



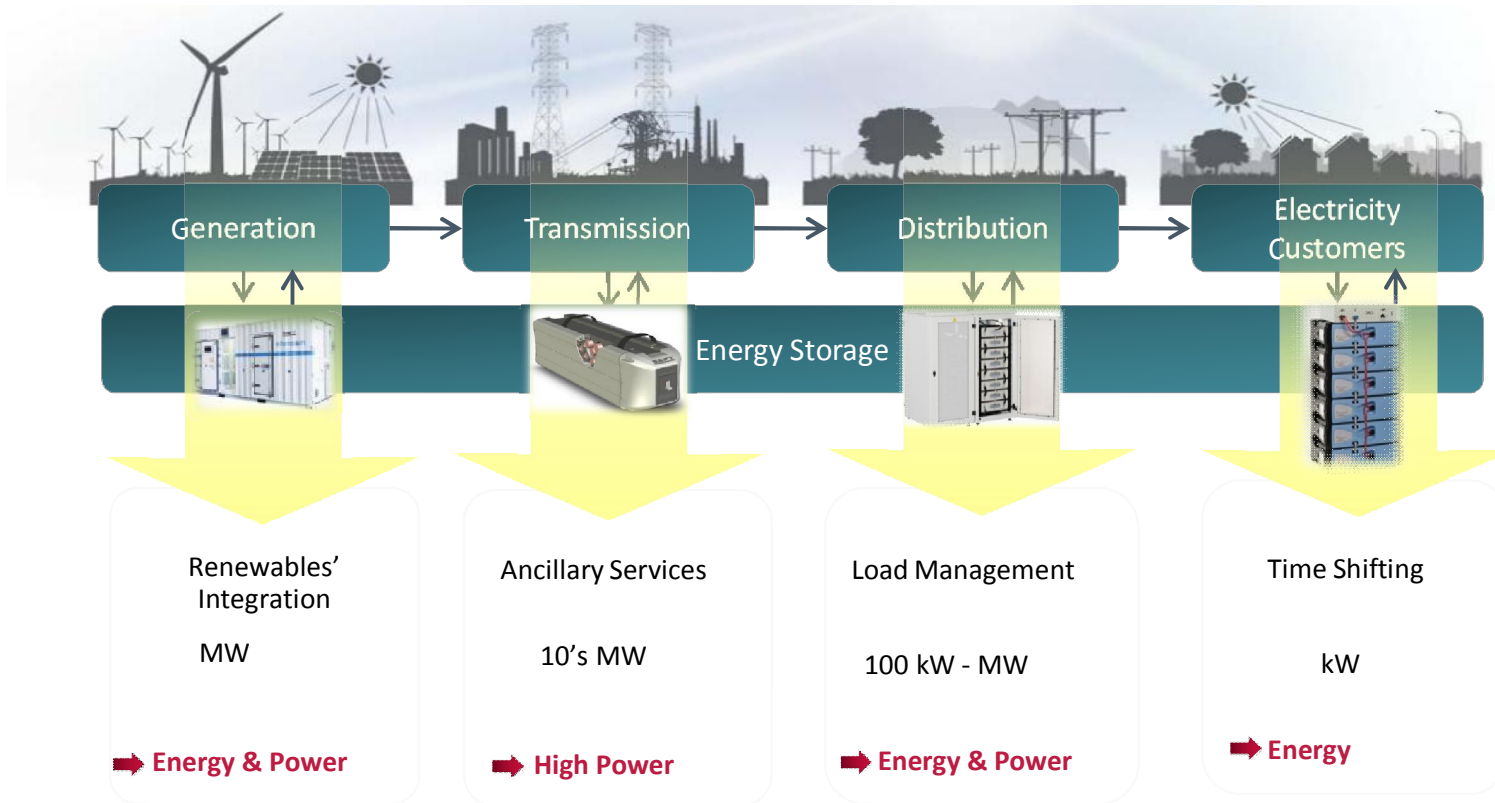
Energy storage in renewable energy systems

Michael Lippert

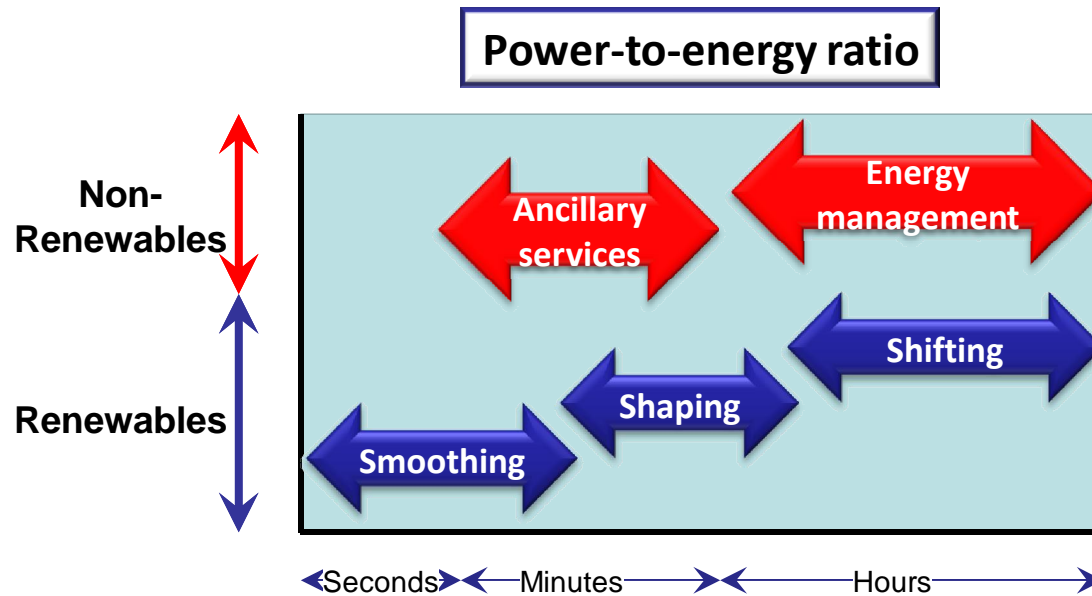
Battery Recycling ICBR 2012



Energy Storage Value Chain



Energy storage solutions – power & energy



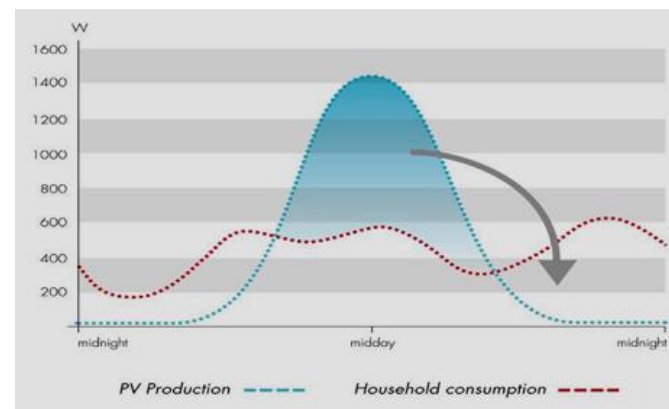
- Li-ion technology has the flexibility to address all these functions

Time Shifting of renewable energy



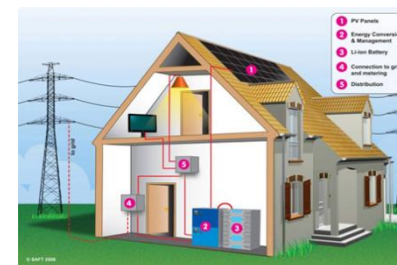
Principle

- Store energy generated in excess of consumption
- Discharge when needed



Benefits

- ✓ Maximise self-consumption of PV energy
- ✓ Increase value of energy
- ✓ Support Demand Response Programs



Peak Shaving



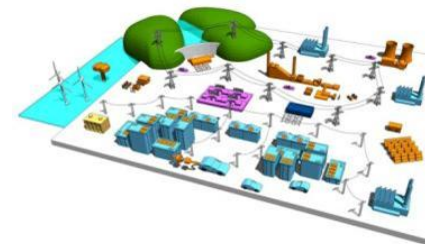
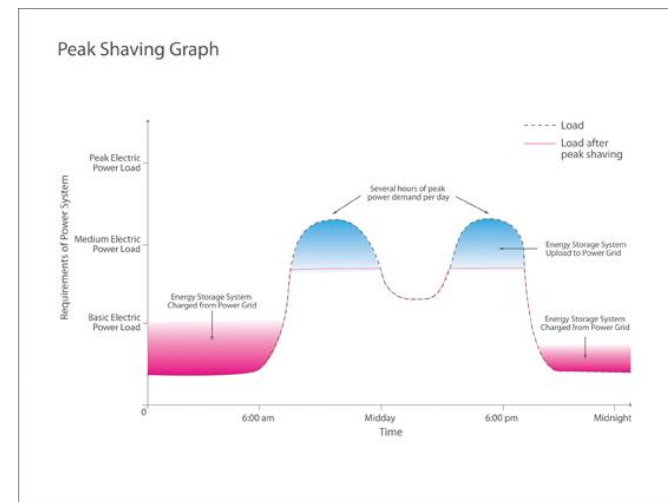
Principle

- Provide peak loads from energy storage devices
- Absorb generation peaks

➔ Relief grid in case of overloads

Benefits

- ✓ Avoid or defer grid upgrades
- ✓ Increase grid hosting capacity

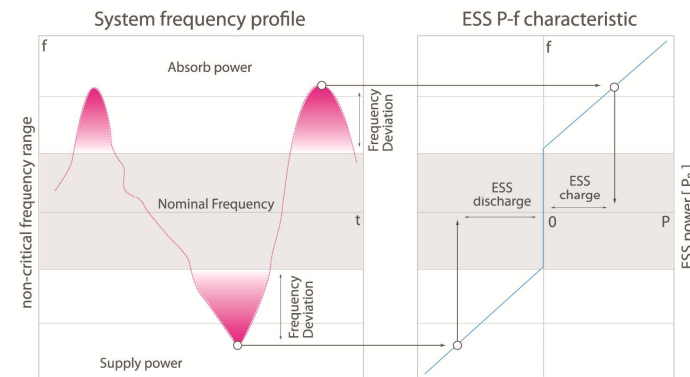


Frequency Support



Principle

- Inject active power to grid
- Absorb active power from grid in case of frequency deviations



Benefits

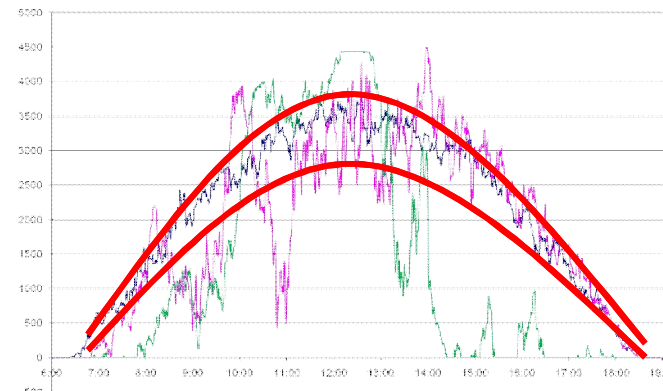
- ✓ Provide ancillary services (primary and secondary reserves) otherwise ensured by conventional generation
- ✓ ...at lower cost and/or environmental impact
- ✓ Increase base load capacity of conventional generation

Renewables Smoothing



Principle

- Compensate short term variations of generation
- Absorb production peaks (charge)
- Compensate power sags (discharge)



Source: Aerowatt

Benefits

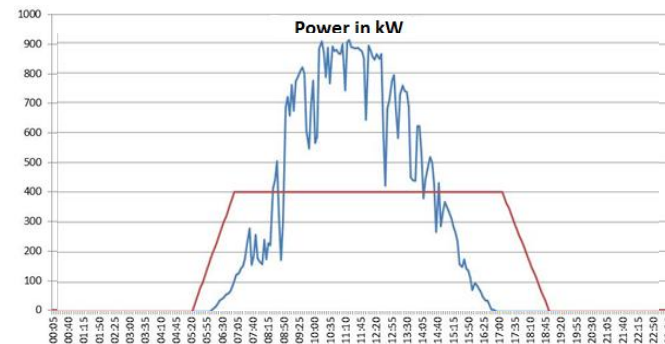
- ✓ Make renewable generation predictable and grid compatible
- ✓ Avoid curtailment

Renewables Shaping



Principle

- Ensure stable output of renewable generation plant
- Absorb production peaks (charge)
- Compensate power sags (discharge)



Benefits

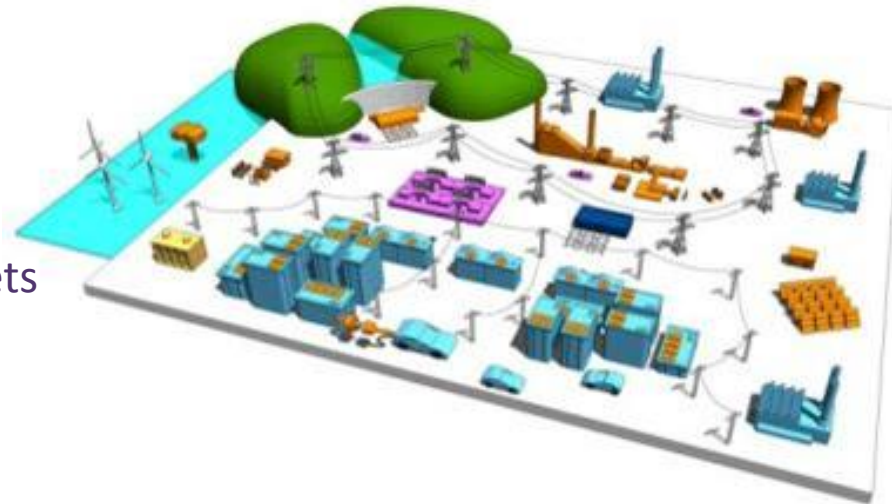
- ✓ Make renewable generation a firm component of energy mix
- ✓ Increase hosting capacity of grids, namely in island grids

THE FUTURE

Integrated Energy System

- Optimised use of all assets
 - > Local generation
 - > Grid
 - > Storage

- Demand Side Management
- Zero Energy Buildings
- Multi-functionality of storage





Thank You

