JARY, 26TH , 2017 - MADRID

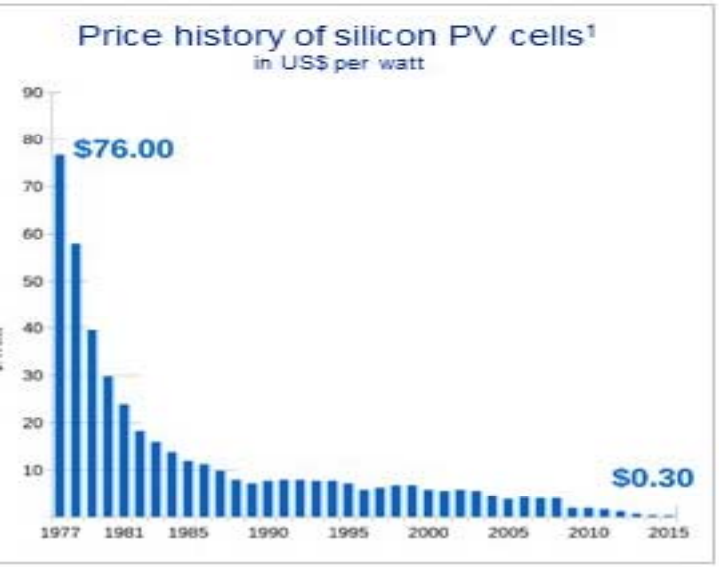
ig shift in Power

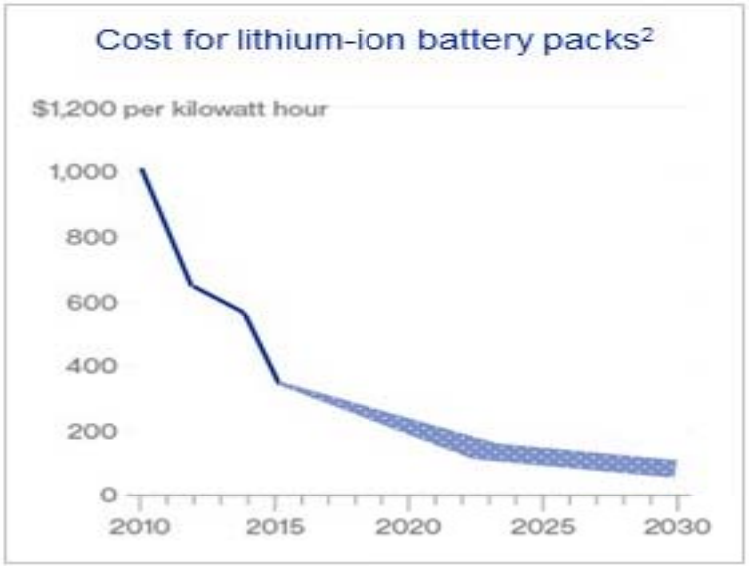
aping power systems of the future

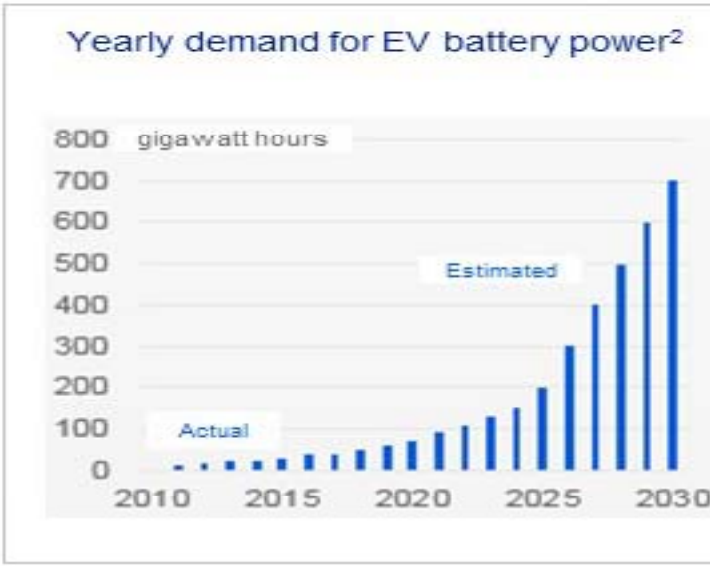
os Marcos, Country Managing Director – ABB in Spain

g shift in power

sruptive developments driving key changes in future grids







Batteries & photovoltaic

- Dramatic cost reduction – to be continued
- Scalability of technologies
- Consumer investment across market segments accelerating developments

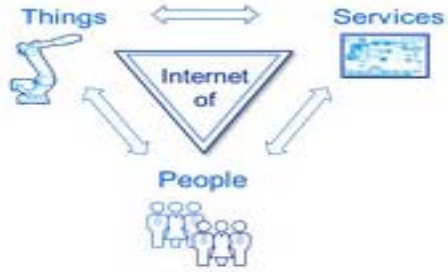
1 Source: Bloomberg New Energy Finance & pv.energytrend.com
2 Source: Data compiled by Bloomberg New Energy Finance

g shift in power
ements of the evolving grid

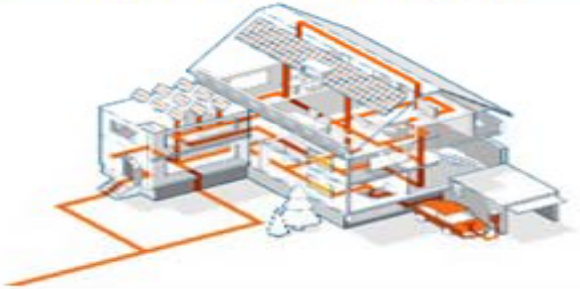
Global super grids

Power quality & demand management

Digitalization



Residential roof top solar plus Micro- and Nano-grids



Energy storage

New business models

UBER

airbnb

NETFLIX

ower systems of the future
id interconnection

Opportunities

Renewable integration across regions
- Fluctuations during the day
- Seasonal variations

Optimal use of reserve and peaking capacities

Diversification of electricity supply

Reduction of wholesale electricity price volatility

Strengthening grid operation in case of fault conditions

Increase capacity utilization factor of conventional generation

Challenges

Political factors

Economic framework

Technological capabilities

Coordinated operation (global harmonization standards, grid codes and operational practi

ower systems of the future
id interconnection: Ultra High Voltage

World's most powerful UHVDC link

Chiangji-Guquan, China

1100kV DC

12000MW

>3000km

World's first multi-terminal UHVDC link

North-East Agra, India

800kV DC

6000MW

>1700km

UHVAC transmission

Bina Substation, India

1200kV Circuit breaker & transformer

ower systems of the future
crogrids and integration of renewables

Resilient and cost-effective technology

Grid code compliant integration of wind & solar

Stabilizing weak grids

Microgrids acting as one controllable generator or load

Access to power in remote locations

Marble Bar, Australia

- PV* (300 kW)
- Diesel (1280 kW)
- Flywheel (500 kW)

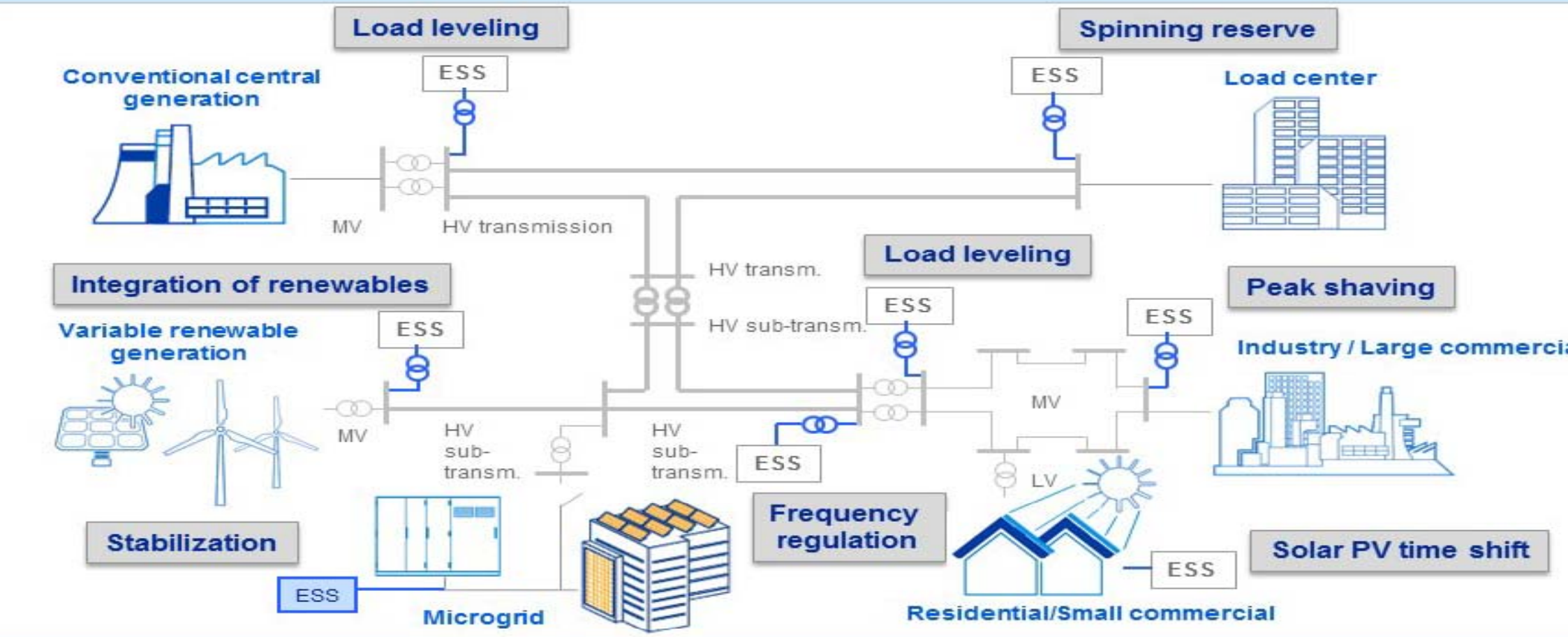
Johannesburg, South Africa

- PV* (380 kW)
- Diesel (2x600 kW)
- Battery (1 MVA/380 kWh)

* PV -Photovoltaic

ower systems of the future

nergy storage – a key element across the power value chain



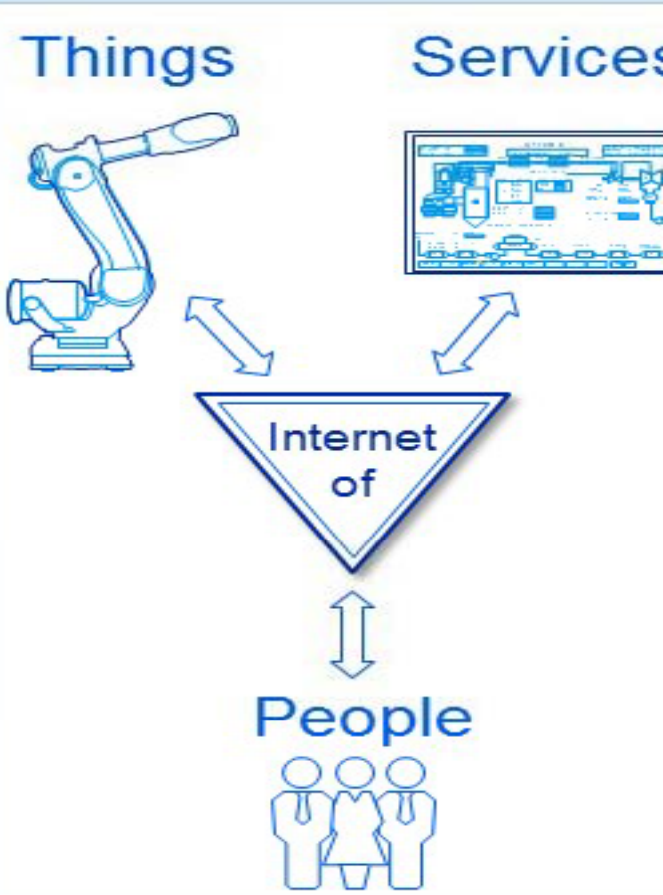
ower systems of the future
wer quality & demand management

istributed renew-ables	Line voltage regulator On-load tap-changers for distribution transformers Extended control algorithms	 *Line voltage regulator for medium voltage grid with RESIBLOC® technology
Bulk renew-ables	Extremoz substation (BR): Static Var Compensator to connect wind energy (>1000 MW) to 230kV level	
Demand esponse nanage-ment	Frequency regulation through short term balancing of supply and demand Smart home and building management Electric vehicle (charging) infrastructure	

ower systems of the future

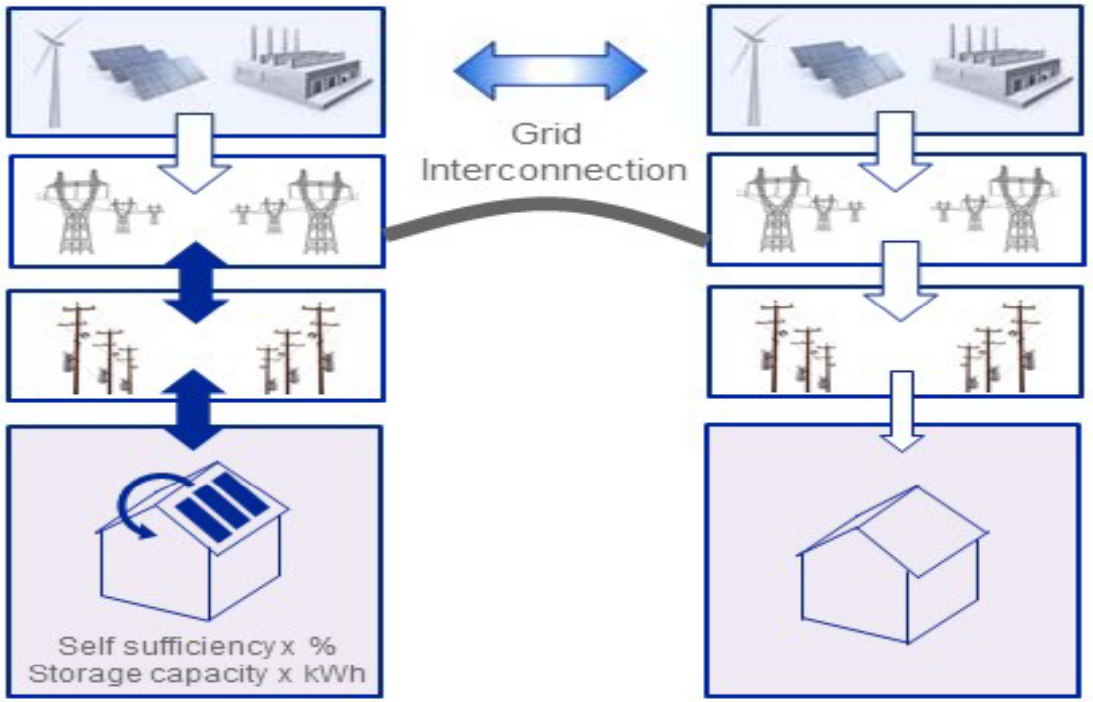
gitalization trend – Internet of Things, Services & People

Design nd build	Optimized design through simulation Faster configuration process Lower lead times and higher quality manufacturing & assembly processes Reduced on-site installation & commissioning
Operate	Virtual power plants Power generation forecasting & scheduling Electricity market management Ownership of assets and business model
Maintain	(Big) Data analysis – continuous learning Remote access – communication Monitoring, asset management & service aligned with expert knowledge Workforce management



ower systems of the future – an evolutionary vision

erconnected system of regional grids with fluctuating demar
d generation patterns



Renewables will take major share in electrica power generation

- Disruptive elements
  - Photovoltaics
  - Batteries
  - Digitalization
- Distributed generation with changing consumer & producer patterns
- Distribution grid role changing
- Transmission backbone essential
- New business & operational models

ew opportunities & challenges require new ideas – evolutionary & revolutiona

Thank you