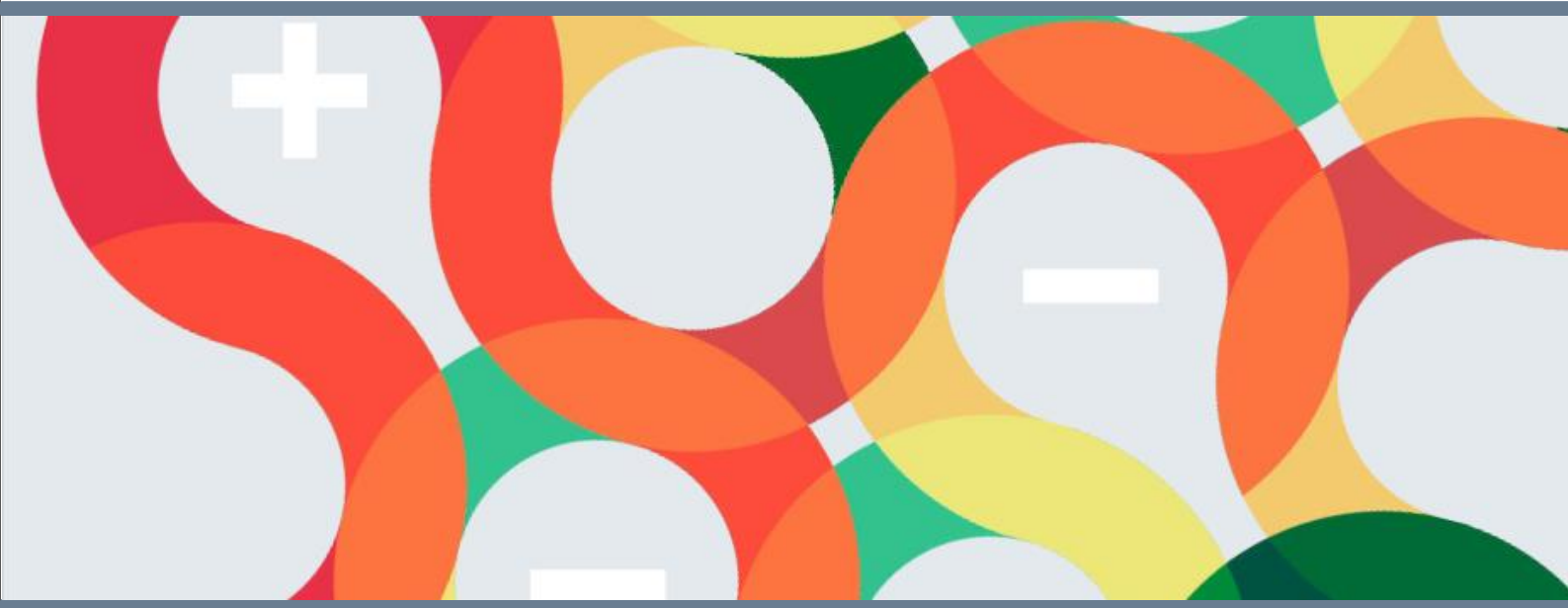




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Recharging Mobility: Innovative Solutions in Battery Technology

Prof. Dr. Priscilla Caliandro – Head of the Energy Storage Research Centre

► 12th ENERGY RESEARCH CONFERENCE – 15.11.2024

Energy Research Masterplan of The Federal Government 2025-2028

Mobility

Energy
Efficient 

Sustainable 

Integrated 

in 2023

37.8%

Final energy
consumption for
transport sector

BFE – Statistique Globale Suisse De
L'énergie 2023 – July 2024

32.9%

Transport sector
contribution to total
greenhouse gas emissions

BAFU - Kenngrößen zur Entwicklung der
Treibhausgasemissionen in der Schweiz
1990-2022 - April 2024

3.3%

share of purely electric cars

6.2 GW

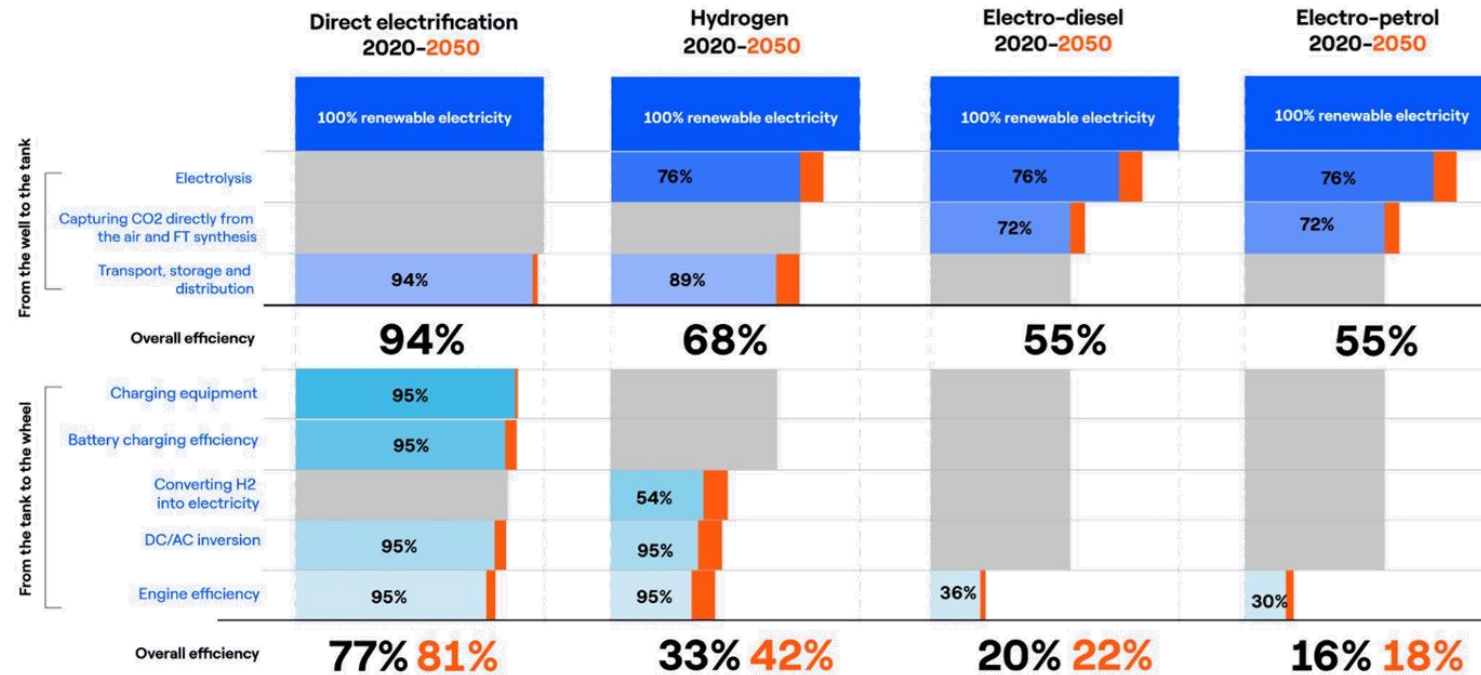
cumulated installed PV

BFS - Fahrzeug-Neuzulassungen 2023 - Jan 2024
Pronovo - Cockpit EIV 2024 30 - Sept 2024

- ▶ Average consumption of **ICE**: 7l/100km = 60-70kWh/100km
- ▶ Average consumption of **EVs**: 15-25kWh/100km

BFE - Energieverbrauch und Energieeffizienz der neuen
Personenwagen und leichten Nutz- fahrzeuge 2023 – June 2024

Cars: Direct electrification is by far the most efficient



Endesa June 2023 Why are neither hydrogen nor e-fuels a solution for road transport? Source: Wrokbank (2014) Apotolaki-Iosifidou et al. (2017), Peters et al. (2017), Larmanie et al. (2012), Umweltbundesamt (2019), National Research Council (2013), Ricardo Energy & Environment (2020), DOE (undated), ACEA (2016)

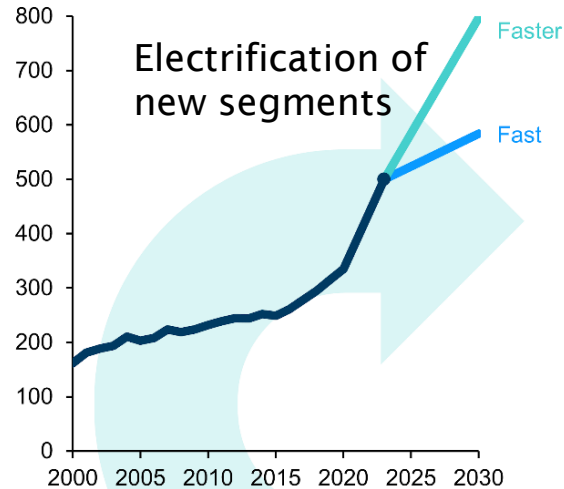
Energy Efficient

Sustainable

Integrated

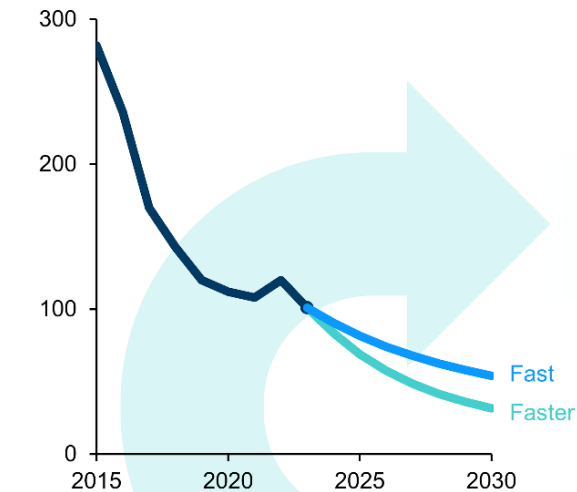
Battery energy density keeps rising...

Top-tier battery cell energy density outlook, Wh/kg



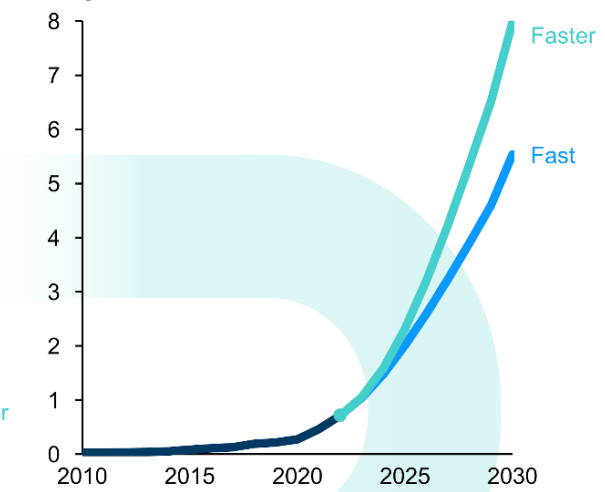
...while battery cost keeps falling...

Battery cell cost outlook, \$/kWh



...driving exponential growth of battery demand...

Battery demand outlook, TWh/y



...which, in turn, further increases energy density and lowers cost through economies of scale and learning effects.

RMI: X-Change: Batteries - The Battery Domino Effect December 2023



New Conversion
Electrodes

Alternative
Insertion Ions

Increased Safety with Solid or
Non-Flammable Electrolytes

Segment	Current share of road transport CO2 emissions	Current estimated global fleet size	Zero-emission vehicle (ZEV) fleet share in 2050 – Economic Transition Scenario	Level of policy intervention needed to hit Net Zero Scenario (100% ZEV share) by 2050
Three-wheeled vehicles	<1%	120 million	95%	On track
Two-wheeled vehicles	5%	1.1 billion	80%	Almost on track: minor additional measures needed
Municipal buses	1%	3.4 million	86%	Almost on track: minor additional measures needed
Light commercial vehicles	11%	170 million	77%	Positive trajectory: moderate additional measures needed
Passenger vehicles	53%	1.3 billion	69%	Positive trajectory: moderate additional measures needed
Medium + heavy commercial vehicles	30%	83 million	28%	Not on track: strong additional measures needed urgently

BloombergNEF: Electric Vehicle Outlook 2024
June 12, 2024

Energy Efficient

Sustainable

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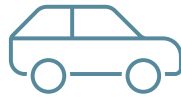


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Projects about Mobility Electrification



CIRCUBAT
2021-2025



Swiss eBus plus
2021-2024



BIENE
2022-2026



MWCharger
CIS4BET
2021-2025



GENESIS
2020-2023

Axes of the research:

- ▶ Experimental testing and Modelling of LIB for BMS algorithms
- ▶ Operating strategies for performance and **lifetime improvements**



OPEN SESAME
2020-2023



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Swiss Federal Office of Energy SFOE

Flagship
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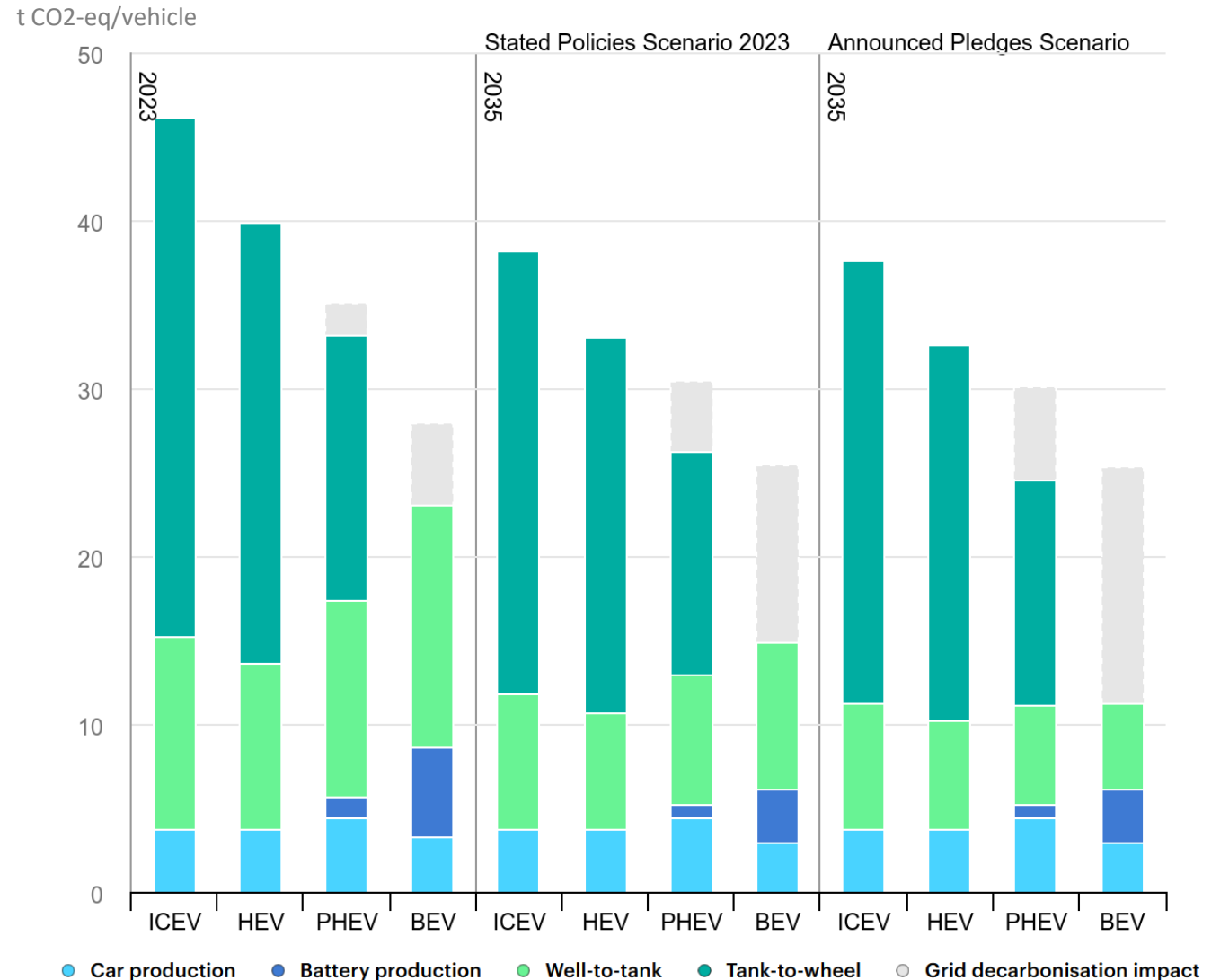
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A battery electric car sold in 2023 will emit half as much as conventional equivalents over its lifetime

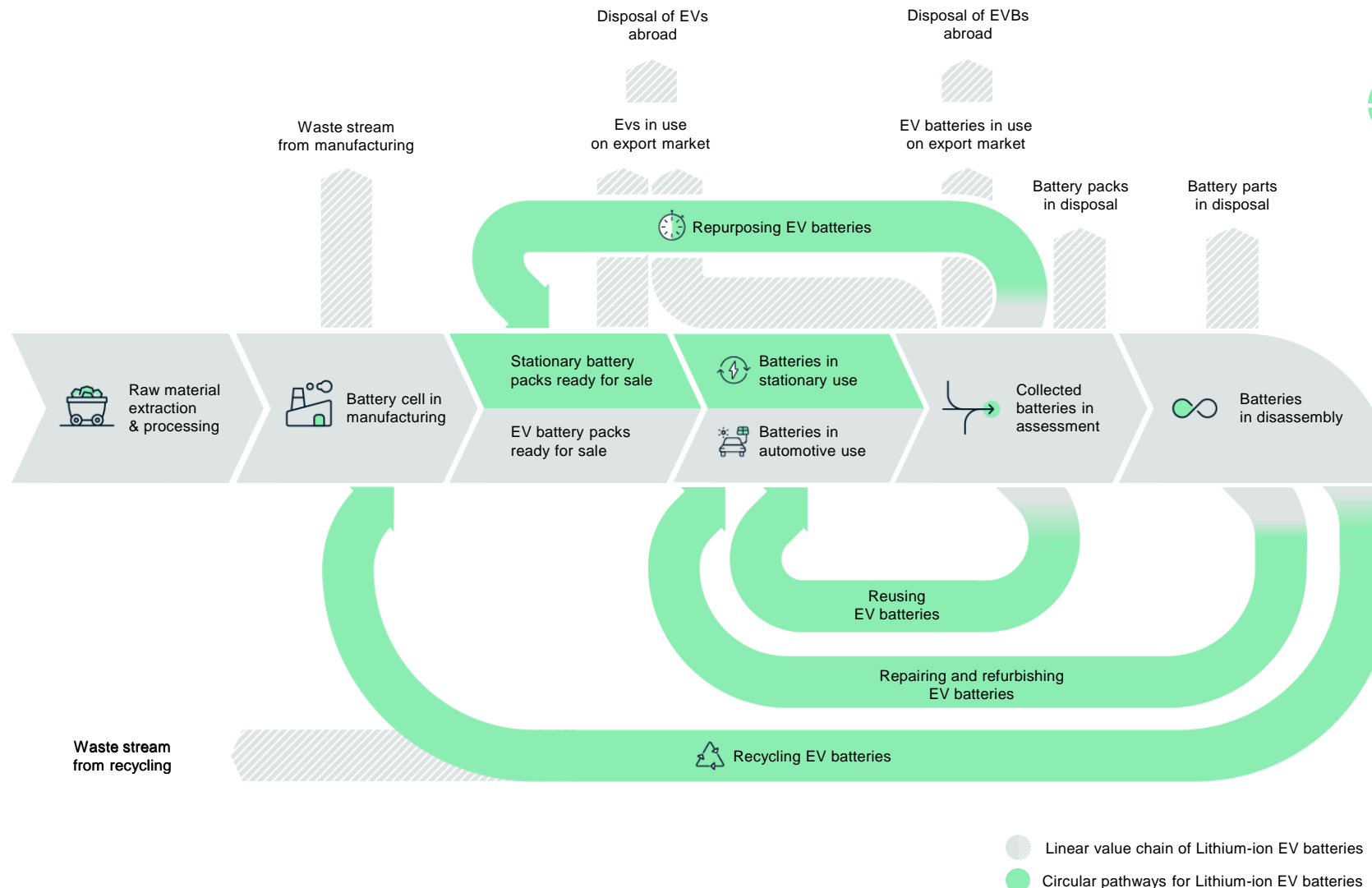
IEA Global EV Outlook-2024



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CircuBAT

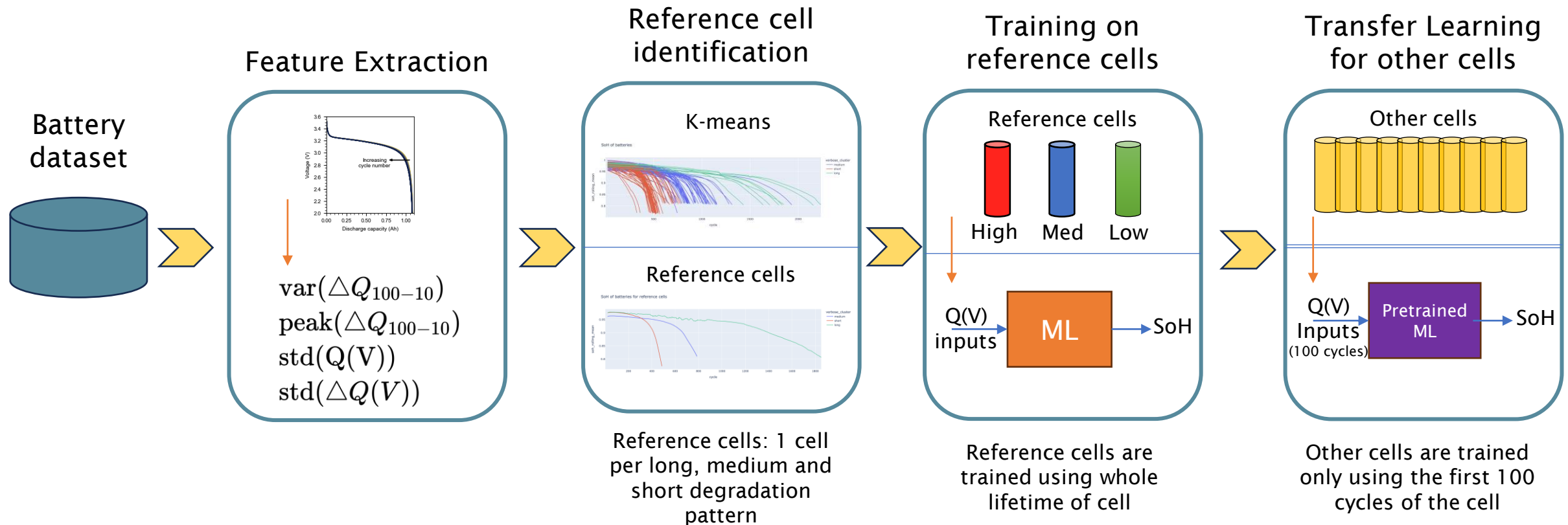
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- ▶ Create models to assess battery Remaining Useful Life via ML
- ▶ Help triage and sorting at the end of first life to increase reuse rate



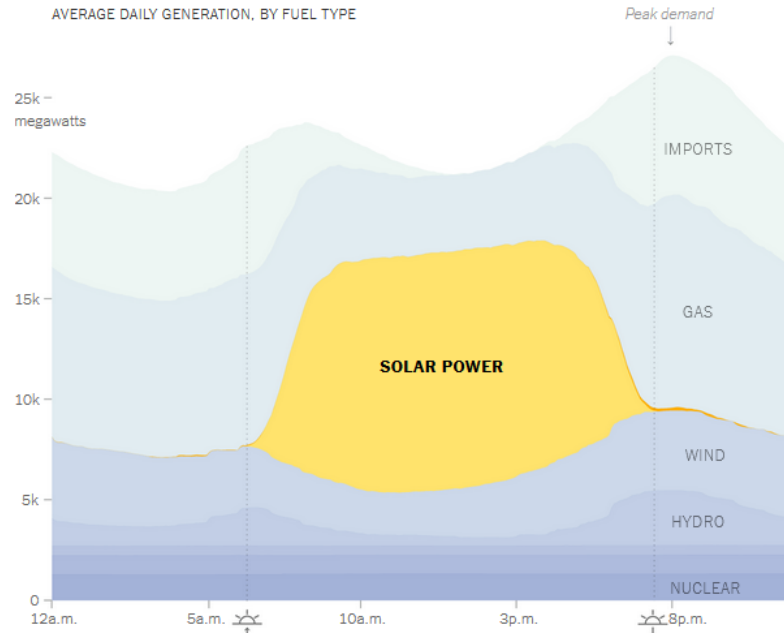
Energy Efficient

Sustainable

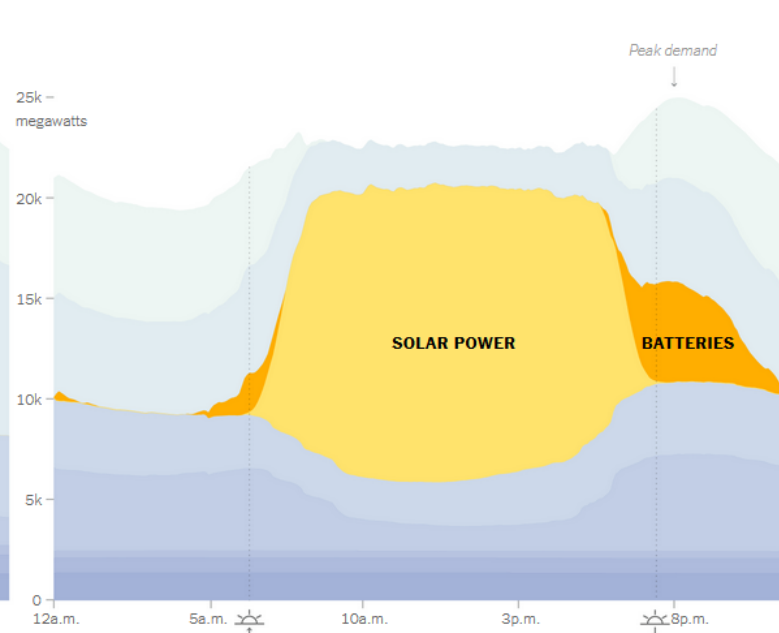
Integrated

How California powered itself in April 2021 ...

AVERAGE DAILY GENERATION, BY FUEL TYPE



and in April 2024.



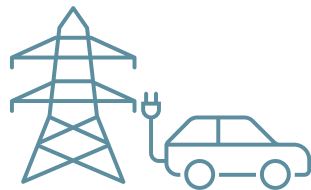
Source: California Independent System Operator via [Grid Status](#)

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STORE



BIENE



MWCharger



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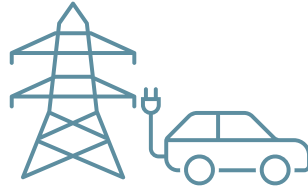
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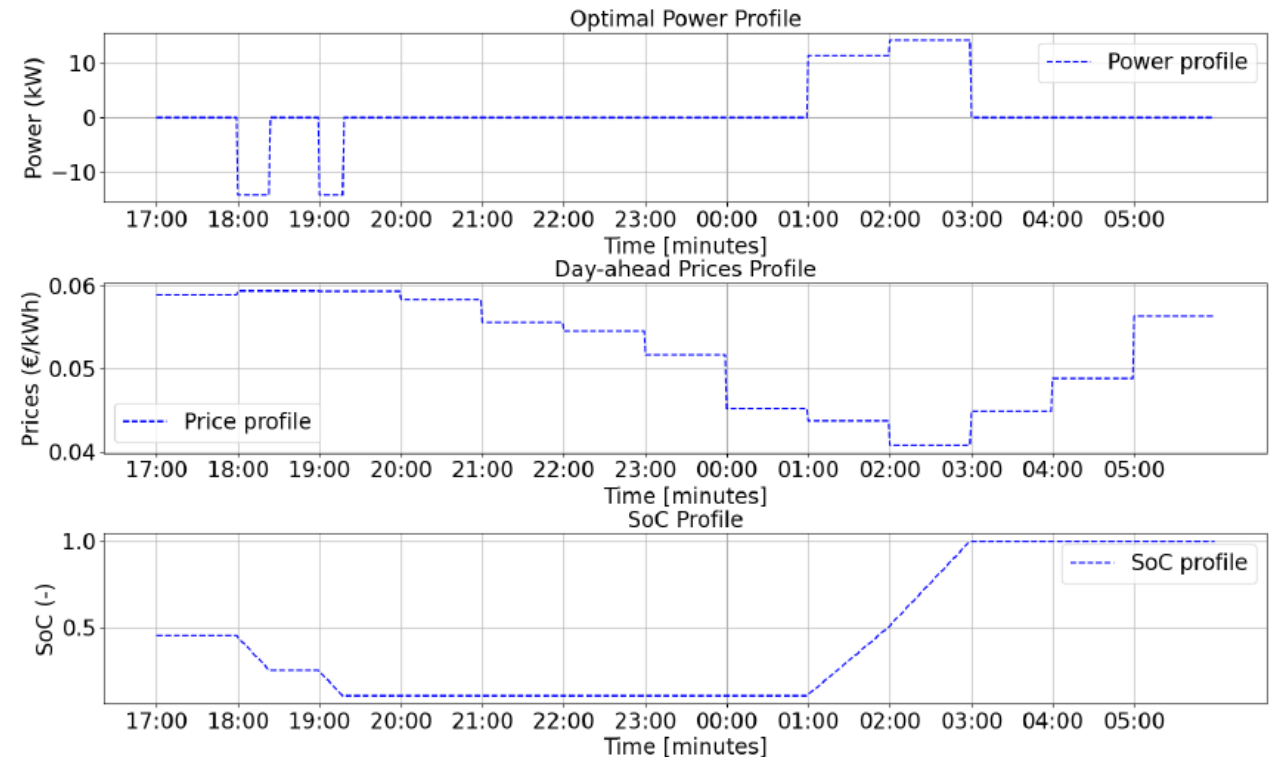
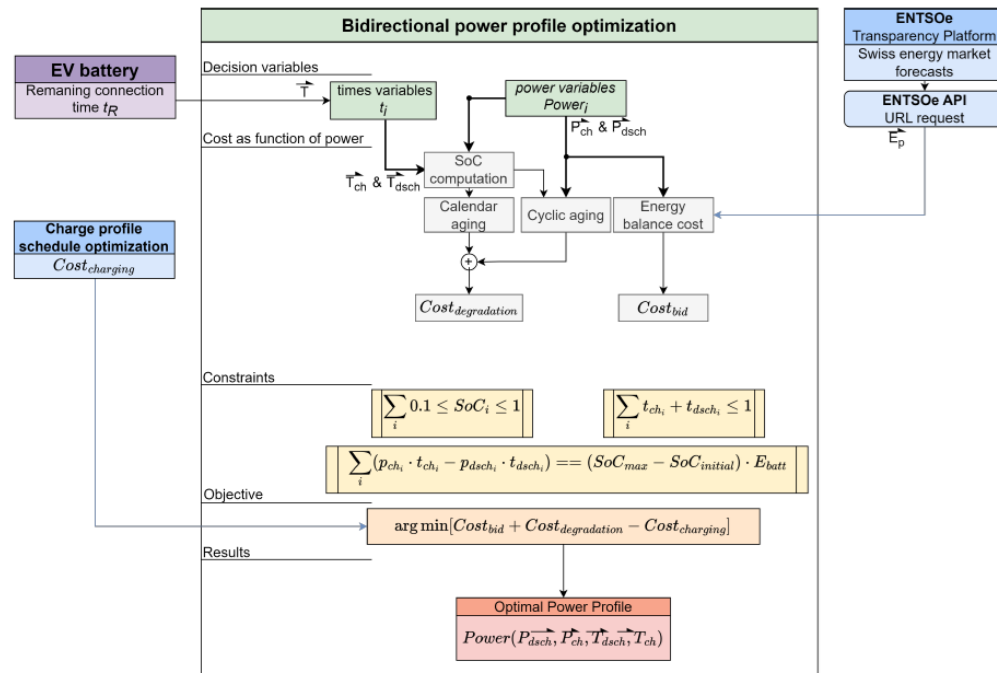
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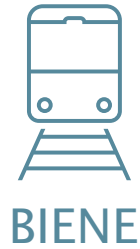
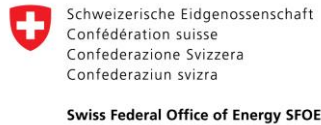
STORE.



STORE

- Optimization of bidirectional power profile based on flexible energy tariff and battery degradation

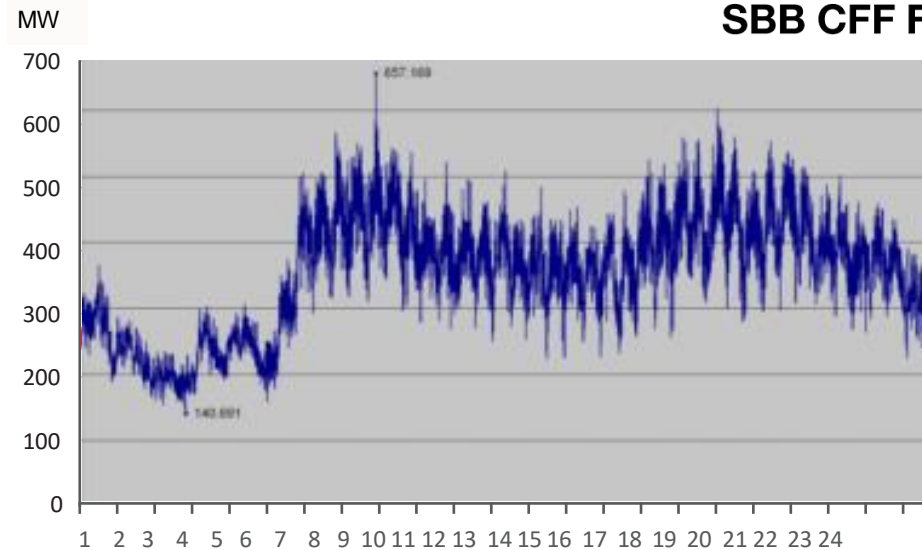


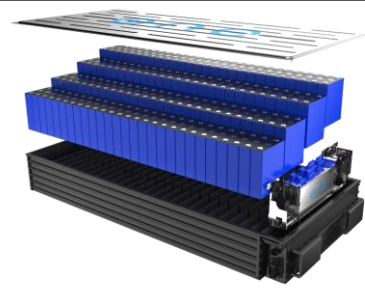


- ▶ Replacement of Diesel Cargo → 11 Mio L consumption
- ▶ Cumulated Capacity → >100MWh
- ▶ Development of Battery Manager to exploit full potential of battery asset



1 day at SBB (16.7 Hz)





Improve Performances

Fast Charging

Higher RE production share

Reliable Energy system

Mobility

Energy
Efficient



Sustainable



Integrated



Extend Product Life

Maximize use of resources

Second-Life Applications

Sectors Coupling



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Thank you for your
attention

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Energy Storage Research Centre, Bern University of applied Science

► BFH-Zentrum Energiespeicherung