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The Role of Batteries Towards Carbon Neutrality

How Can Distributed Electricity Storage Contribute to Balancing Supply and Demand in Power Markets and Grids?

Research Topics

THREE Types of Battery Applications and Their Use for Flexibility to Markets / Grids:
Assessment of Technology and Business Model

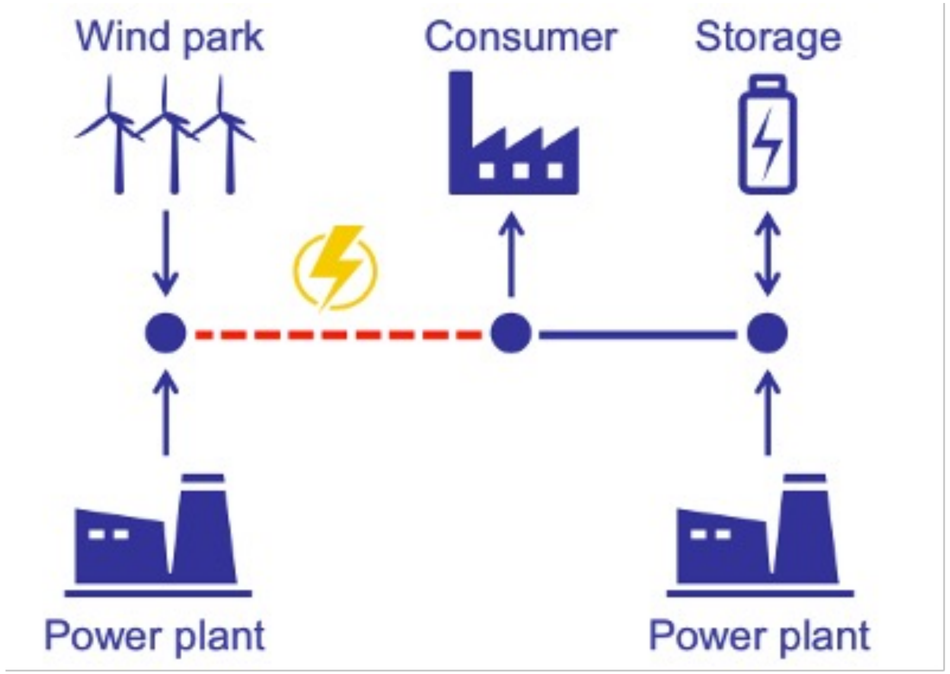
<table>
<tr><th></th><th>Primary Use</th><th>System Balancing / Grid Stability</th></tr>
<tr><td>Grid-Integrated Large Scale Storage (LSS)</td><td>System Balancing/Grid Stability</td><td></td></tr>
<tr><td>Building (Home/Commercial) Industrial Storages (HSS/ISS)</td><td>• Roof-Top PV maximum use
• Reducing energy costs, e.g. demand charge
• Backup power supply</td><td rowspan="2">A big potential with increasing deployment toward 2030.

No business cases, a few pilots both in Germany and Japan.</td></tr>
<tr><td>BEV Storages (BEV)</td><td>Transportation</td></tr>
</table>

- **The potential of further using BEV batteries** (second life) **in buildings or grid-integrated larger stacks and other re-uses**
- **Needs for battery recycling**
- **Country studies of potentials, business cases, status of application, regulation**

Technology Assessment: Grid-Integrated Batteries
(Large Storage Systems – LSS)

So-called “**grid boosters**” can store power downstream of the congestion point during non-congested periods and dispatch that electricity during periods of congestion.



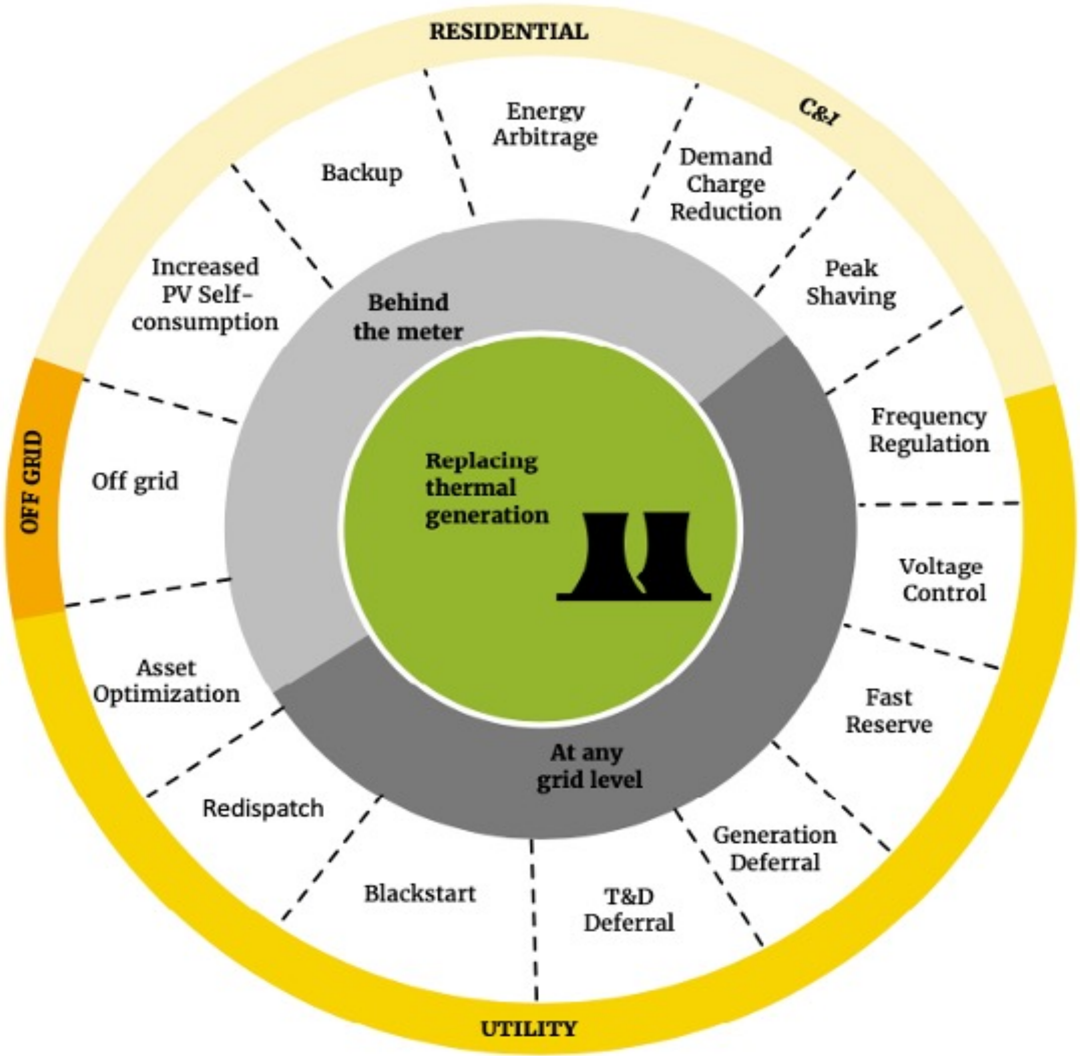
Source: DENA (2020)

➡ Used at overloaded grid points, batteries can prevent renewable energy generators from being shut down.

Technology Assessment: Building-Integrated Batteries
(Home Storage Systems – HSS, Commercial/Industrial – ISS)

Off Grid:
Batteries without connection to the grid.
(not part of this study)

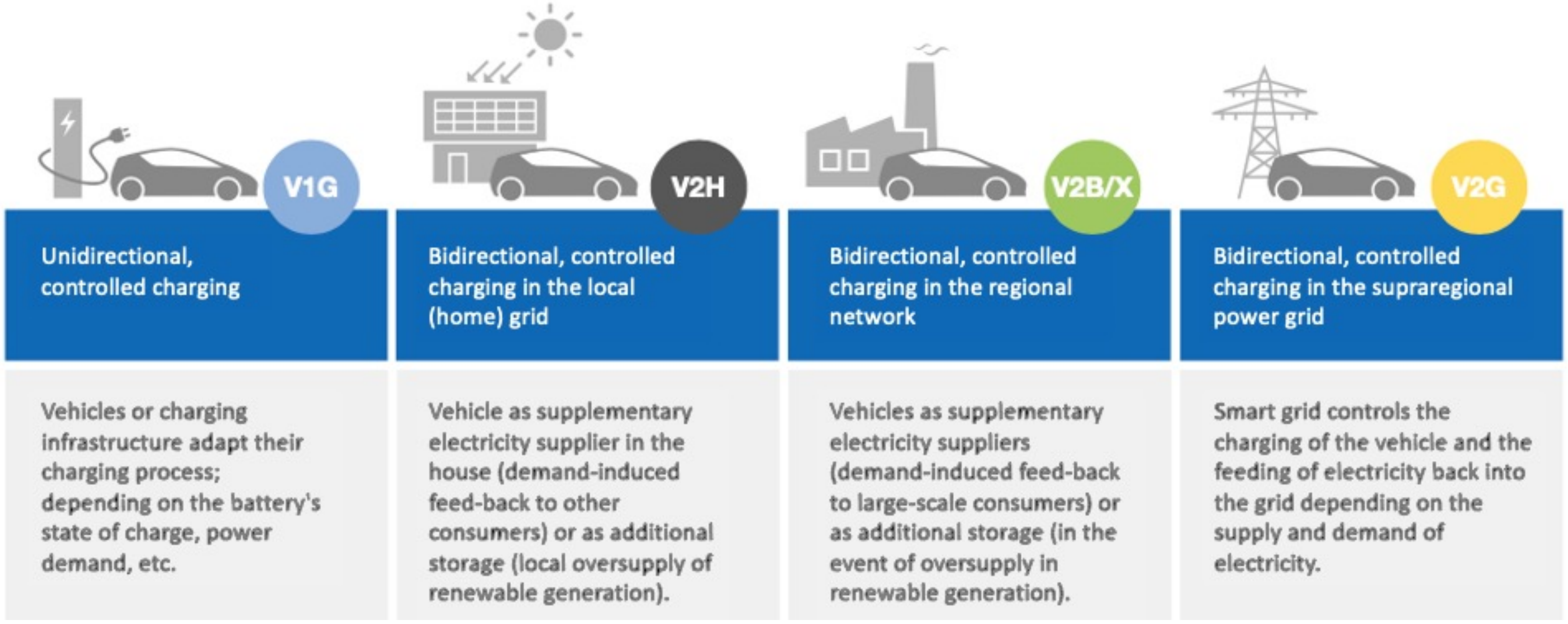
Utility:
Batteries located in a transformer station or a building/facility and owned and operated by a utility for optimizing its operations.



Residential and **Commercial** and **Industry (C & I) Sectors**: Batteries are owned by the building/facility owners and are at first place used to optimize their own operations and energy costs.

Technology Assessment: Battery Electric Vehicles (BEVs)

- Passenger cars are estimated to be **used only 5% of the time**
- Electric vehicles generally need **10% of the time for charging**
  - **85% of the time free** for potentially providing flexibility services



Germany

- **Utility-scale batteries** (LSS) have been operating for several years now
- Regarding **HSS and BEVs**, Germany is still gaining experiences on their use as flexibilities in pilot projects
- One exception: Some well-established ventures when it comes to **HSS pooling**

<table>
<tr><th>Type</th><th>Number and Capacity (2019)</th><th>Market Growth Potential (2030)</th></tr>
<tr><td>Large-Scale Batteries
(LSS)</td><td>68 storages
460MW/620MWh</td><td rowspan="4">Y2030 estimate (NEP2019)
Transmission Grid Load: 80GW

PV and HSS could provide 10GW
BEV could provide 15GW/<1.5 TWh
(15 million BEVs)</td></tr>
<tr><td>Home Batteries
(HSS)</td><td>185,000 storages
750MW/1420MWh</td></tr>
<tr><td>Industrial Batteries
(ISS)</td><td>700 storages
27MW/57MWh</td></tr>
<tr><td>BEVs</td><td>400,000 BEV newly registered
in 2020</td></tr>
</table>

Japan

- Currently no policy target of LSS deployment
- HSS deployment, one of the highest worldwide. HSS/ISS deployment study group by METI submitted the recommendation in 2021 with the target cost reduction and the deployment plan.
- Currently no policy target of xEV deployment

Type	**Number and Capacity** (2019)	**Market Growth Potential** (2030)
Large-Scale Batteries (LSS)	Hokkaido-TSO requires LSS on 5 solar/ 3 wind projects (5 solar with 316 MW LSS)	**LSS: No policy target, TSOs are encouraged to procure flexible resources from markets.** **Stationary battery storage deployment study group** **HSS: 18.0 GWh by 2030** **(40% new homes, 3.6 mil. existing homes)** **CSS/ISS: 2.37 GWh by 2030 (Four sectors)** **xEV: No policy target, auto industry roadmap** **206-261 GWh by 2030**
Home Batteries (HSS)	HSS: 2.4 GWh (2019)	
Industrial Batteries (ISS)		
BEVs	BEV: total Nissan Leaf EV exceeded 100,000 in 2020 HEVs are popular, 30% of new car sales	

Comparison:
Same and Different Implementation Status

a) Germany and Japan share the **same implementation status**

- HSS deployment increasing to maximum use of rooftop PV power
- The experience with aggregating HSS/BEV is still low

b) Germany and Japan are in **different implementation status**

- Germany has more experiences with Grid Balancing/Flexibility with LSS deployment (68 systems/ 620 MWh, as of 2019)
- Japan has more defined pathways of HSS/ISS deployment toward 2030
- In Germany, a few major automobile manufacturers are working with industrial waste disposal companies in EV battery recycling pilot projects

c) Different policy priorities / implementations between Germany and Japan

- **Strategy of BEV/xEV (Electrified Vehicles) promotions**
  Germany is increasing BEV sales, **Japan** is promoting xEV not limited to BEVs, but including HEVs
- **A technology standard** is required in the development of **BEV battery "second-life" and "recycling"** business

  In Europe, draft amendment to "**Storage Battery Directive**" published late 2020, with environment labelling and manufacturers' recycling obligations
  In Japan, an **industrial voluntary guideline** with METI's supervision. The guideline honors competition by avoiding excessive standardization

Conclusion (1)

- Three types of Battery Storage Systems studied
  - HSS/ISS and BEV storages have a big potential as a flexible resource with increasing deployment toward 2030
  - **HSS/ISS and BEV storage use as a flexible resource has limited business cases, a few pilots both in Germany and Japan**

- To improve the conditions for using LSS, HSS/ISS and BEVs as a flexibility ressource:
  - Starting from **a clear definition of "storage" in the electricity system.**
  - Carefully compare "**Extra costs in metering/monitoring/control**" (of HSS/ISS/BEV resources) with "**Values of flexible measures**" (in Power System).
  - **Remove double levies** (fees or taxes) with "consumption" levies during charging and "generation" levies during discharging.
  - Create financial incentives for use of batteries as system balancing/grid stability resource, e.g. time-dependent BEV charging tariffs or PV+battery feed-in prices
  - Roll-out of smart meters in Germany

Conclusion (2)

- A suggestion by Hildermeier (2019): **“Time” and “Location” Conscious BEV Charging**

  *The first contribution of BEV to the power grid is to manage the charging “**Time**” (when renewables generate…) and “**Locations**” (where the grid capacity available…) so that BEV charging demands not excessively give stresses to the grid.*

  Bi-directional charging (private, local, system): Second/further steps

- More **regulatory framework required for “Second Life” & “Recycling**” of BEV Batteries
  - Labelling and information necessary for the identification and characteristics
  - Clear and operable standards to determine the state of health and the remaining capacity
  - Discuss and agree on the “manufactures’ responsibility” in the second life

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