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Adding value to the future electricity grid: The Role of Energy Storage

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European Organisation representing the **Electrochemical Storage Industry**

Members:

- Battery Manufacturers
- Battery Supply Industry
  - Cell and Module producers
  - Battery System Integrators - Battery packs

Members representing the EU market

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Eurobat regular and associate members - Battery manufacturers and supply industry:

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Markets & Structure

Industrial Markets

- Stand-by: UPS, telecom…
- Motive power: forklifts
- Transportation: train, maritime, aviation, space
- Electricity grid: production, transmission, distribution
- Renewable energy

Automotive Markets

- Cycle & motorcycles
- Passenger cars, LCV, HCV, buses
  - LSI & start-stop batteries for ICEs
  - for Micro, Mild and full HEVs
  - for pHEVs and EVs

➲ **Committee for Environmental Matters (CEM)**

➲ **Research and Technical Development Committee (RTD)**

➲ **Industrial Battery Committee (IBC)**

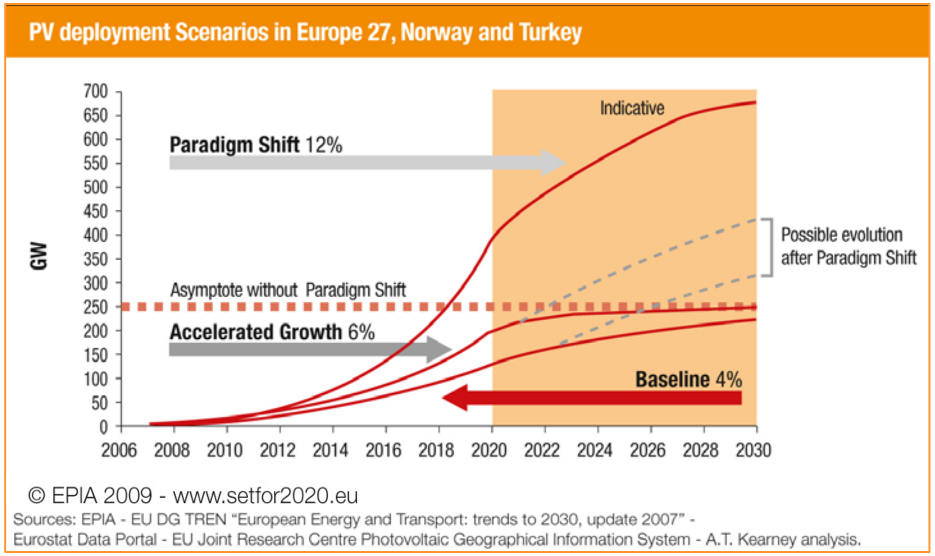
- IBC Task Force: batteries for Renewable Energy and electricity grid

➲ **Automotive Battery Committee (ABC)**

Grid Integration is Key

Integration of Renewables

- …is a political and environmental goal
- …meets technical challenges due to variable nature of generation
- …requires increased *flexibility* of grid management and generation mix



*« The **Paradigm Shift Scenario** (…) requires the rapid and widespread adoption of power storage and smart grid technolgies, (…) »*

EPIA, SET for 2020

How to create flexibility ?

Supply Side

→ Compensate for variations

- Transmission grid → upgrades, interconnection
- Short term generation → gas turbines
- **Storage → Centralized? Decentralized?**

Demand Side

Source: Tenesol

→ Smart energy management

- Demand side management
- Smart metering
- Dynamic pricing
- Power on demand
- **Storage: in batteries, in vehicles, heat, cold, …**

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Energy storage matrix

	Supply Side Production & Distribution	Demand Side Household / Commerce / Industry
Centralized	• Bulk energy storage – Energy dispatching • High power Energy Storage – Smoothing / Ramping support – Grid stabilization/PQ – Ancillary services	• Commercial Storage – Peak Shaving to avoid Demand charges
Distributed	• Smart Grids – Virtual Power Plants –Controlled (upon demand) injection in peak periods	• Smart Houses – Self-consumption – Zero-energy houses

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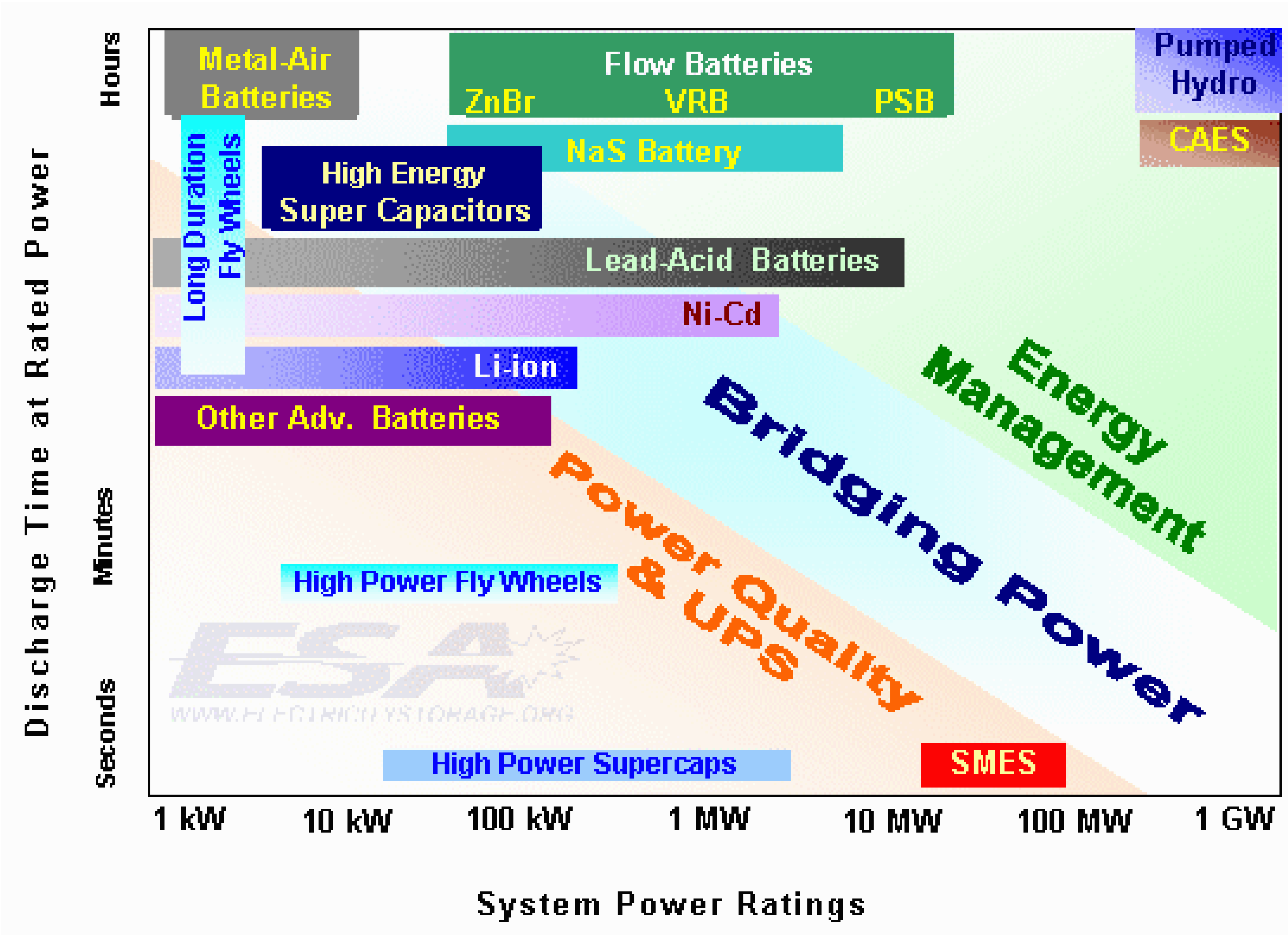
Energy Storage – technologies



Source: ESA

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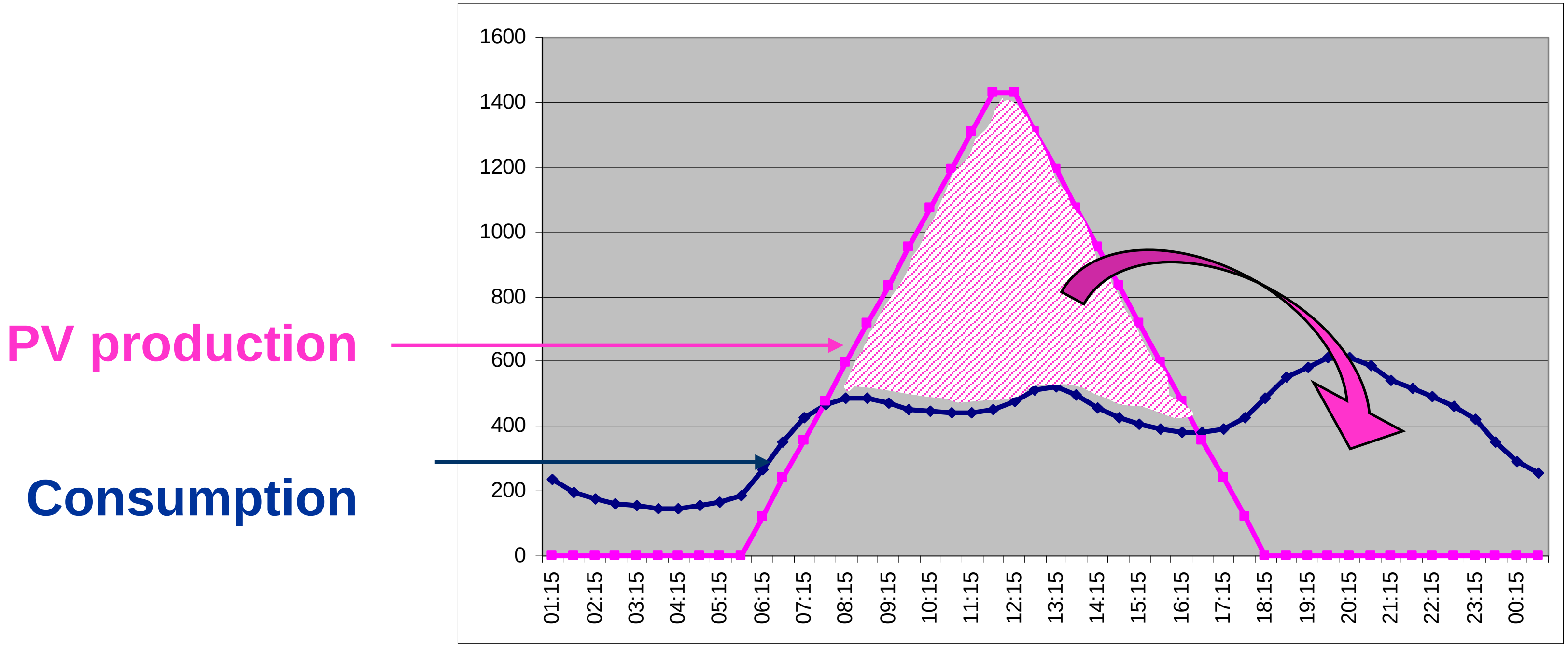
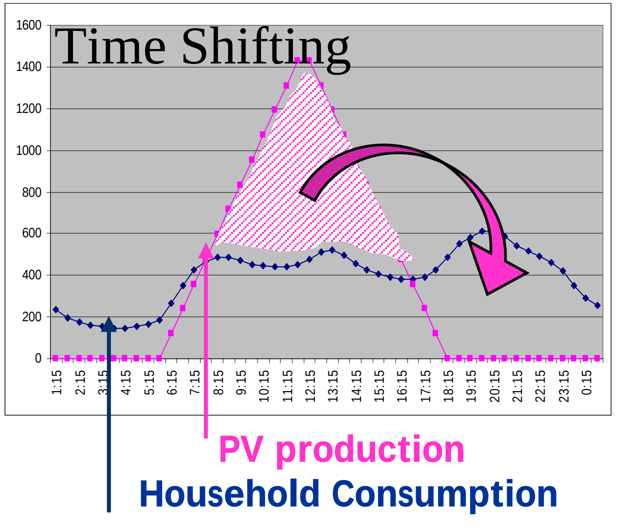
Dispatching

➡ Shift PV excess production to consumption peak period



Example: residential PV



- **PV market is decentralized** :
  - 70% grid connected small/medium size systems

- Local energy production and consumption
  - Self-consumption: effective demand side management
  - Grid support: peak shaving

- Requirements for typical household Europe (Epia-Eurobat model)
- Household 3kWp 10kWh/day
- Battery to cycle between 2 and 8 kWh / day

Value of Energy Storage

Household

- Energy Self Sufficient House
- Safe against outages
- Competitive vs commercial electricty at mid term

Grid operator

- **Reduce peaks**
- **Ancillary Services**

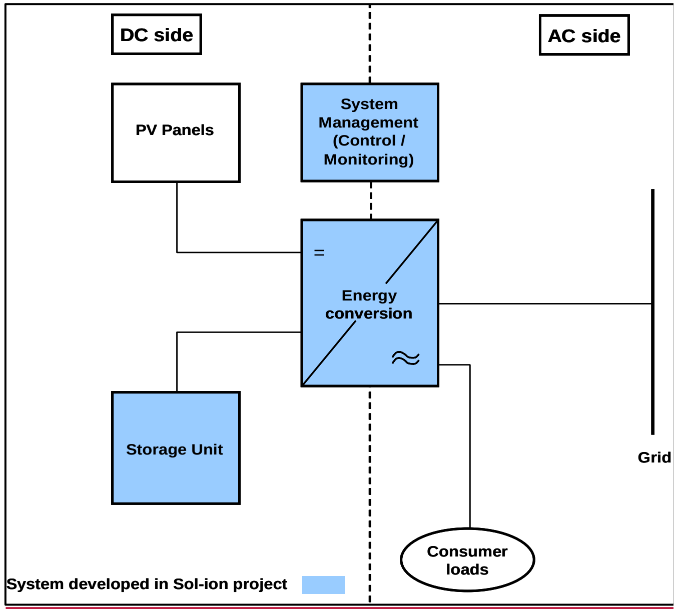
Socio-Economic

- Contribute to CO_2 savings
- Enhance broad implementation of decentralized PV

Sol-ion-Project

- Integrated Energy Kit
  - Conversion, storage & management of PV energy
  - 75 systems in France & Germany in 2009 / 2010

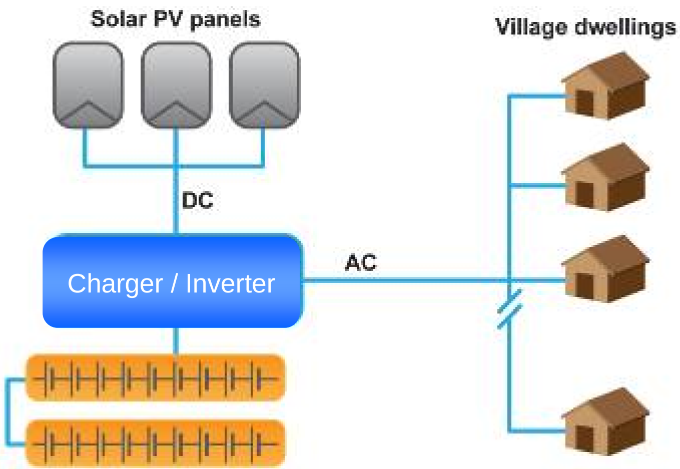
- Demand Side Management
  - Control over storage & loads using smart metering
  - Integrating future smart grid
    - •Demand response
    - •Dynamic Pricing



- PV 5kWp
- Li-ion Battery:
  - 5 to 15kWh, 170V to 650V
  - 20 years lifetime
- System functions
  - multidirectional energy flows
  - self consumption
  - grid support
  - back-up

Example: Rural electrification

- **Viable electrification scheme in developing, low population density countries**
  - 20% of PV market by 2030
  - Electricity for 1.6 bn people



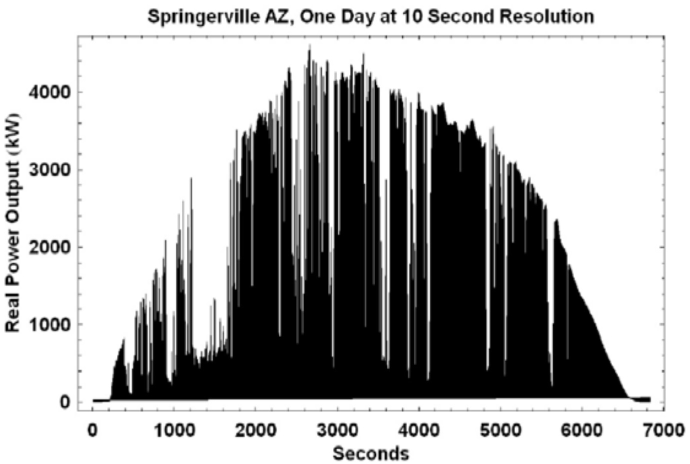
- **Various schemes call for different energy storage solutions:**
  - Solar home systems
  - Mini-grids (villages)
  - Hybrid Systems (PV/diesel/wind)
  - Telecom infrastructure

Example: PV Plants

- Load Levelling : several 10's MWh
- Smoothing of PV production

Short term power variations

- due to cloud cover and other sources
- form an integration issue
- short duration storage can help to mitigate these fluctuations by reducing ramp rates
- Requires storage with high-cycle life and power density



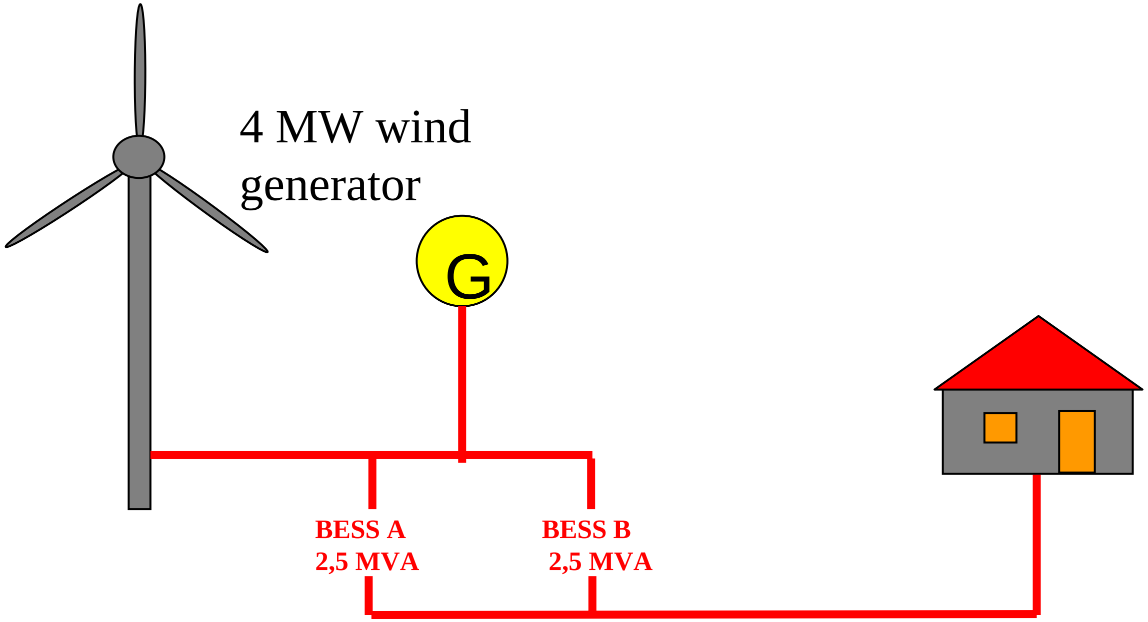
Source: EPRI

Jay Apt and Aimee Curtright"The Spectrum of Power from Utility-Scale Wind Farms and Solar Photovoltaic Arrays", Carnegie Mellon Electricity Industry Center Working Paper, CEIC-08-04

Utility scale energy storage

- Wind Energy Park Herne
- Lead-Acid battery
- 1.2 MW / 1h


Source: EXIDE



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Contribution of all 3 major battery chemistries

Lithium based (Li)	Highest energy density, smaller, lighter
Nickel based (Ni)	Proven off-shore & harsh environments. Long life
Lead based (Pb)	Proven in application, low cost production and recycling

Recycling technologies and collection circuits established and operational

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Roadmap

- Different Energy Storage technologies and solutions respond to a variety of application requirements.
- Optimization of current technolgies to specific requirements of PV
  - Energy / Power, efficiency, cylce life, calendar life
  - System integration & Energy Management
- Cost*) per delivered kWh varies considerably among applications, e.g.
  - 10% daily dod with 5 days backup (typical off-grid)
  - 60% daily dod (load shifting in residential on-grid PV)
- Cost projections
  - Today between 0.2€ and >1€ per delivered kWh
  - 2020 between 0.06€ and 0.4€ per delivered kWh
- Cost reductions are driven by technical improvements and volume.
  - Calendar life
  - Cycle life
  - Technology Maturity

*) Cost reflects purchase price for the PV Industry

Conclusion

- Multiple Applications for Energy Storage
- Future grid architecture and market mechanisms will enhance role of storage
- All Technologies contribute
- Technical and cost roadmap will increase spectrum of economically viable value propositions

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- Thank you -

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