

ENERGY STORAGE SEMINAR

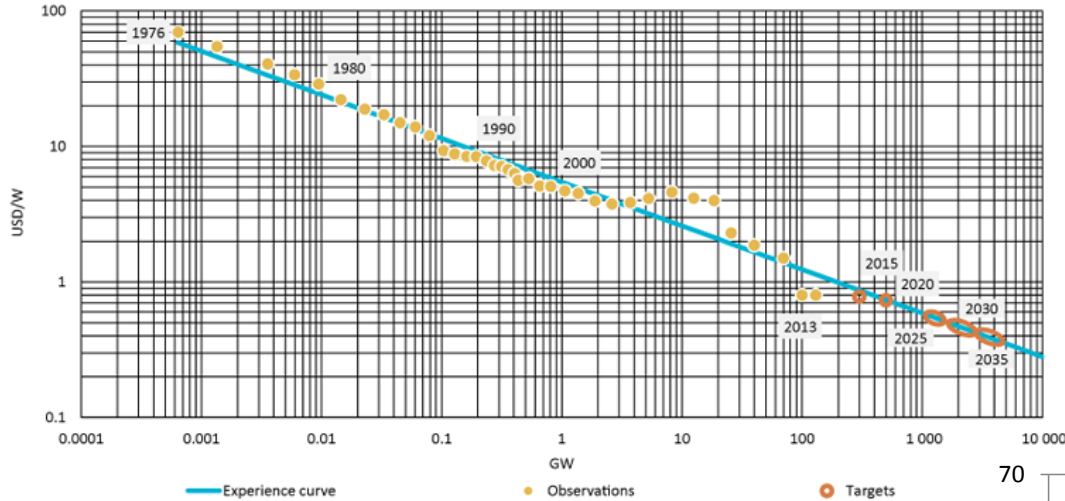
TRONDHEIM 2014-10-21

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Technology Analysis

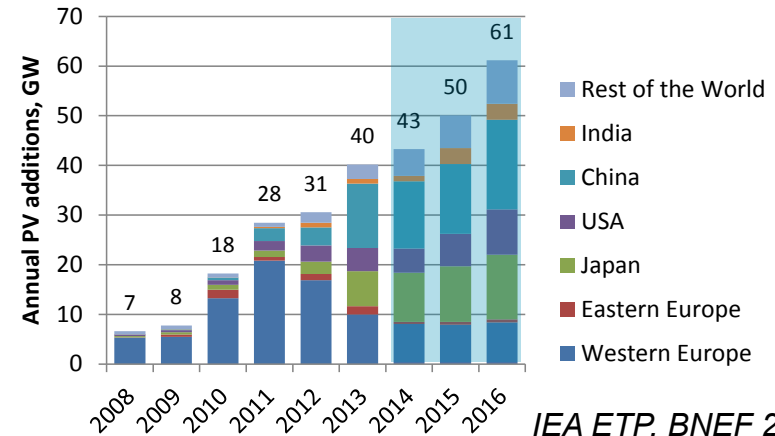


Solar PV is transforming the energy system



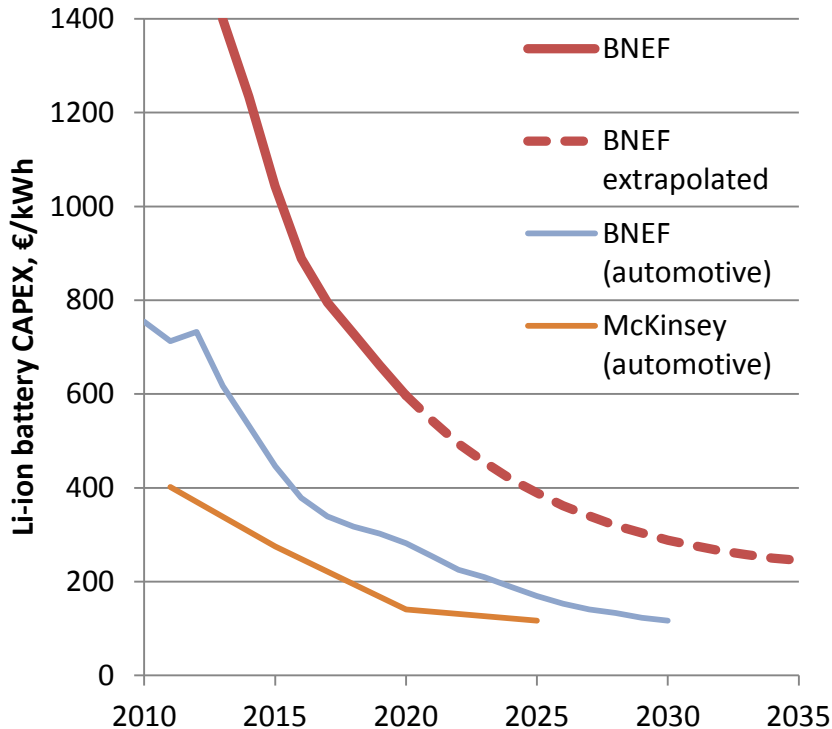
→ Decreasing prices

Increasing volumes →



IEA ETP, BNEF 2014

Can batteries do the same?



▶ Battery cost expected to decline

- Growth in electric vehicles
- Technology development
- Subsidies in Germany, Japan

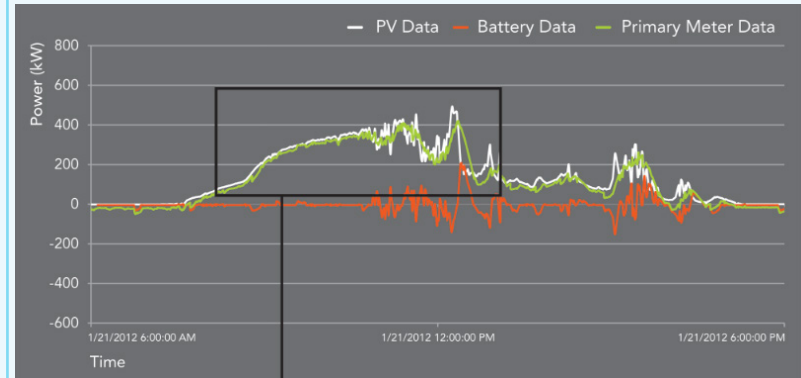
▶ Similar properties as solar PV

- Modular/scalable
- Location independent

Energy Storage Applications by time-scale

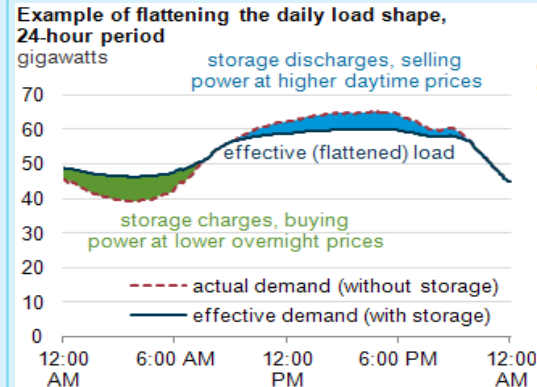
Power applications

- Time-scale: seconds - minutes
- Ancillary services
- Renewable smoothing



Energy applications

- Time-scale: hours - seasons
- Arbitrage



Conclusions

Applications

- ▶ Batteries well-suited for ancillary services
- ▶ Limited potential for batteries in wholesale market
- ▶ Opportunities for batteries behind the meter to increase self-consumption, but complex investment proposal
- ▶ Long-term growth potential for solar/battery systems in off-grid markets

Effects on Energy system

- ▶ Low marginal costs of batteries may reduce value of ancillary services
- ▶ Demand for back-up power and flexibility will remain
- ▶ Enable more distributed solar and self-sufficiency (-> new retail pricing model?)
- ▶ Save diesel fuel, facilitate rural electrification

RES integration solution		Deficit solved?	Surplus solved?	Residual load		Limitations
0	Base case situation			Deficit + Surplus -		
1	Dispatchable generation (hydro, bio-mass, fossil)	✓	✗	Deficit + Surplus -		- Hydro and biomass quantity is limited - Fossil fuels generate CO₂ emissions - No utilization of excess energy
2	Transmission and distribution expansion	✓	✓	Deficit + Surplus -		- Ineffective if RES production correlated over large area - Hampered by permitting issues and long construction times
3	Demand side management	✓	✓	Deficit + Surplus -		Limited by amount of demand that can be shifted and time for which it can be delayed
4	Energy storage			Deficit + Surplus -		- Backup non-RES energy will still be required and substantial excess energy will remain even with P2P storage - Conversion to other carriers (heat and hydrogen) can utilize most excess energy
	Power-to-power	✓	✓	Deficit + Surplus -		
	Conversion to heat and heat storage	✓	✓	Deficit + Surplus -		
	Conversion to Hydrogen for use outside power sector	✗	✓	Deficit + Surplus -		



Commercialization of Energy Storage in Europe

Launch date 6th November 2014

Over 30 organizations involved





THANK YOU



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