"Innovation" - DAY 2

Grid Balancing & Storage

MAY 25 2022, 09:00-10:30 CEST

Leading experts discuss the issues facing China and Europe

- smart grids
- storage
- behind-the-meter
- gas-to-power
- system integration

Octavian Stamate - Counsellor, EU Delegation to China

Guido Dalessi - CEO, Elestor

Walter Boltz - Senior Adviser on European Energy

Anders Hove - Project Director, GiZ

Co-operating in China

MAY 25 2022, 10:45-12:15 CEST

Leading experts discuss the issues facing China and Europe

- case studies
- wind turbines
- transmission
- smart energy systems
- efficiency

Dongye Zhang - Head of Offshore Wind, Shell China

Luc Liu - GM China, Schneider Electric

Alfred Che - VP, Danfoss China

EU-China Energy Cooperation Platform

THE EUROPEAN UNION CHAMBER OF COMMERCE IN CHINA

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ONLINE PANEL DISCUSSION

- Innovation - Grid Balancing & Storage

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Energiepartnerschaft
DEUTSCHLAND - CHINA

国家能源局
National Energy Administration

Supported by:
Federal Ministry for Economic Affairs and Climate Action
on the basis of a decision by the German Bundestag

Role of EV smart charging in grid balancing

Sino-German Energy Transition Project

Anders Hove, Project Director

25 May 2022

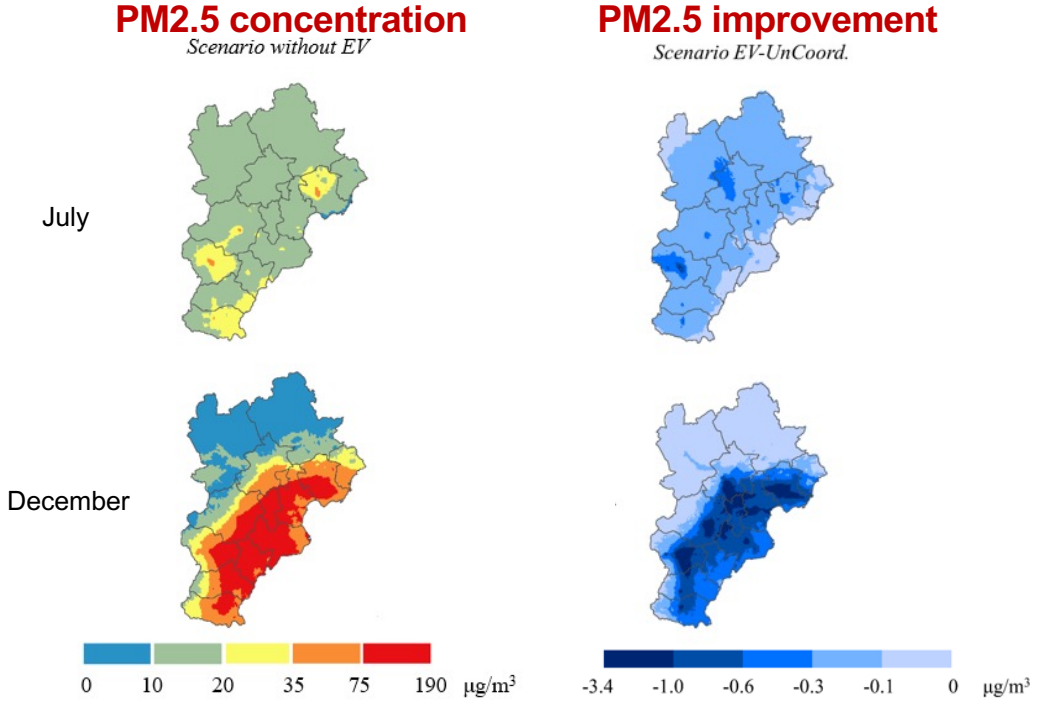
giz

1

Transport electrification can reduce average PM2.5 concentration in Jing-Jin-Ji, and the effect is more significant in winter than in summer

Change (improvement) in PM2.5 concentration in Jing-Jin-Ji region as a result of EV charging

(Darker blue means greater improvement)



Assumptions: market share of passenger EV at 25%-30%, and reaching 35% in 2030; public fleet electrification rate even higher

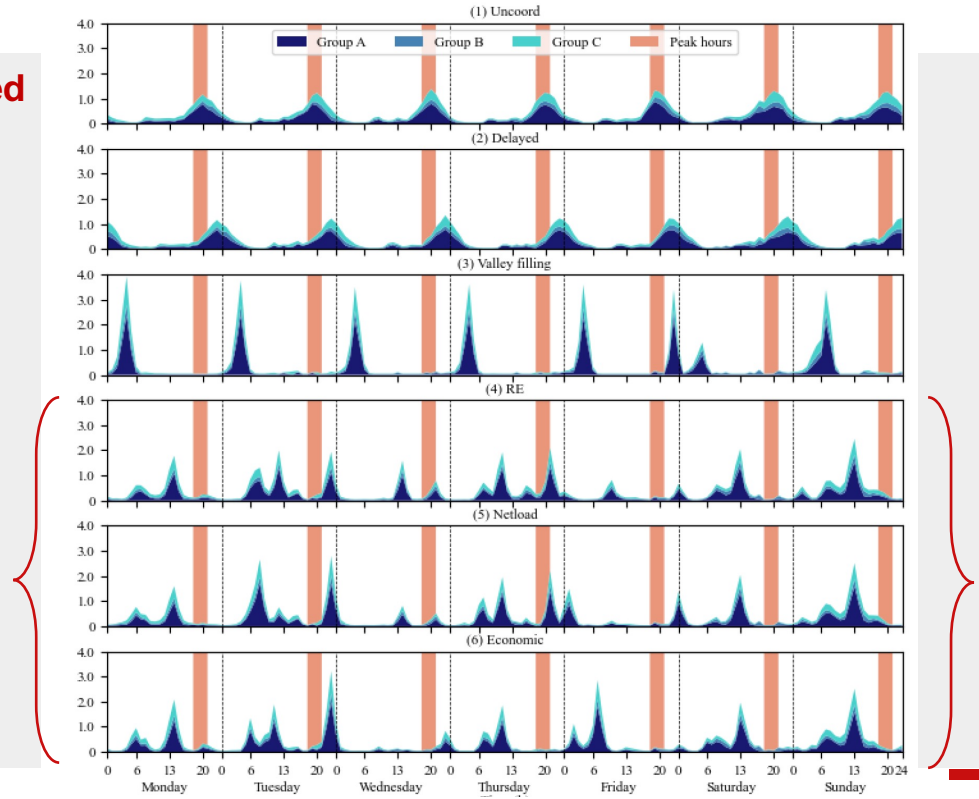
Source: Tsinghua University, April 2021

2

Tsinghua developed several charging profiles for Beijing based on trip data and generation profiles

Smart charging profiles look similar for several different scenarios

- **Uncoordinated**
- **Delayed**
- **Valley filling**
- **Max RE**
- **Net load**
- **Economic**

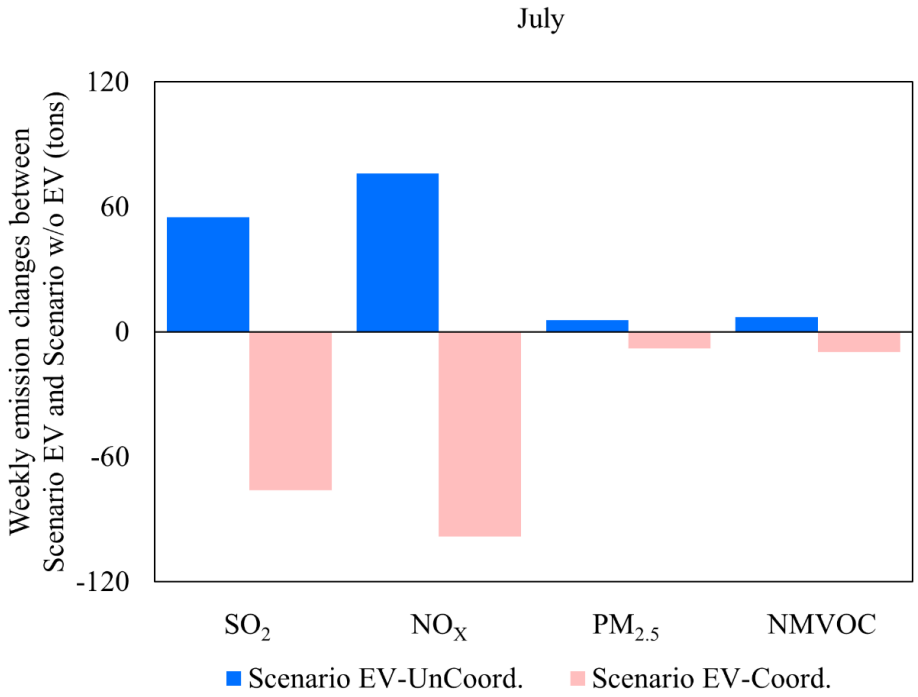


Source: Tsinghua University, April 2021

3

Air quality improvement was significant for summertime smart charging, less so for winter

Difference in criteria air pollutants in July, Beijing

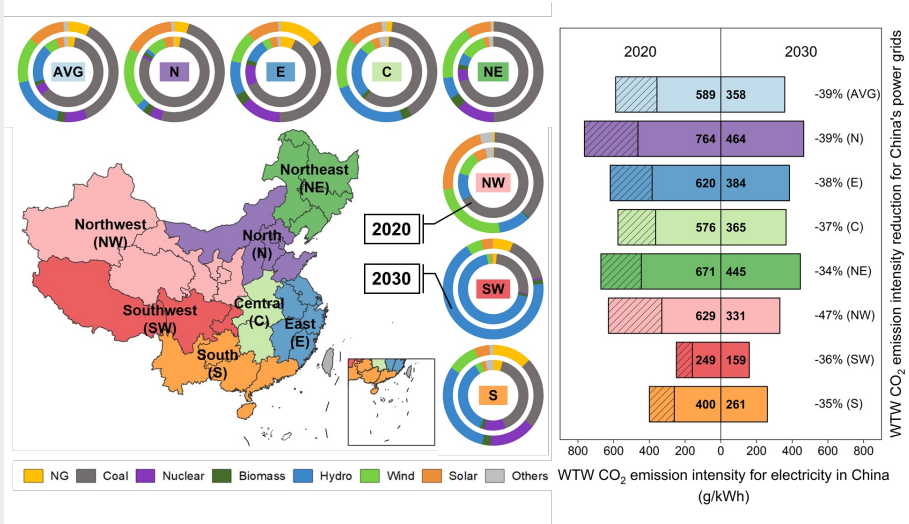


Source: Tsinghua University, April 2021

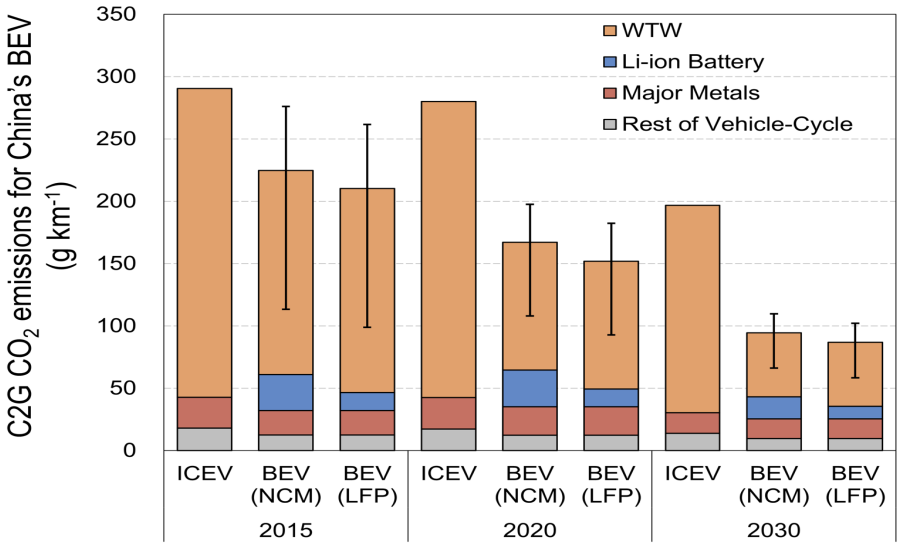
4

Cleaner electricity mix in 2030 will lead to much lower GHG life-cycle emissions for battery EVs

Power sector regional mix changes



Cradle-to-grave GHG emission of ICEV and EVs

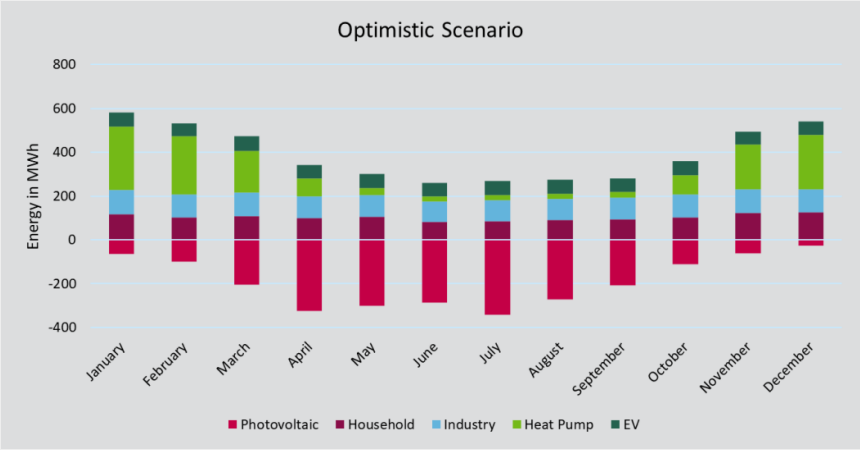


Source: Tsinghua University and GIZ, March 2022

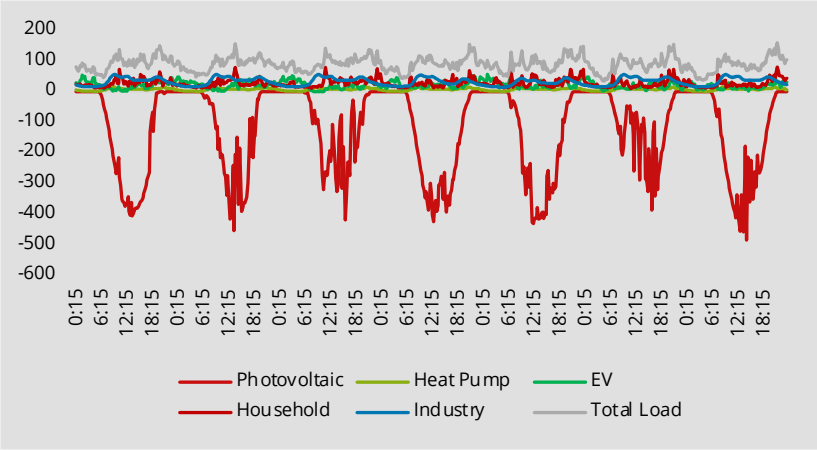
5

For rural areas, modeling by our research partners showed EVs have strong potential to enable energy self-sufficiency

Schwaig, Bavaria, monthly household energy use and production, Optimistic scenario



Schwaig, Bavaria, summer daily energy use and production, Optimistic scenario



Source: Wuppertal University, January 2022

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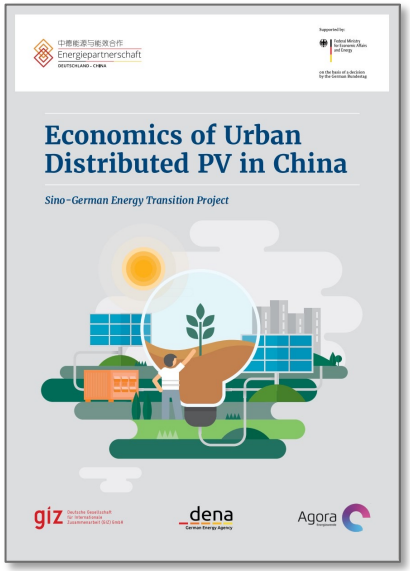
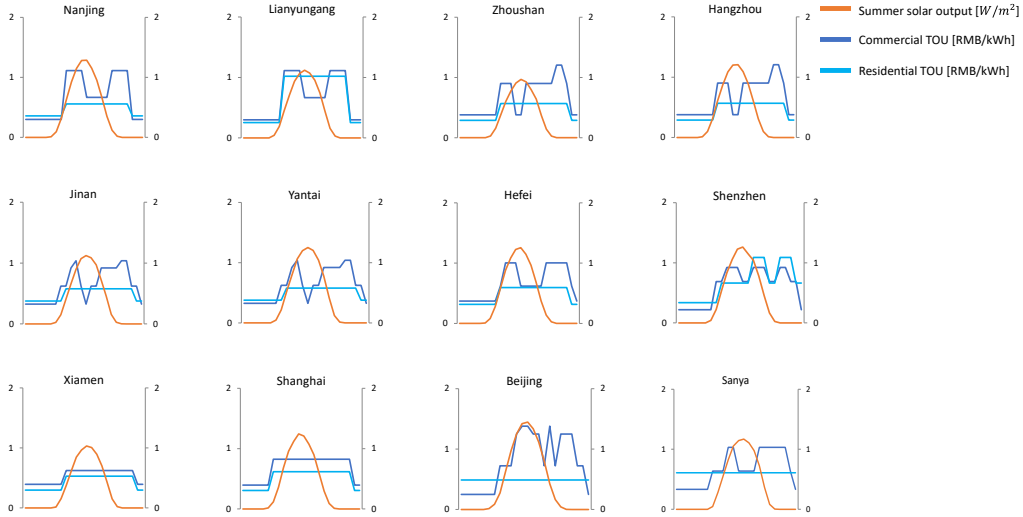
GIZ has also updated its view of the IRR of distributed solar and storage incorporating urban time-of-use prices in China

Issue brief: Economics of DPV+ES



TOU rates and solar curves, Chinese cities



Link:
https://www.energypartnership.cn/fileadmin/user_upload/china/media_elements/publications/2021/Economics_of_Urban_Distributed_PV_in_China_EN.pdf

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Flow Batteries Boosting the Energy Transition

The enabling technology for a 100% carbon free electricity supply

Guido Dalessi, CEO

Elestor’s battery technology

- For large scale, stationary electricity storage
- Typical applications:
  - Combined with large PV and Wind
  - Substituting gas fired power plants
  - Integration with hydrogen infra & electrolysers
- Fully modular, up to GW/GWh range
- Based on:
  - Flow battery technology
  - Active materials: Hydrogen & Bromine
- Patented worldwide

ELESTOR’S MISSION:

Targeting the lowest possible storage costs per MWh (LCoS)

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Global bromine reserves are virtually unlimited, thus extremely low cost

Material	Global reserves (Kilotons)	Usage (kg/MWh)	Sufficient for ...% of required capacity	Supply & cost contraints
3 Li Lithium — Li-ion batteries	16.000 [2]	0,9 [3]	4%	- >90% of global reserves in 4 countries: Chile, China, Argentina, Australia. - Oligopoly, no price pressure - Mining creates large scale depletion and pollution of groundwater
27 Co Cobalt — Li-ion batteries	7.100 [4]	0,2 [5]	7%	- Approx. 60% of global reserves in 1 country: Congo, extreme geographic dependency - Mined under torturous labour conditions
23 V Vanadium — Vanadium Redox Flow	20.000 [7]	4,4 [8]	1%	- 85% of the global supply comes from China, Russia, South Africa - Cost increased >400% from US$ 13.50/kg in 12-2015 to US$ 68/kg in 5-2018 - 90% of the Vanadium supply is used for hardening steel
35 Br Bromine — **Hydrogen Bromine Flow batteries**	**100.000.000.000**	**3,2**	**100%**	+ Only 0,0016% of the global bromine reserves are sufficient for a 100% decarbonized electricity supply

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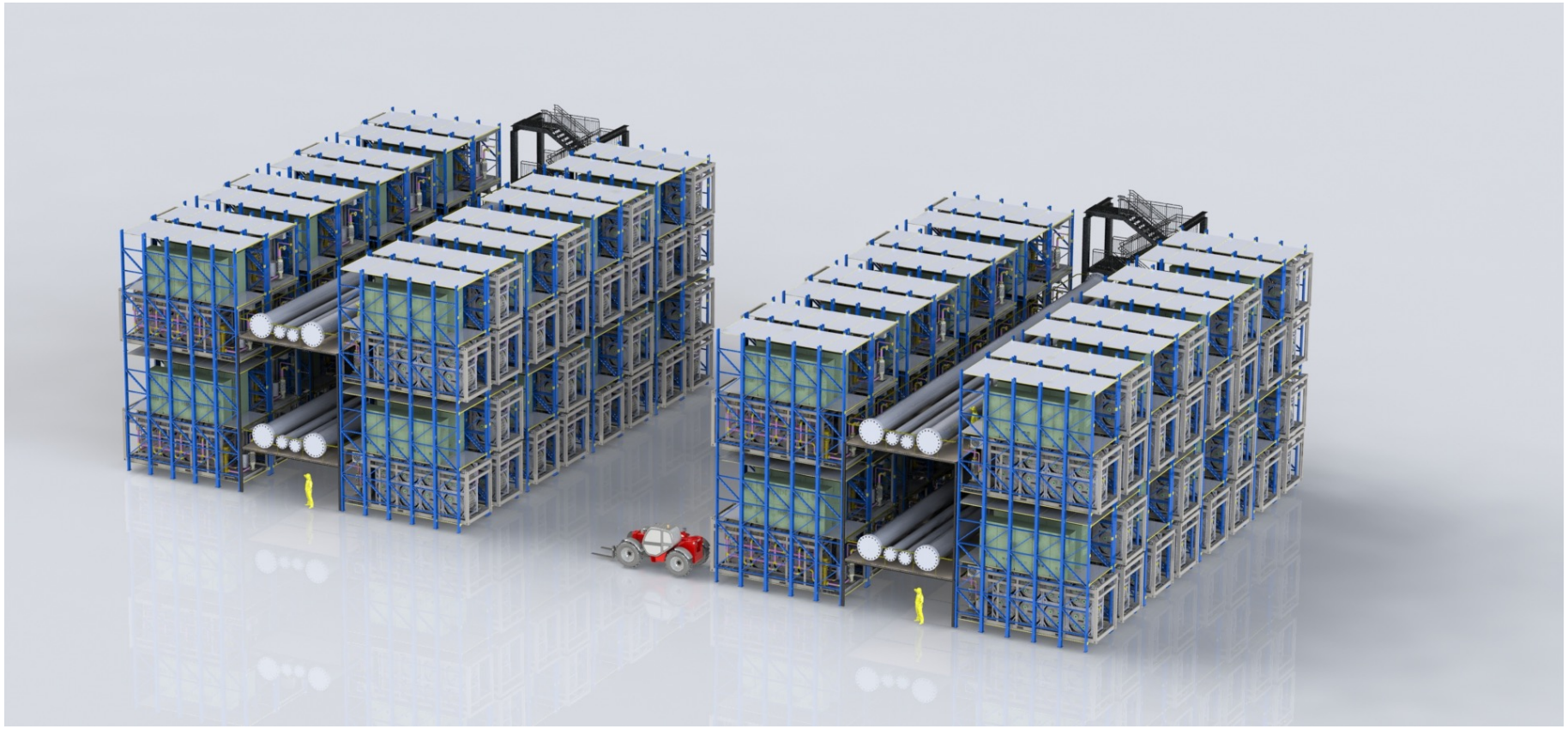
The HBr flow battery as Bi-Directional Power Plants, replacing current gas fired power pants



An in-depth analysis shows that, with the optimal combination of Sun+Wind+Storage, Elestor's technology offers the optimal economic solution for a reliable and fully decarbonized electricity supply, with 100+ hr storage duration

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The market for Long Duration Energy Storage (LDES)

Battery storage grew by 50% in 2020 alone and this rapid trajectory is likely to continue [1]

However, the predictions for the future of storage vary dramatically:

- **IEA** (Energy Information Administration, USA) estimates that global installation of utility-scale batteries will increase 25 times between 2020 and 2040, reaching **10 TWh** by 2040, which equals 50 times the current market size[2]
- **McKinsey** predicts an even steeper growth, reaching **85 to 140 TWh by 2040** [3]
- **Elestor**'s estimate is **500 TWh** for a 100% carbon-free electricity supply

Clearly, the energy storage industry is set to thrive, with a particular focus on long-duration energy storage.

Whatever prediction turns out right, the need for 100's of TWh of electricity to be stored with flow batteries translates into **massive opportunities**.

[1] *IEA (2021): https://www.iea.org/reports/energy-storage*
[2] *IEA (2020): https://www.iea.org/reports/innovation-in-batteries-and-electricity-storage*
[3] *McKinsey (2021): https://www.mckinsey.com/business-functions/sustainability/our-insights/net-zero-power-long-duration-energy-storage-for-a-renewable-grid*

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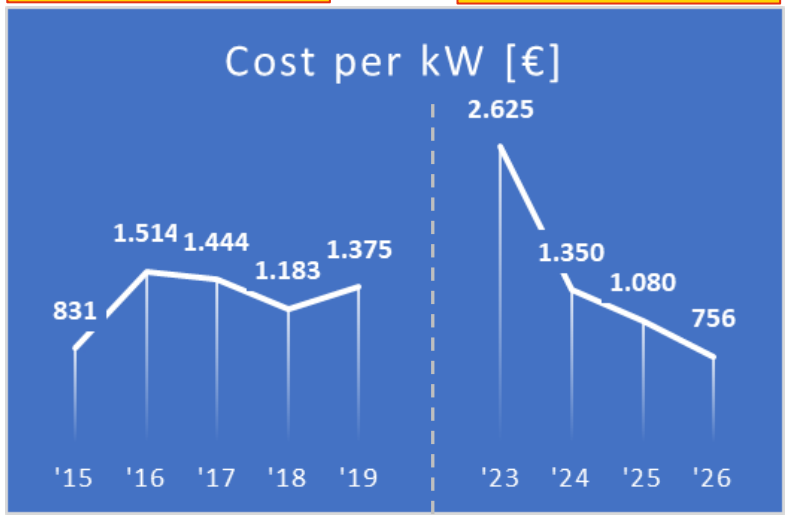
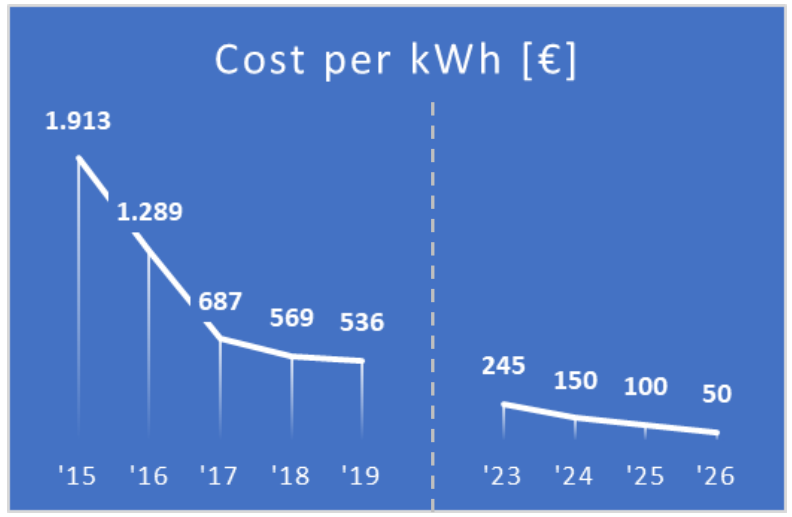
Source historical Li-ion capex figures: IEA (Energy Information Administration, USA)

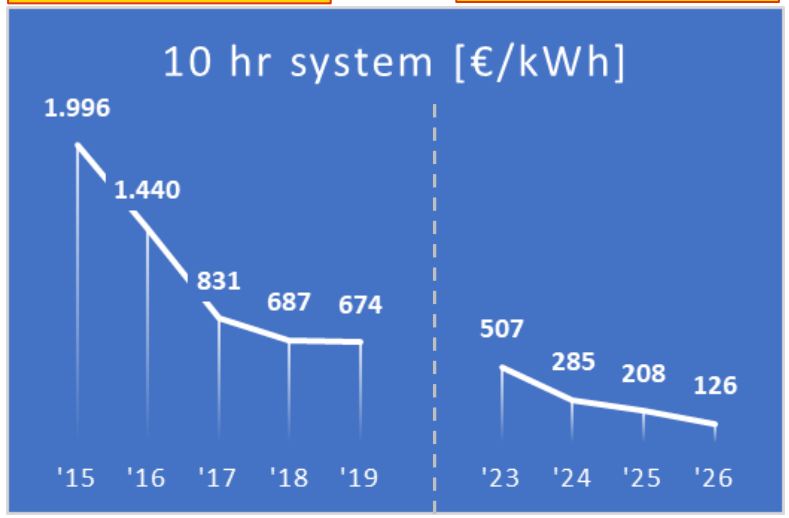
Capital cost developments

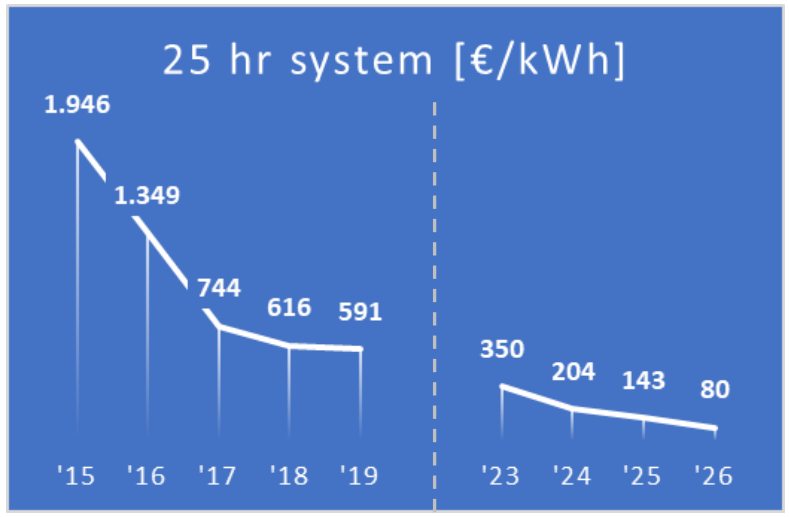
EIA: Li-ion | Elestor: Flow





EIA: Li-ion | Elestor: Flow





- Cost per kW
  - Stabilizing for Li-ion
  - Decreasing for Flow
- Cost per kWh
  - High for Li, curve flattening
  - Low for Flow, curve decreasing
- Economies-of-scale
  - Li-ion: Already max benefiting
  - Flow: At the verge of entering
- 10 and 25 hr systems show the low cost potential of Flow for Long Duration Electricity Storage
- This comparison only concerns capex, but in terms of LCoS the differences are much larger

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“We will make electricity so cheap,
that only the rich will burn candles”

- Thomas A. Edison

Elestor BV
Westervoortsedijk 73, building BF
6827 AV Arnhem
The Netherlands

www.elestor.nl
info@elestor.nl