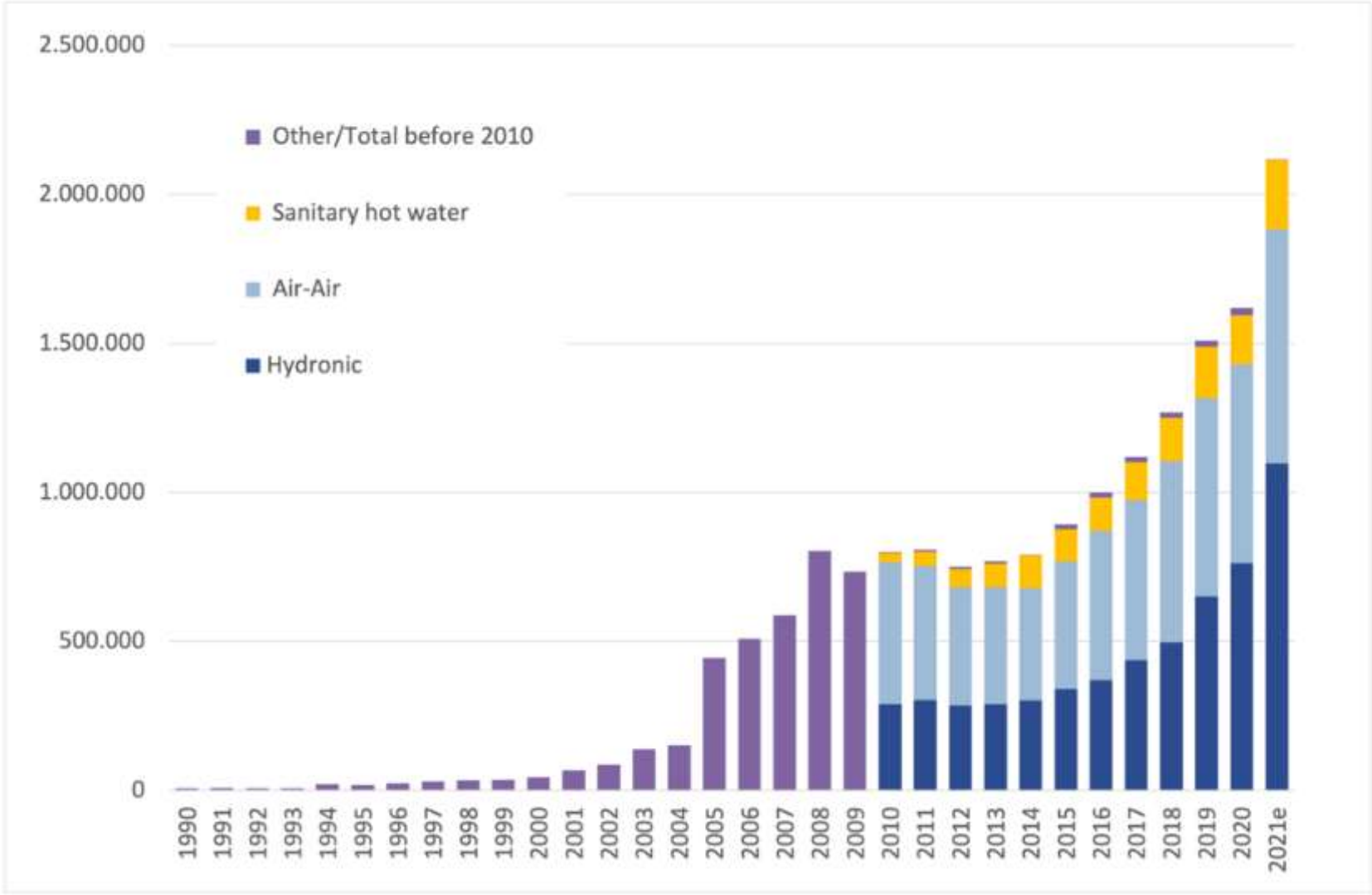
https://www.polarismarketresearch.com/industry-analysis/electric-vehicles-ev-market

Actualities



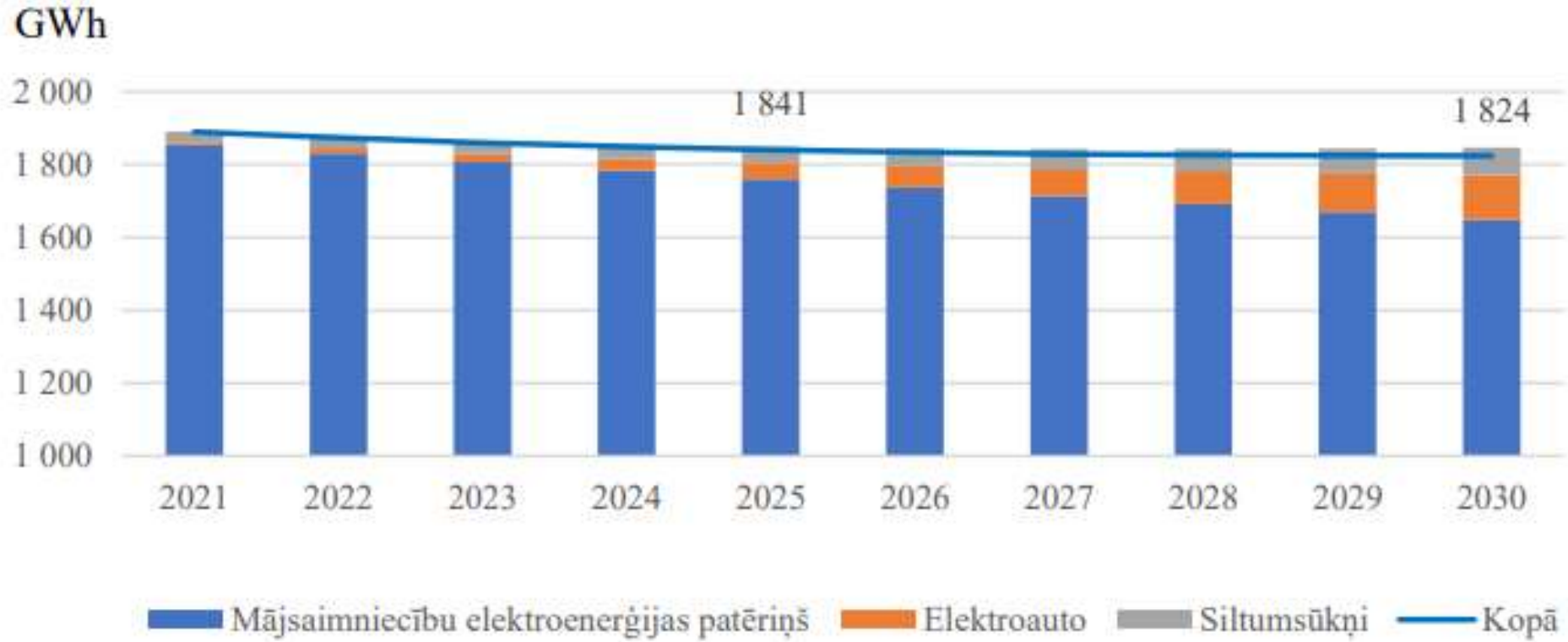
https://www.eea.europa.eu/data-and-maps/daviz/energy-consumption-by-end-uses-3#tab-chart_1

Actualities



https://www.eea.europa.eu/data-and-maps/daviz/energy-consumption-by-end-uses-3#tab-chart_1

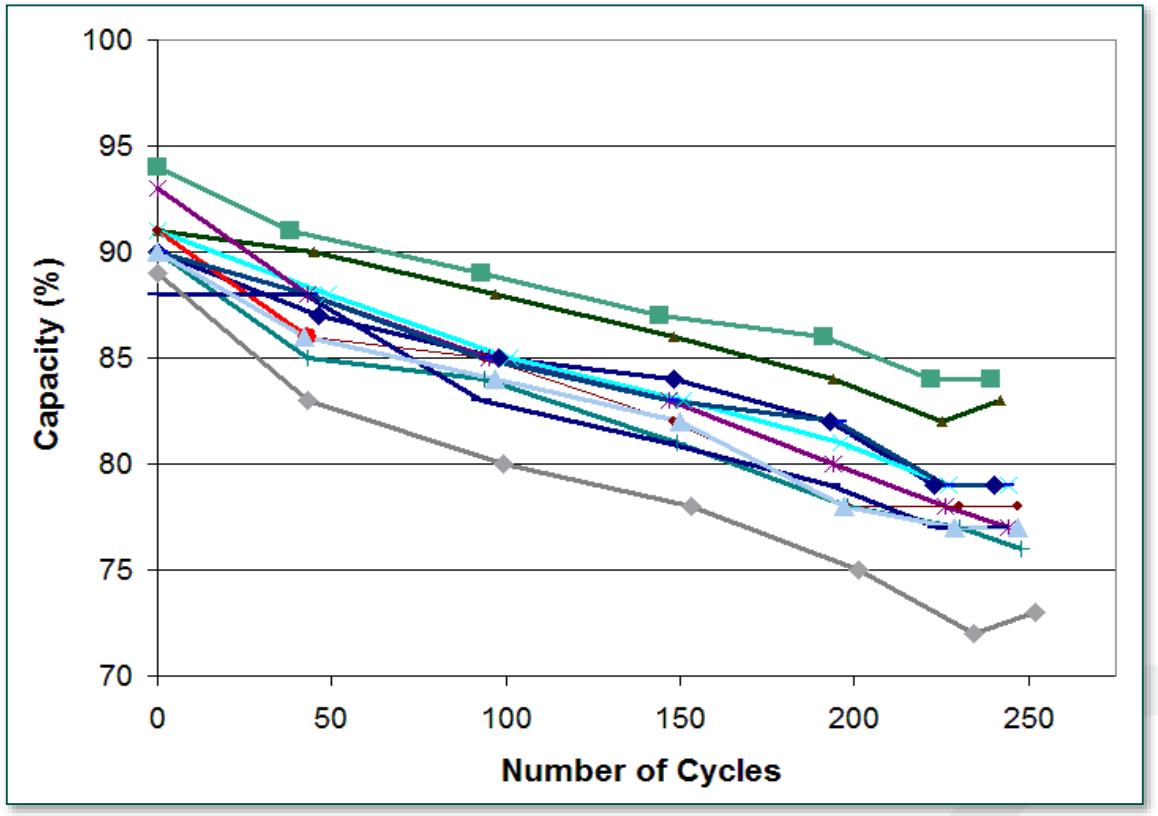
Actualities



Attēls 23 Elektroenerģijas patēriņa prognoze mājsaimniecībās

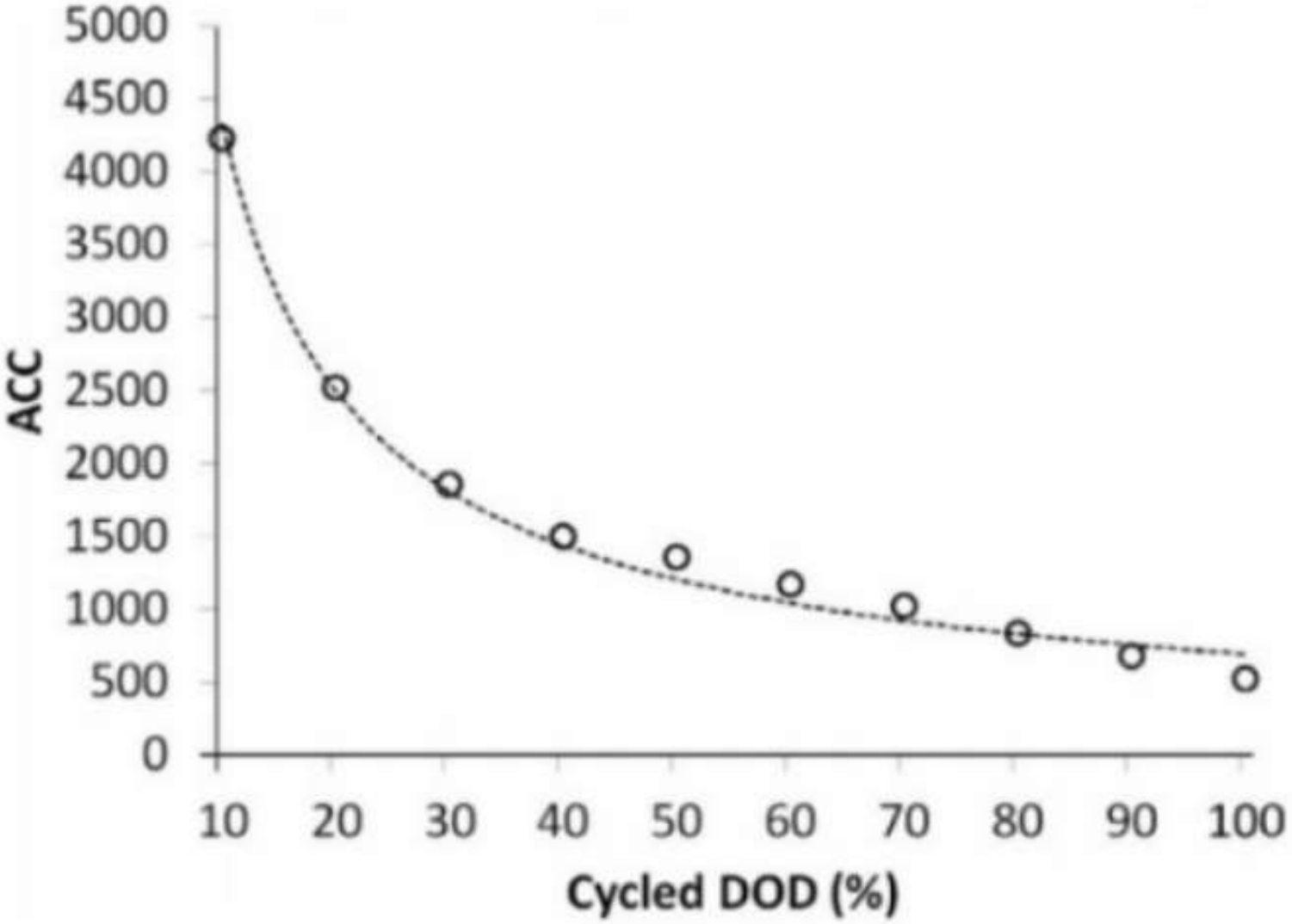
Battery fade cannot be stopped, but slowed

- Li-ion provides 300-500 full discharge cycles
- Capacity is the leading health indicator of a battery
- A capacity-drop to 80 or 70% marks end of life



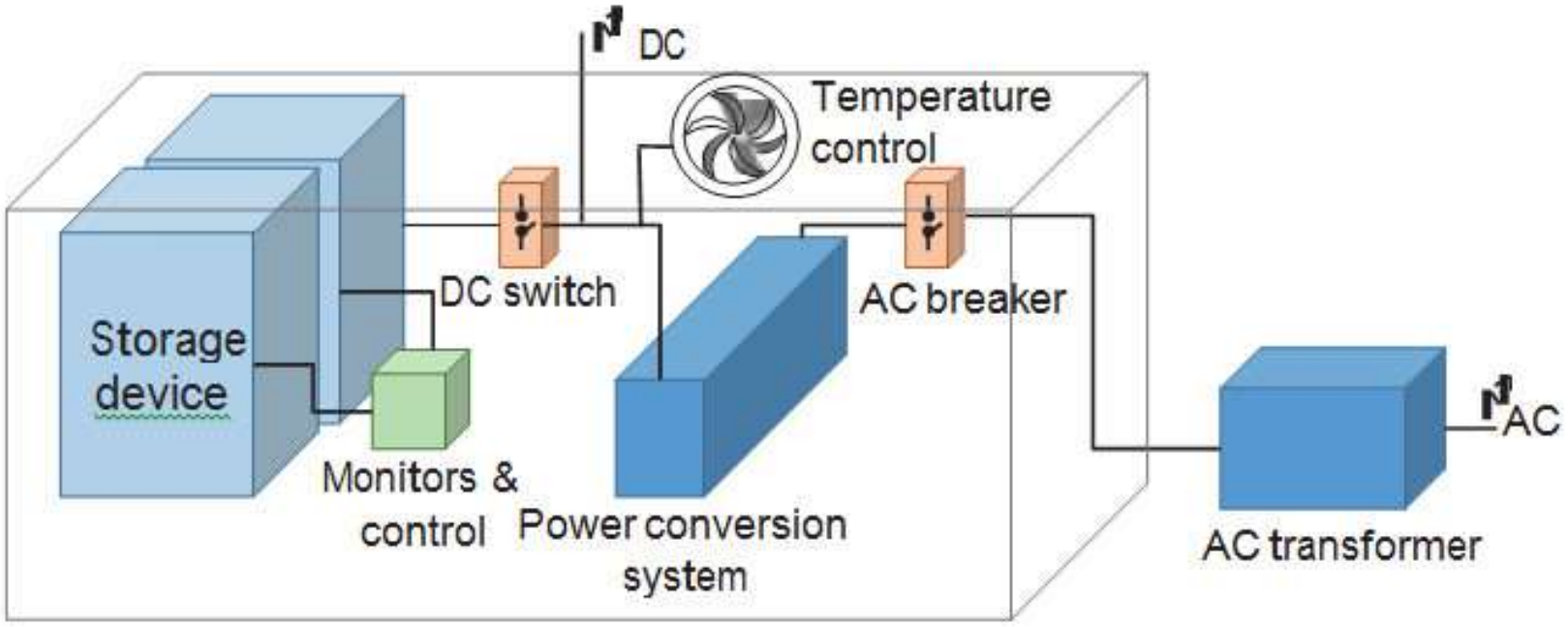
Capacity loss of 11 Li-ion batteries for mobile phones when fully cycled at 1C

Degradation



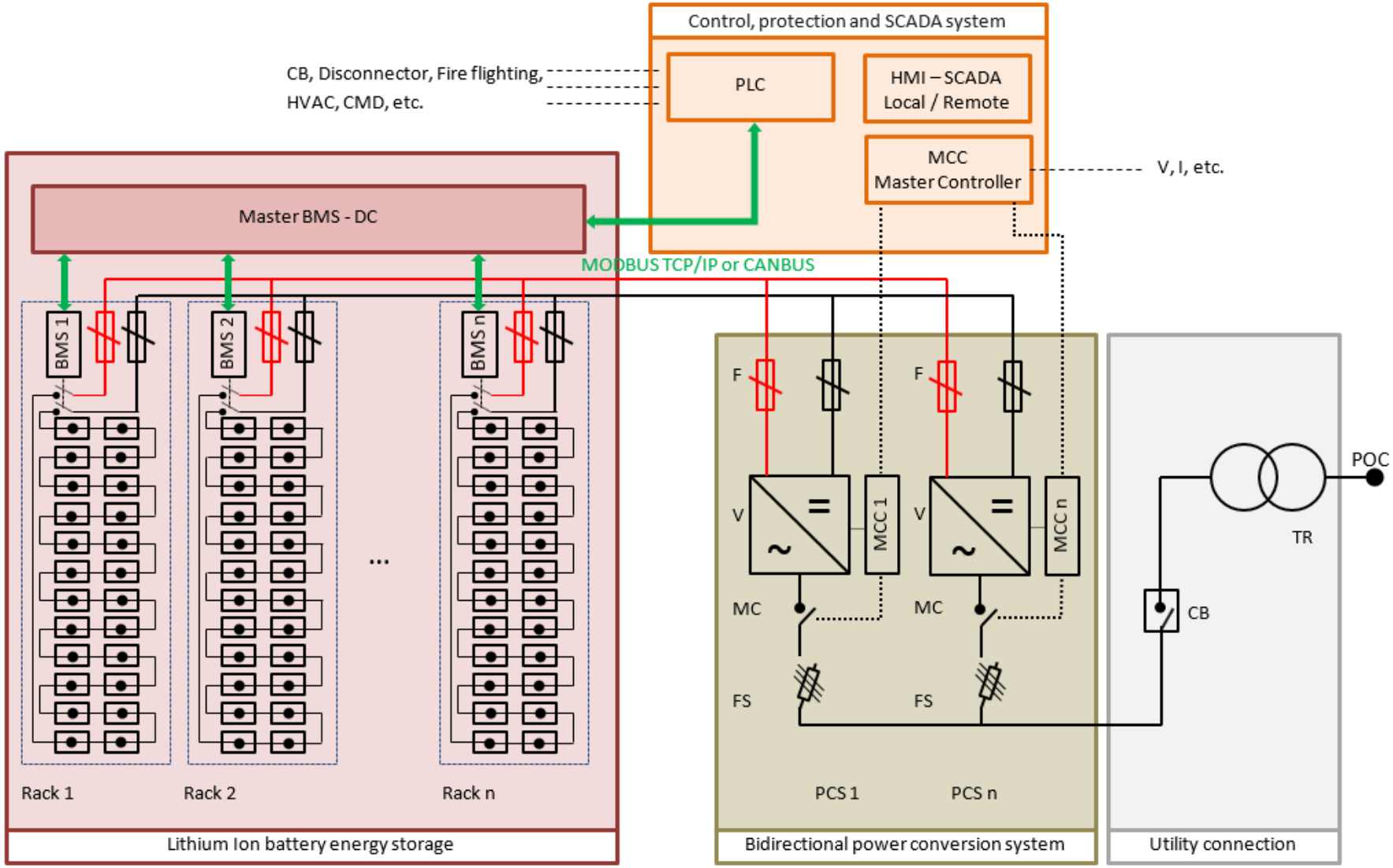
BESS systems

Figure 1: Battery Energy Storage System and Primary Power Components

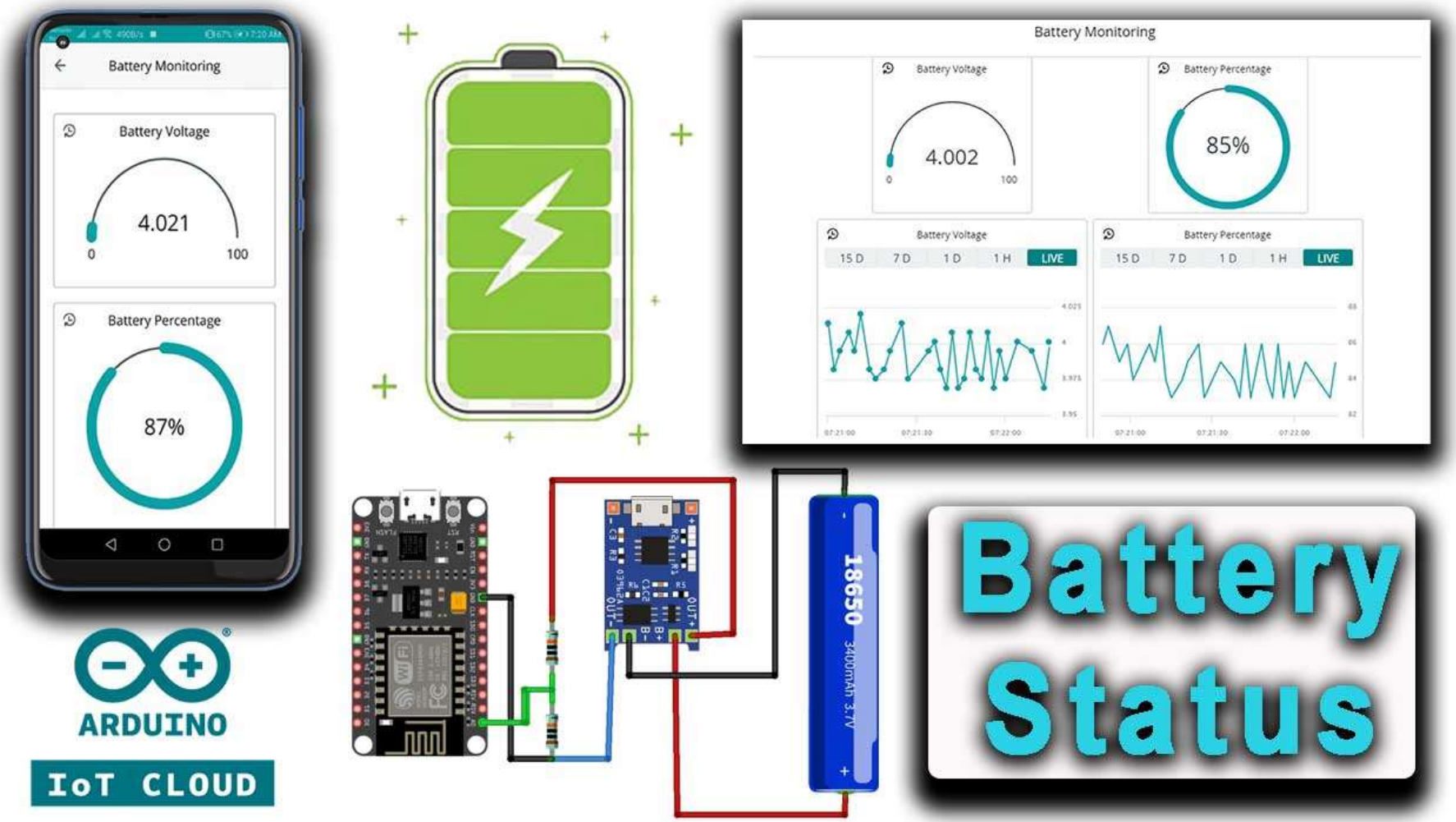


BESS systems

Typical BESS systems structure



Battery monitoring systems (BMS)



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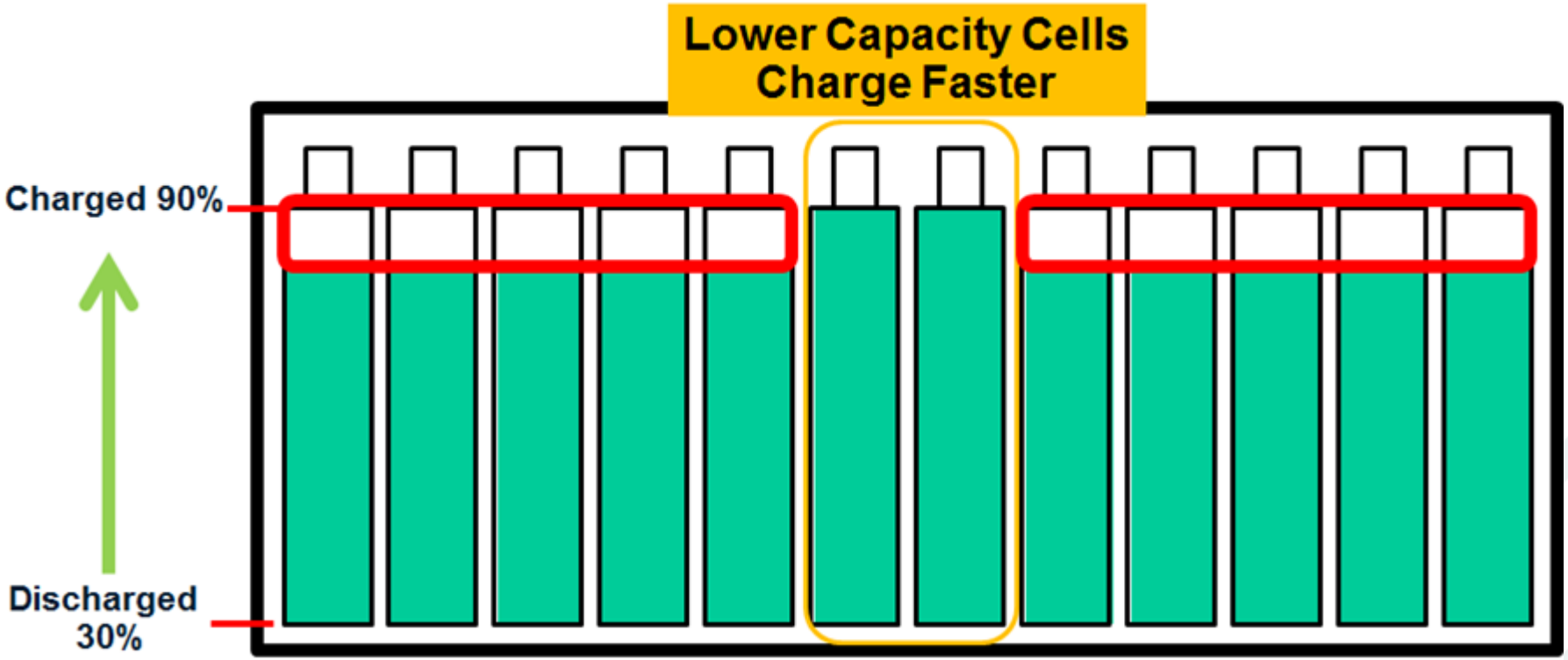
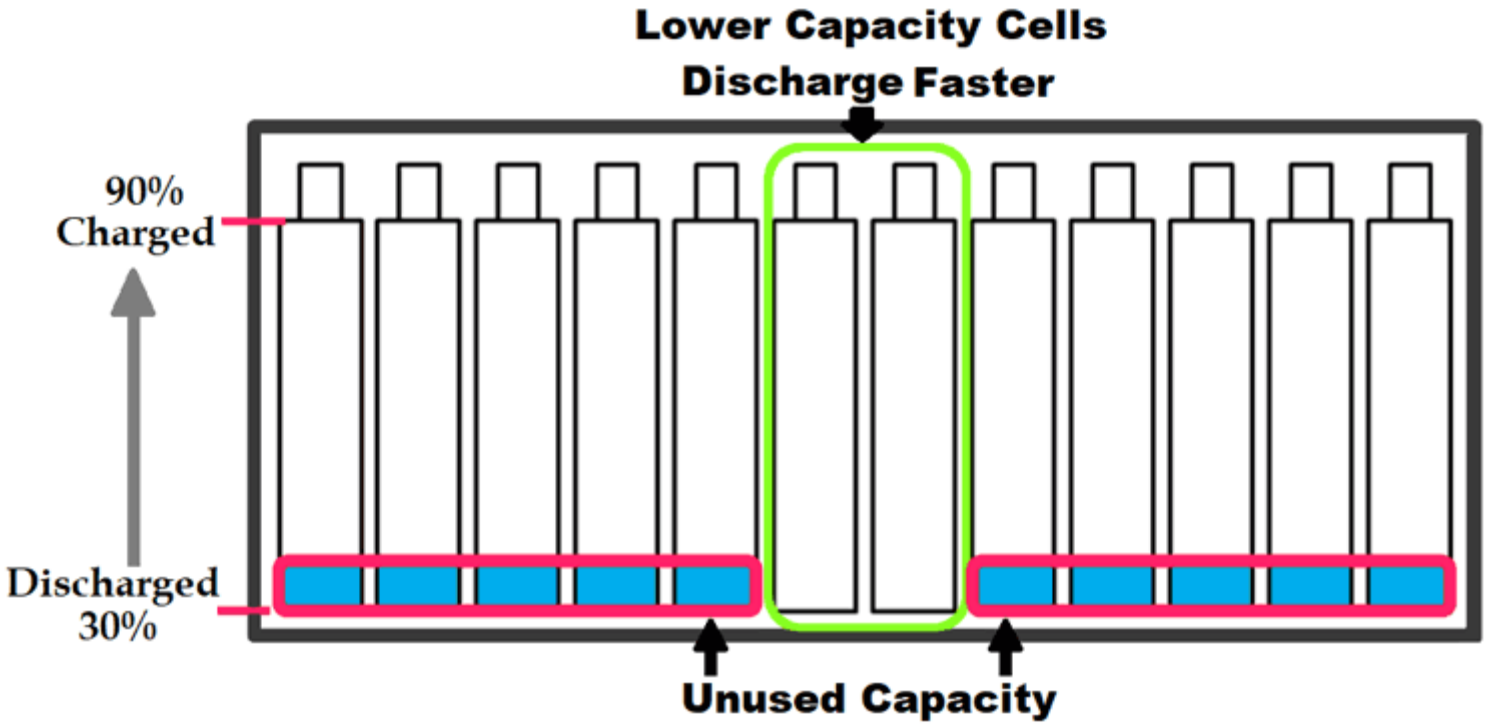
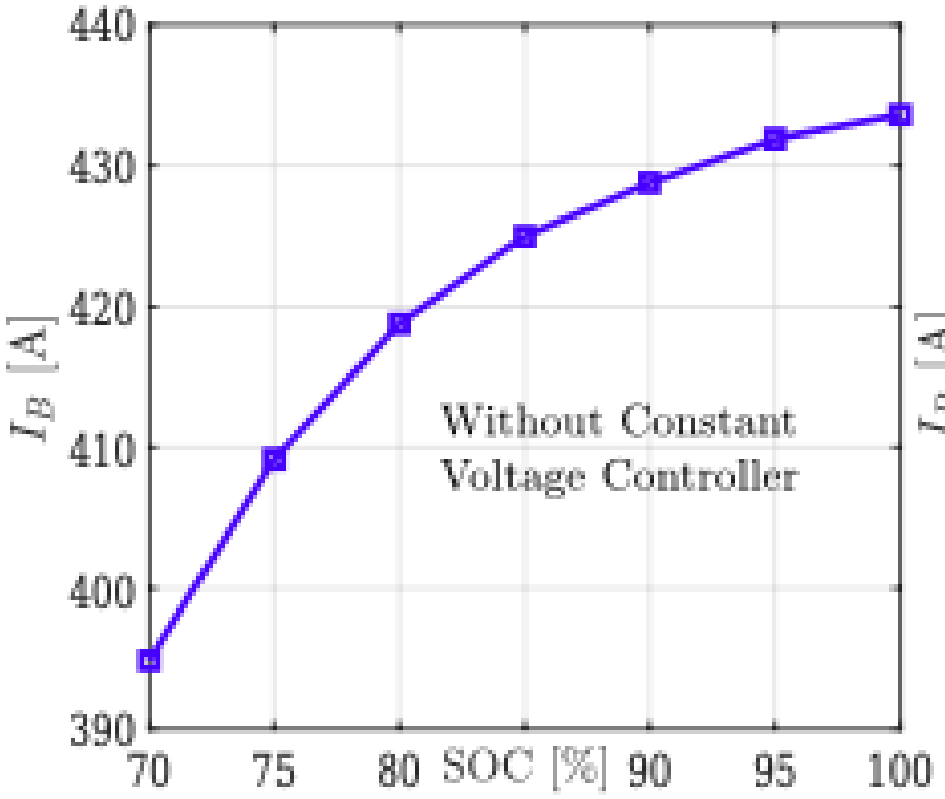
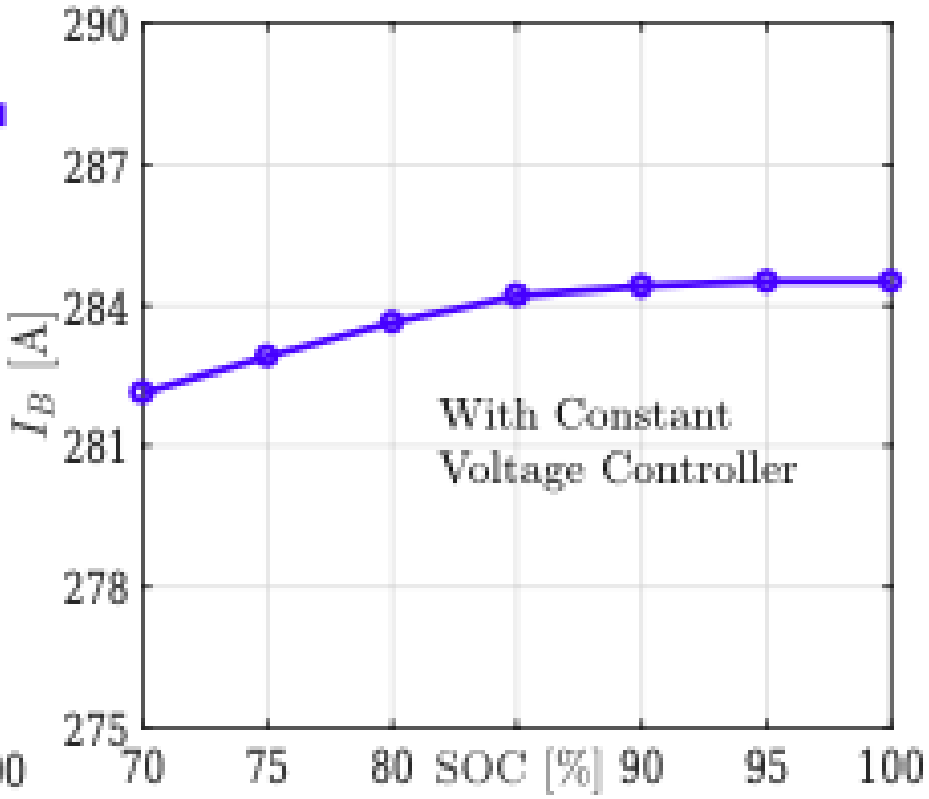


Battery monitoring systems (BMS)

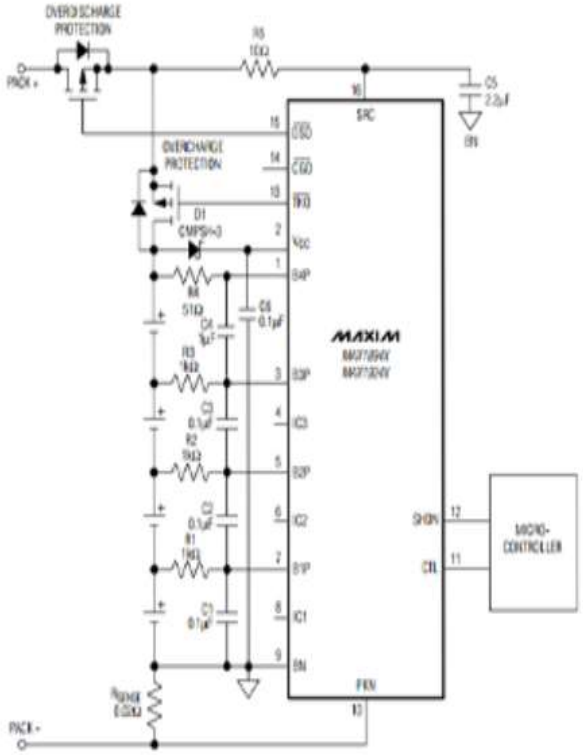


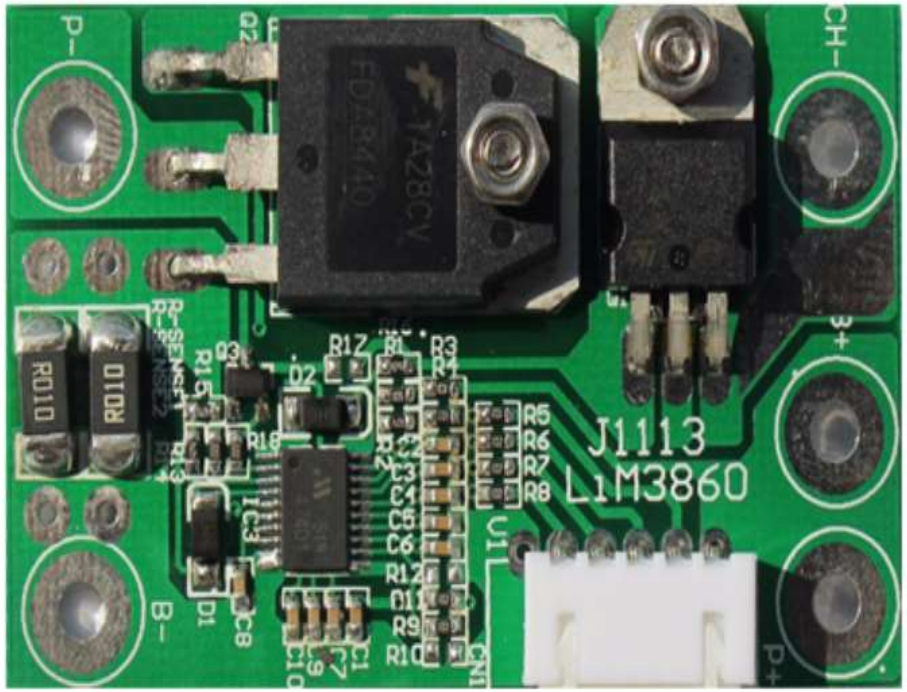
Battery charge control





Battery monitoring systems (BMS)





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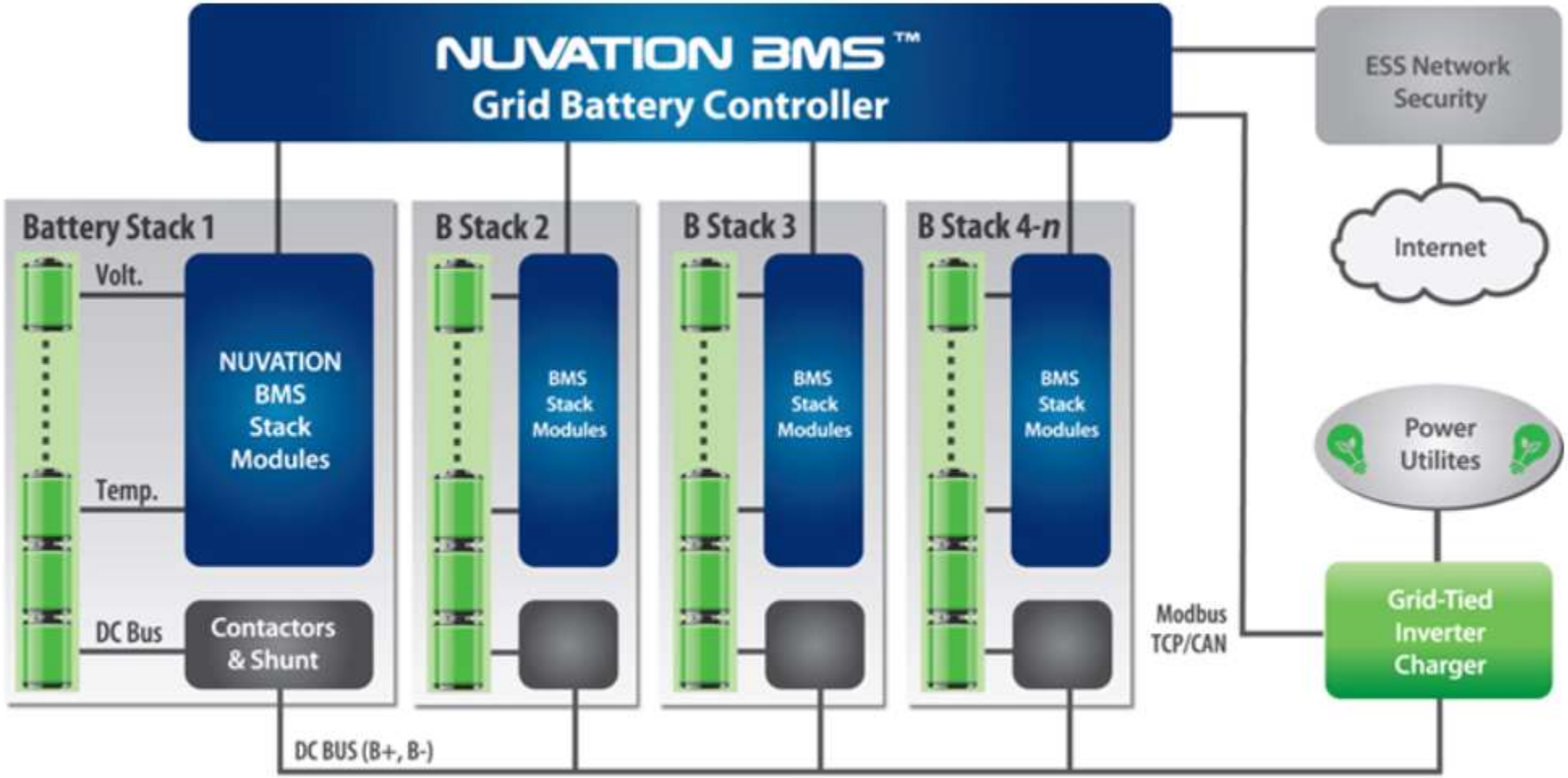
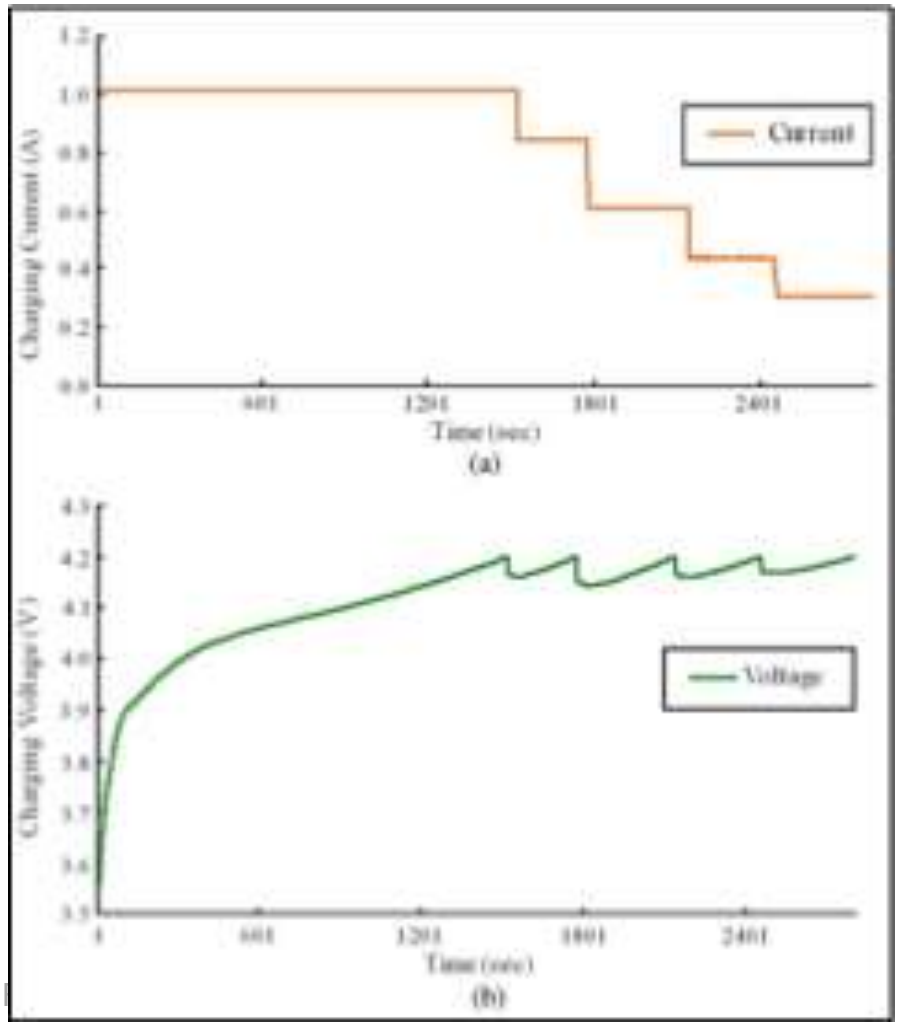
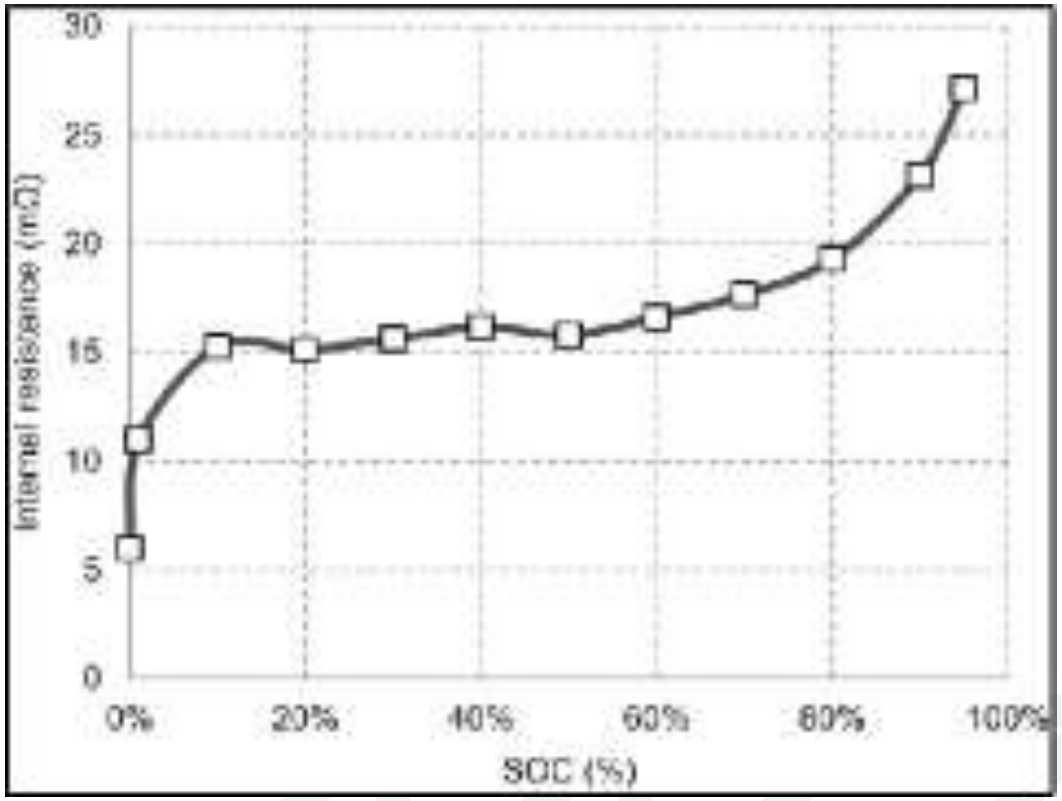


Multi-Stack View: Grid ESS Managed by Nuvation BMS

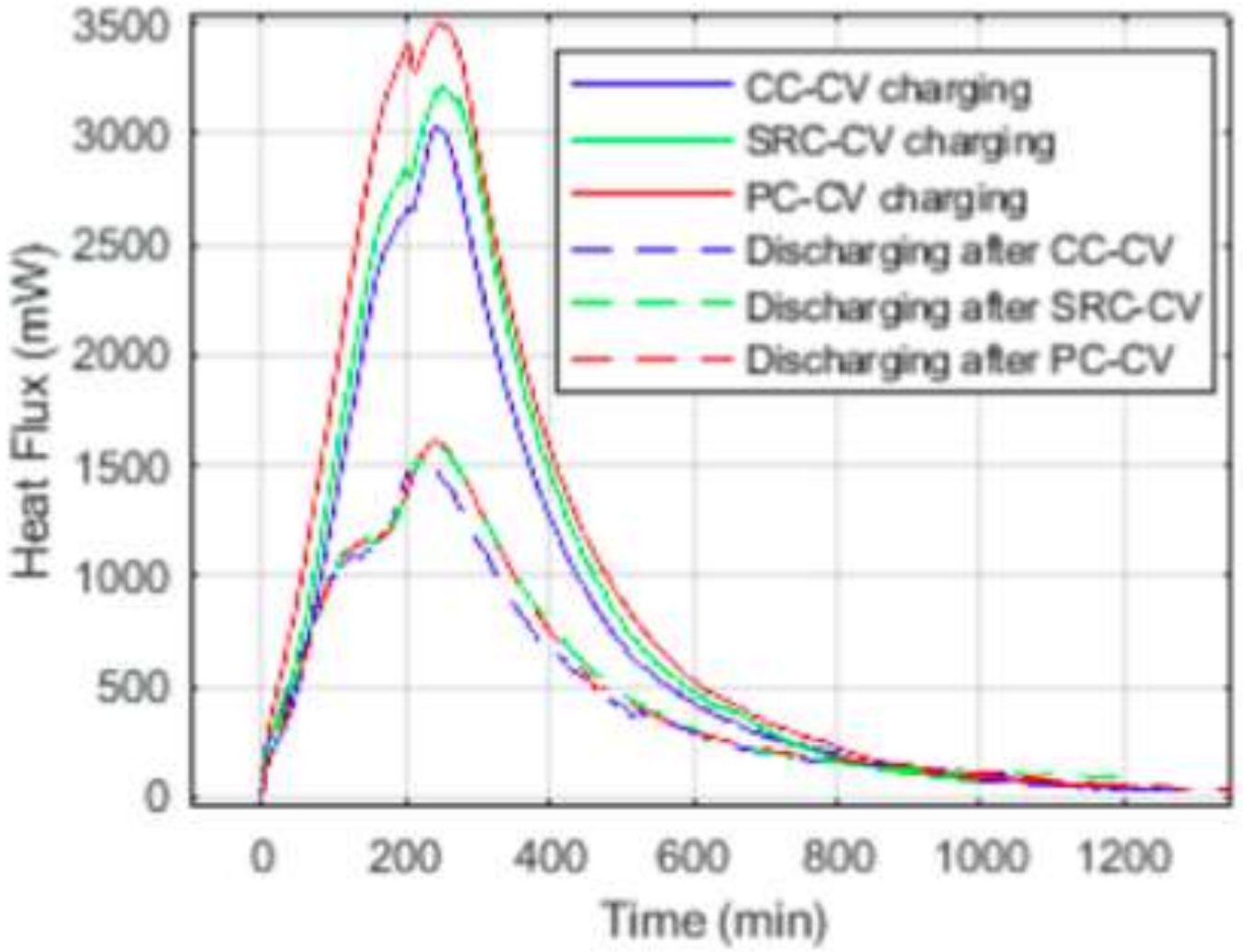
Battery charge profiles





$$\text{State of Health (SOH)} = \frac{\text{Battery Capacity}}{\text{Rated Capacity}} * 100$$

Battery charge profiles (thermal activity)



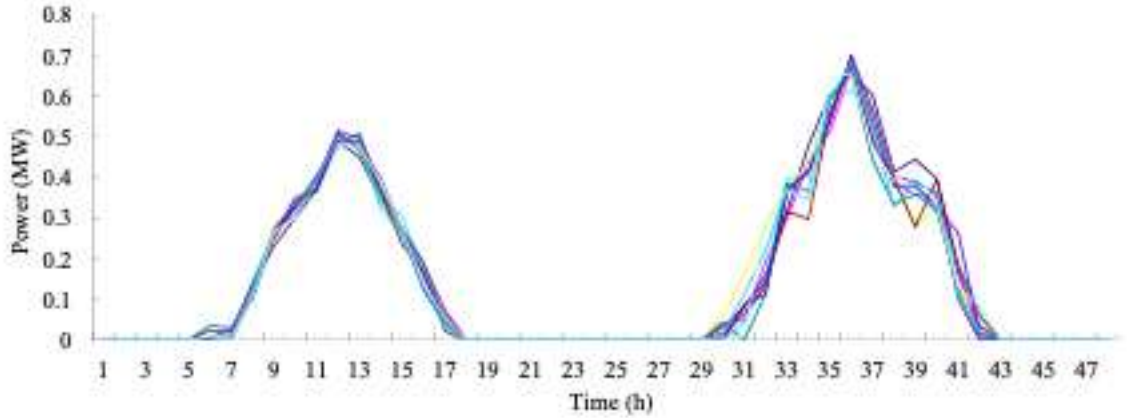
Problem

Existing battery solutions not provide end solution for cost reduce (households)!

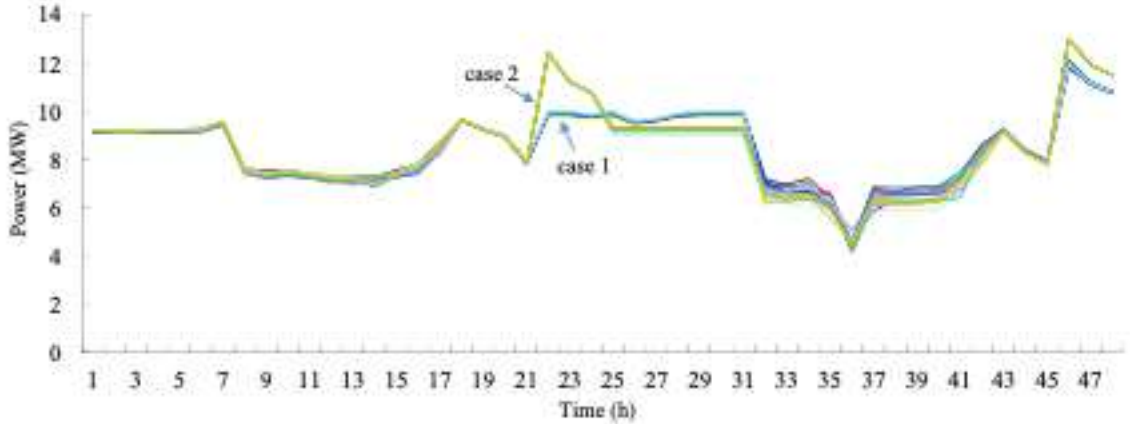
Concentrations is only for backup power

Battery charge profiles/existing experients

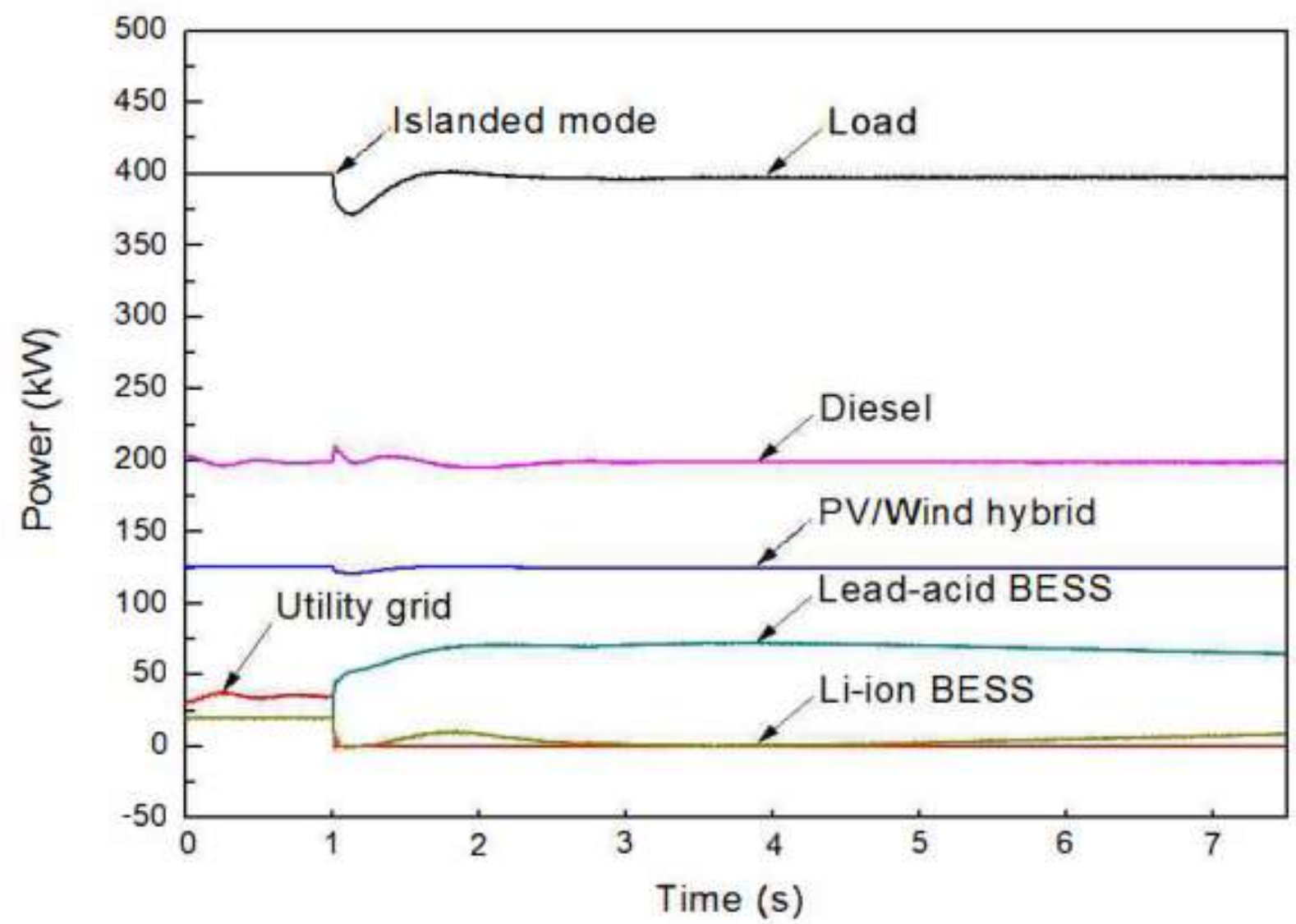
13



(b) PV output power



SIMULATION iceland mode



Power System Frequency Response

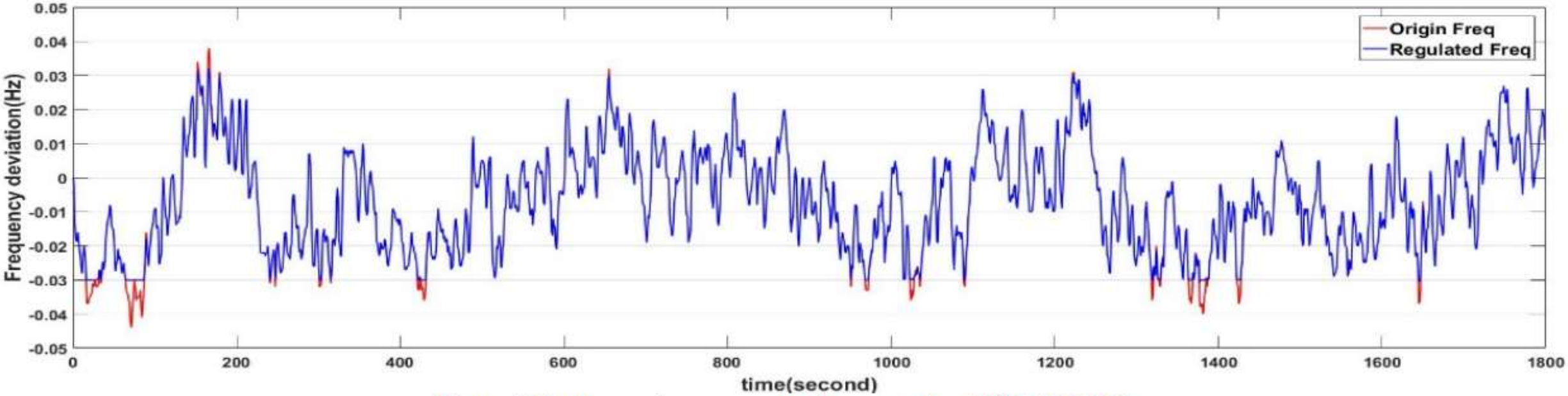


Figure 6-Frequency improvement due to employ 500MW BESS

SIMULATION iceland mode

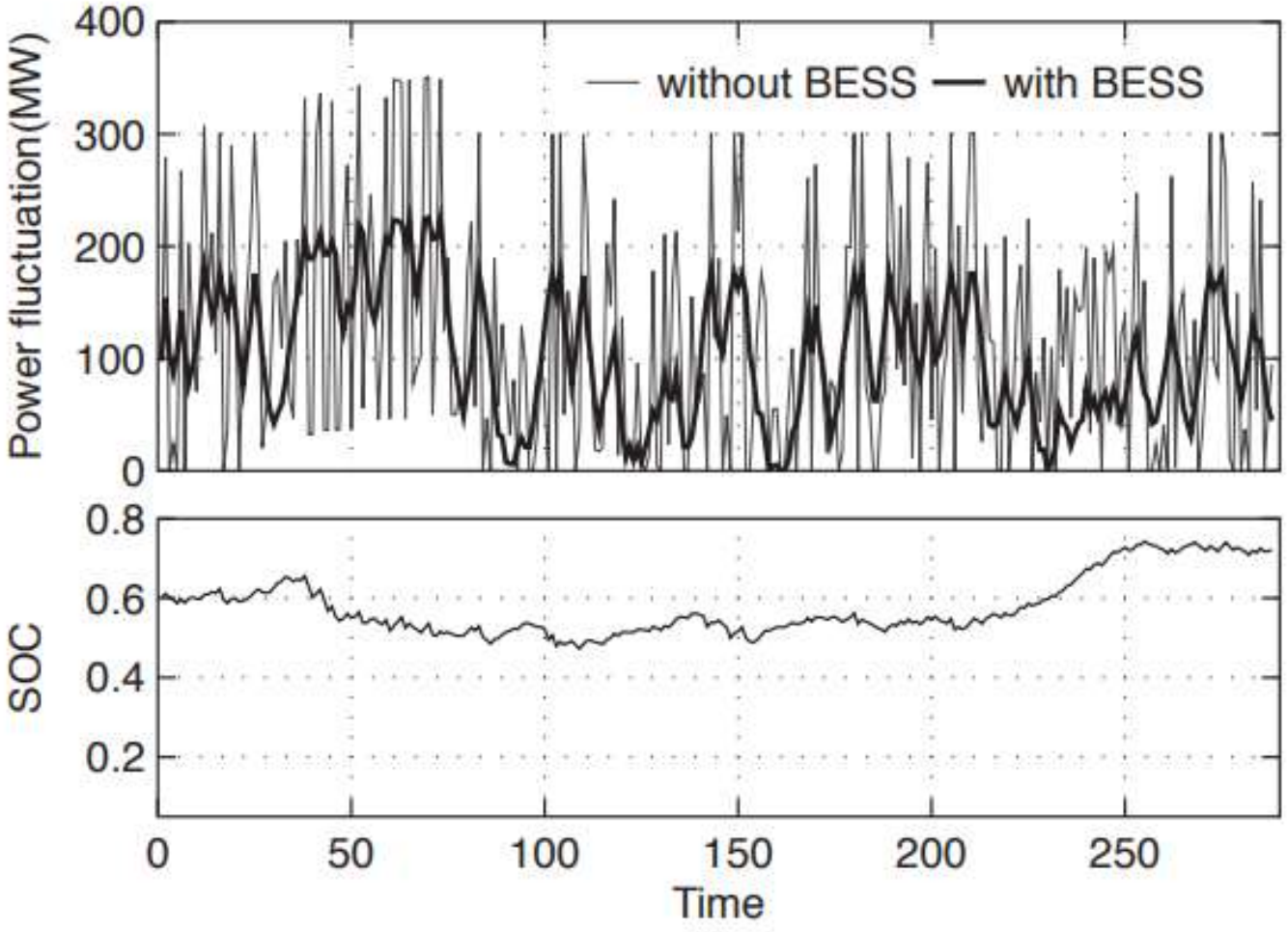
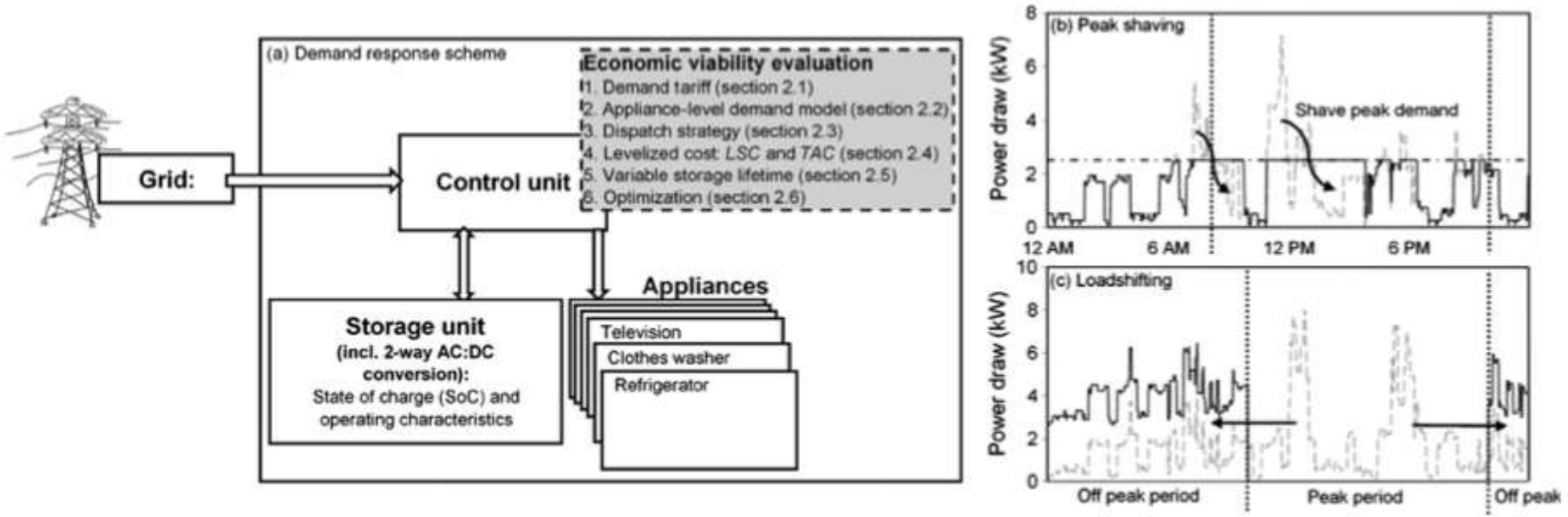


Fig. 2 Power fluctuation and SOC curve with and without on-site BESS (N_{BESS}=20)

SIMULATION control mechanism



User deferences

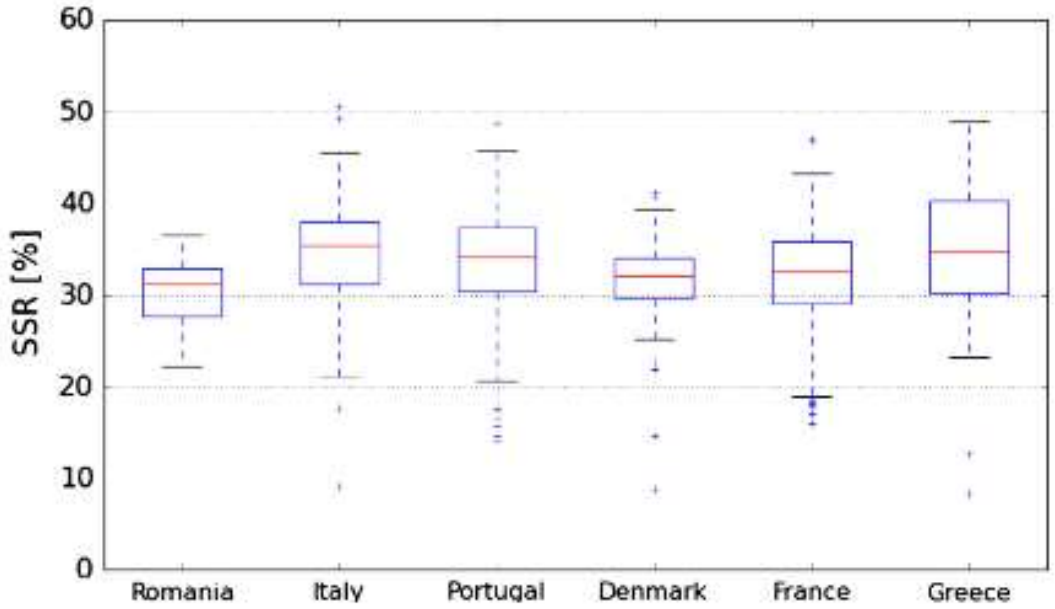
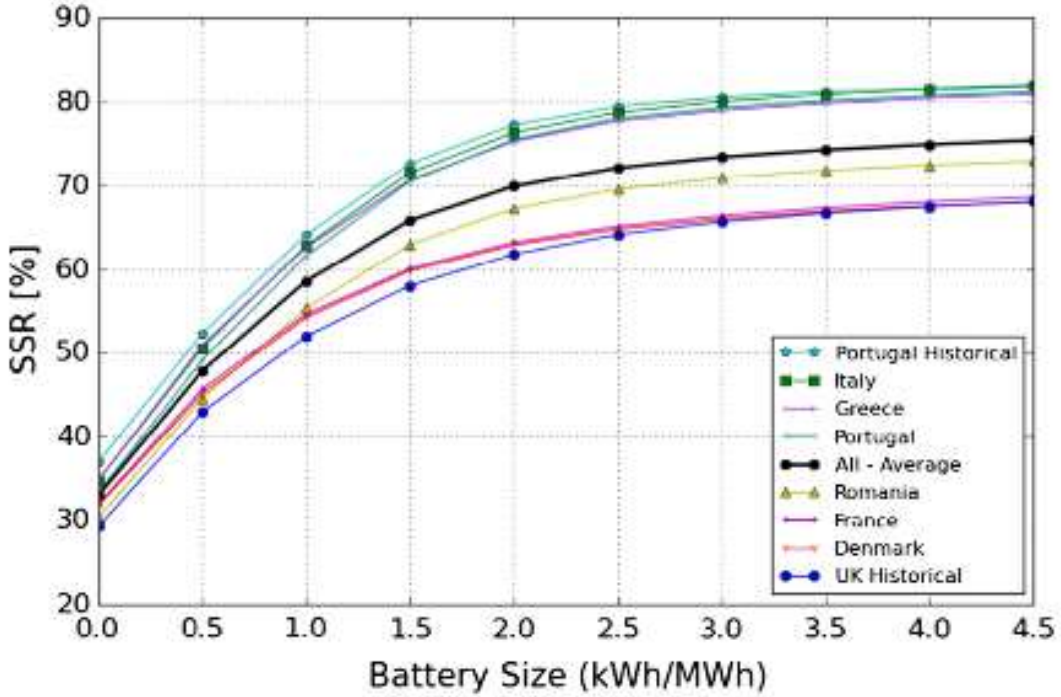


Fig. 5. Box plot of the self-sufficiency rate for each country (PV/demand ratio: 1).



SIMULATION control mechanism

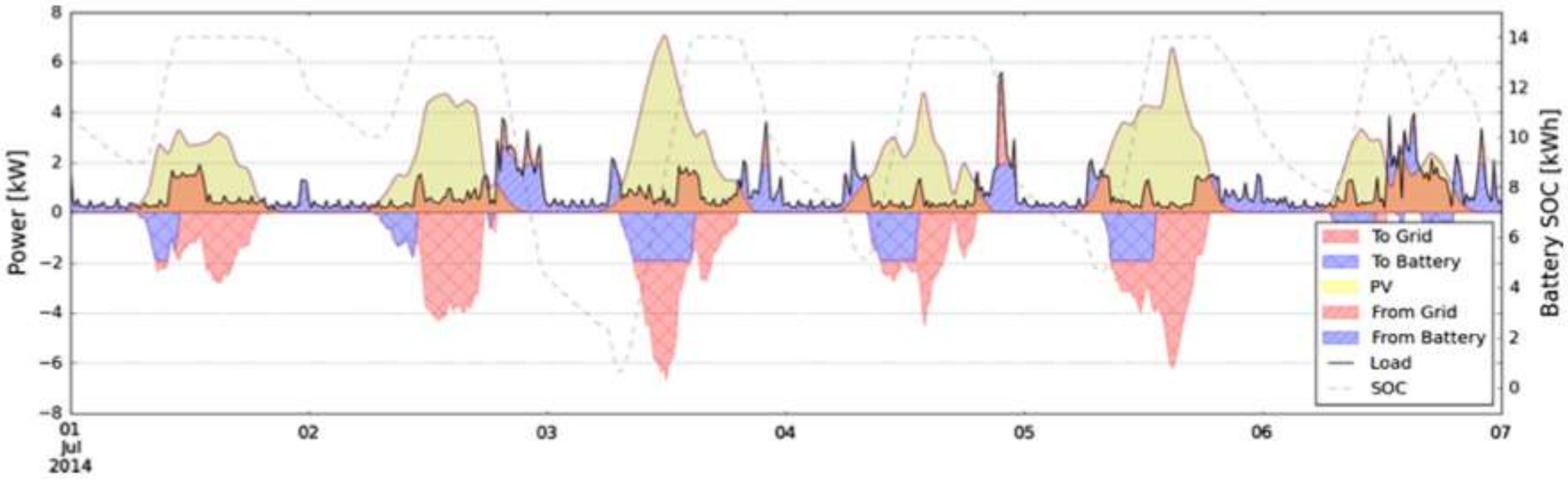
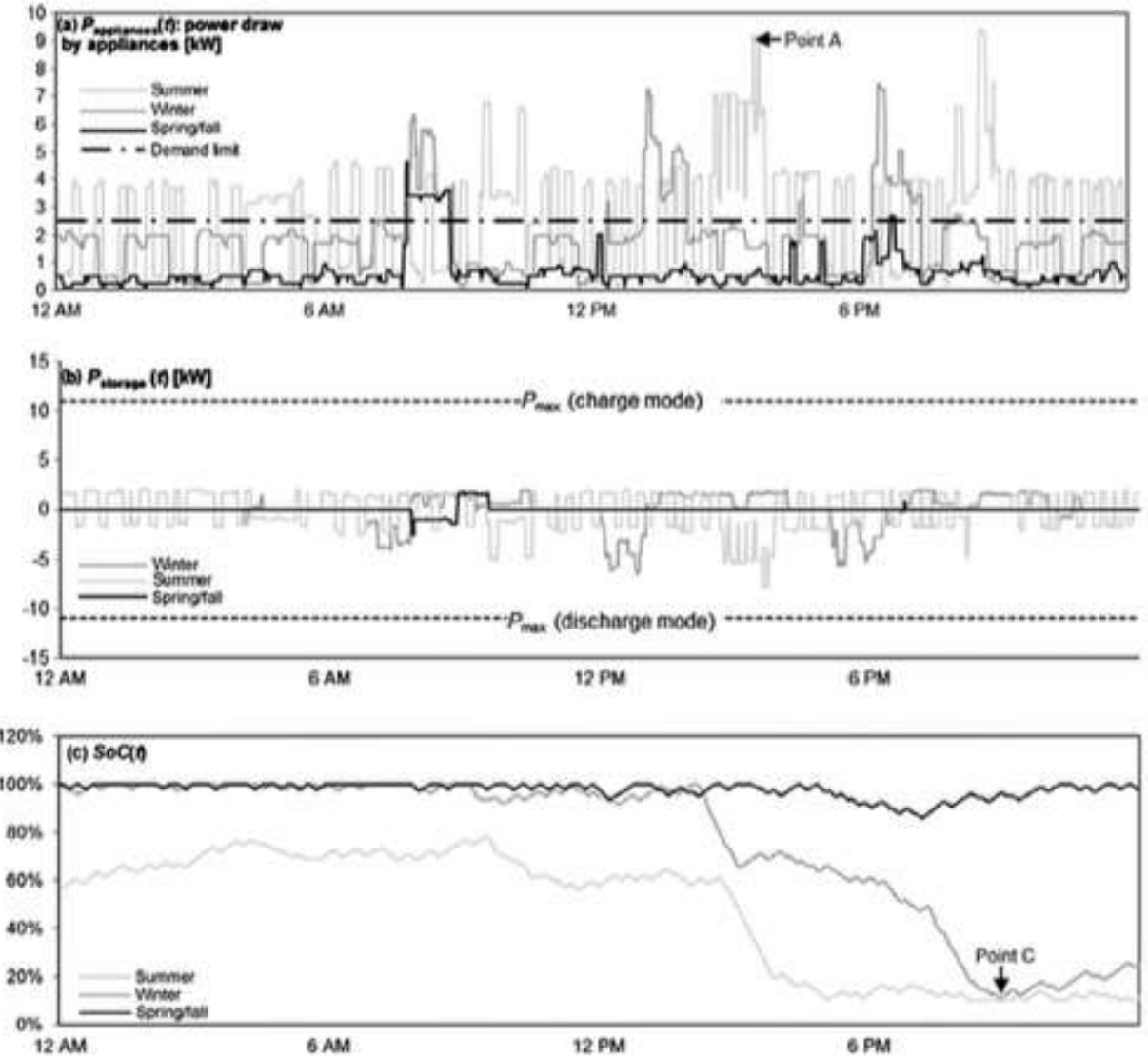
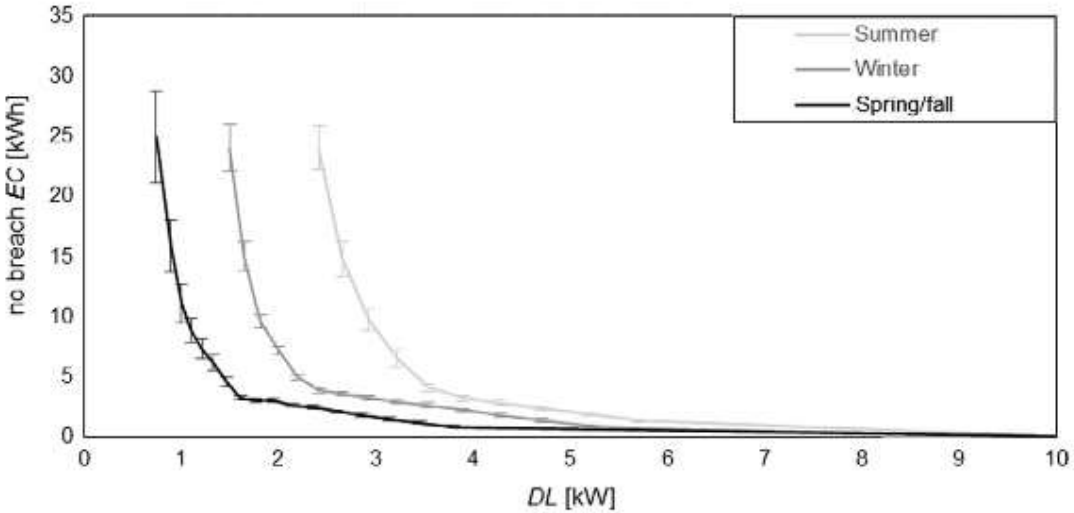


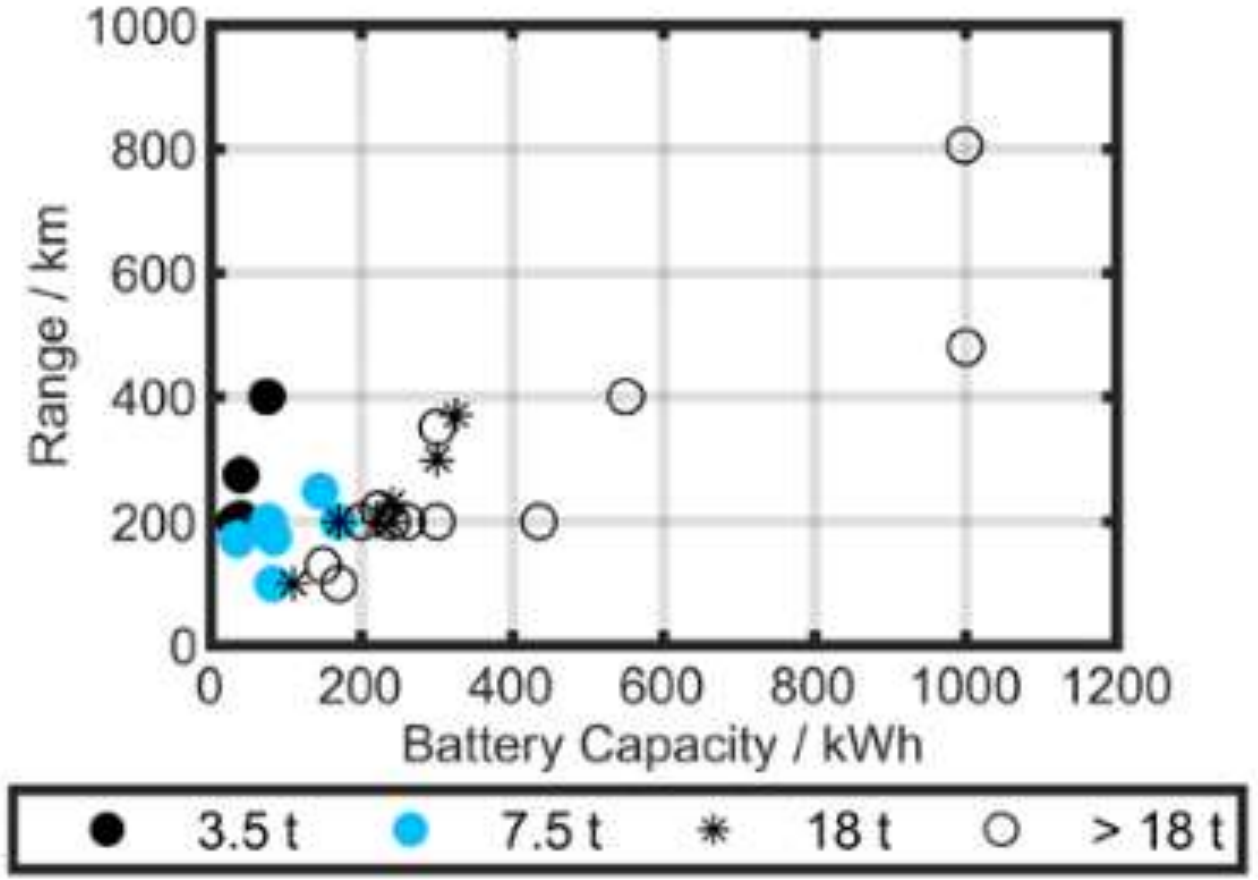
Fig. 3. Power dispatch for a typical week of July.

SIMULATION control mechanism

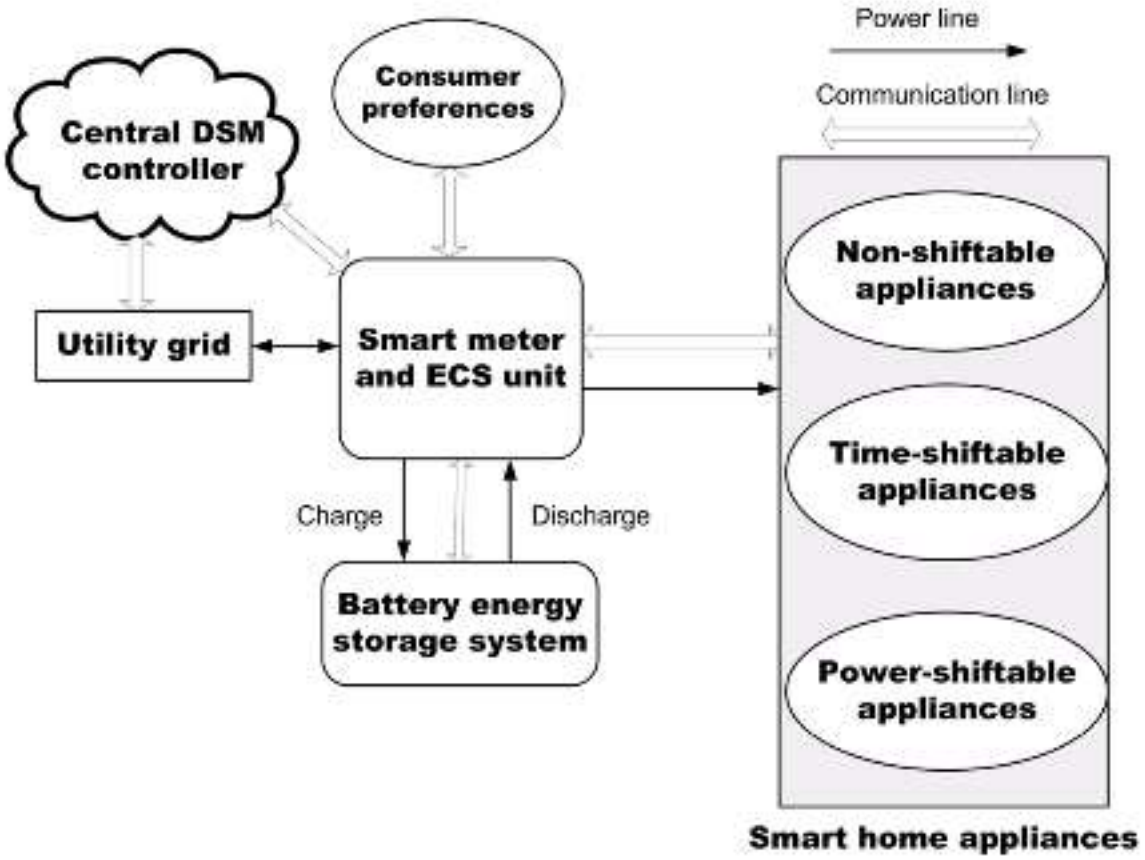


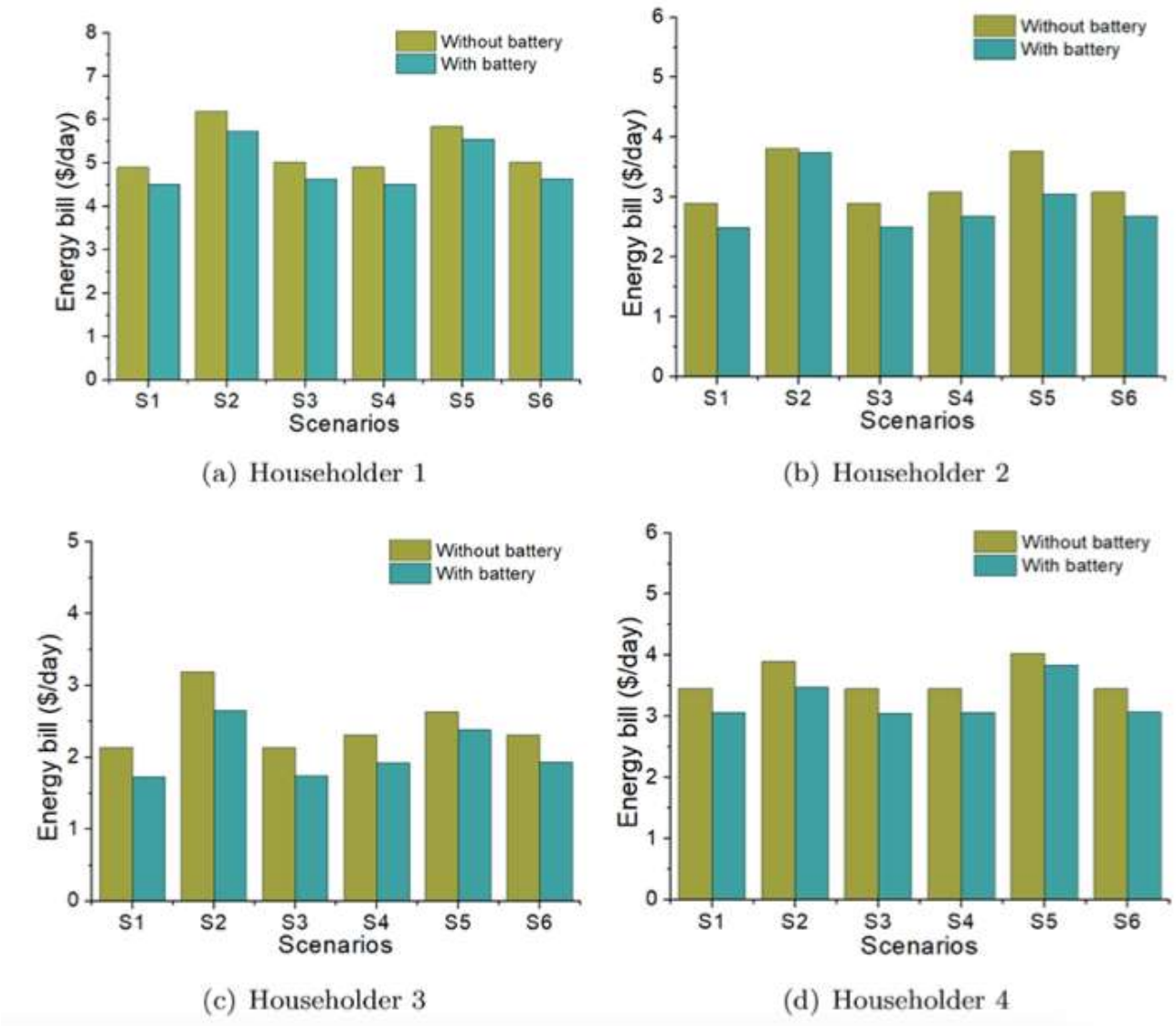


Battery charge profiles



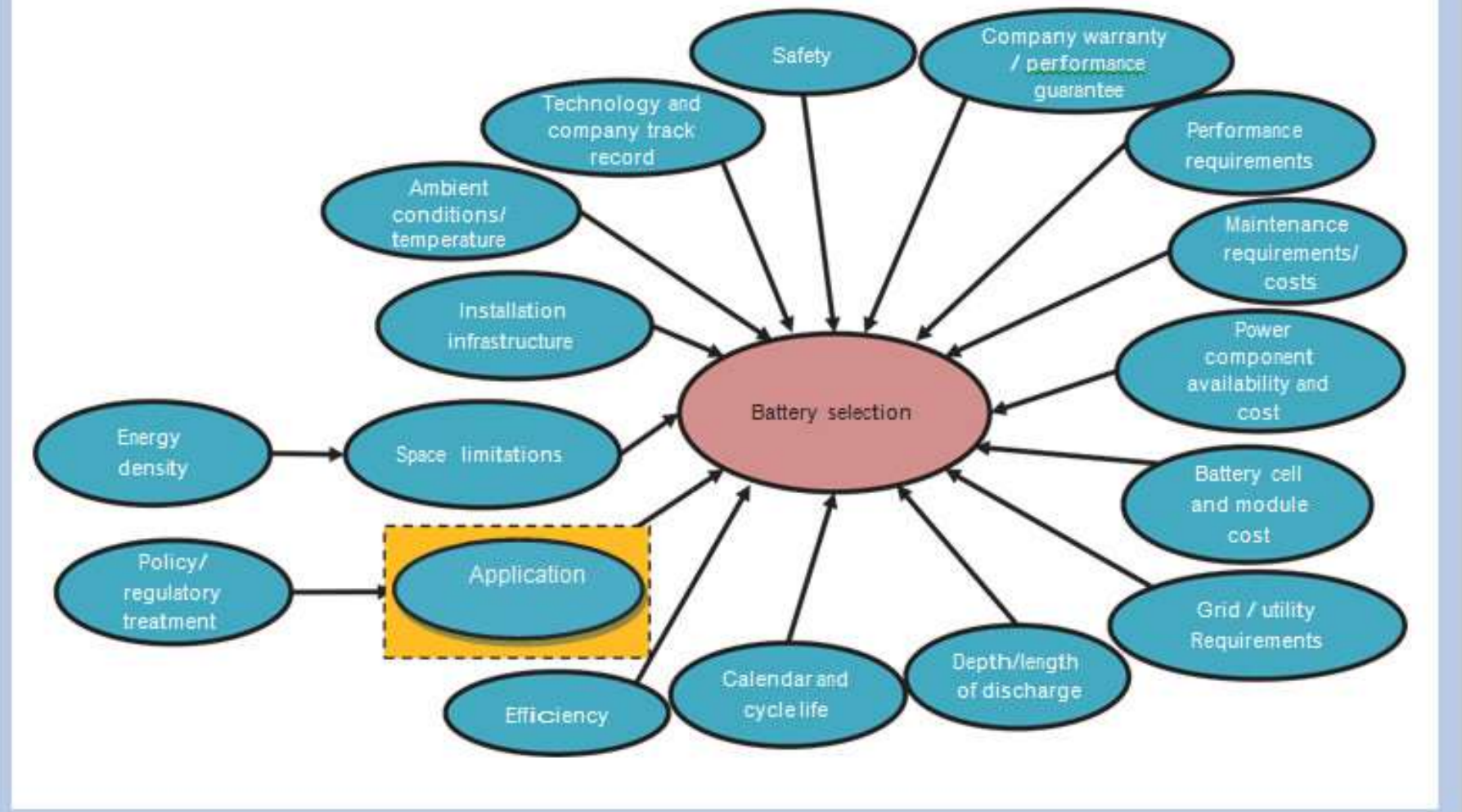
Model of examle





BESS systems

Figure 2: Criteria for Battery Selection



Battery in future SSD

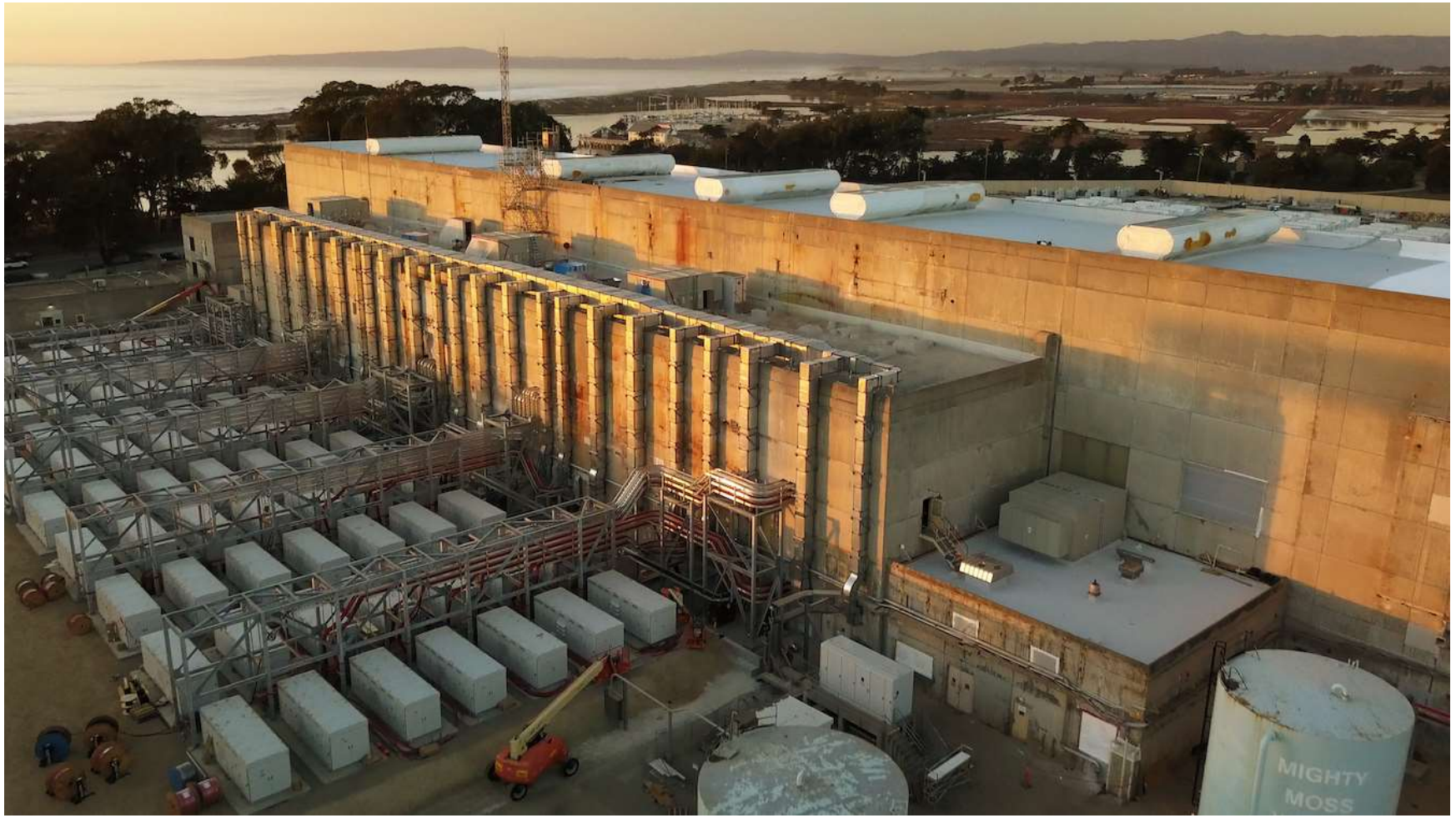
BESS systems

BESS systems

BESS systems

BESS systems

BESS systems



Project

OPTIMISED RESIDENTIAL BATTERY ENERGY STORAGE SYSTEMS (ORBES)

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Thank you for your attention!

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