



Soft Energy Storage Systems – Markets & Applications

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Energy Storage Functions



Large power plants

Grid compatibility

Photovoltaic Power Plants
Wind Power Plants



Grids

Demand-supply flexibility

Transmission Grids
Distribution / Smart Grids
Microgrids
Private Grids (e.g. railways)



Behind the Meter

Residential, Commercial, Industrial

Self-consumption

Smart Buildings
Industrial / Commercial

Applications

Energy Shifting	■		■
Smoothing / ramp control	■		
Frequency regulation	■	■	□
Peak Shaving		■	■
Hybrid Power Generation	■	■	■

Dedicated solutions for specific application requirements



Large solar plants

- Energy shifting
- Peaking capacity



IM20 High Energy

- 2.5 MWh in 20ft
- systems of 100MW+



Island grids

- 30 min spinning
- ramp control



IM20P High Power

- 3MW in 20ft
- 400% daily cycling



Arctic Microgrids

- Diesel optimization



IM20 cold climate package

- operation to -50°C



Industries

- Self consumption
- Peak reduction



Intensium mini

- 100kW self-contained system



On grid large solar plants: renewable integration (PV)



Large solar plants

- Energy shifting
- Peaking capacity



IM20 High Energy

- 9*1 MWh in 20ft



Bardzour 10MW Solar Farm La Réunion
+
4.5 MW / 9MWh ESS

Application = energy shifting
& frequency support



Battery operation :

- ≈ 0.5 cycle /day
- 96% DC round trip efficiency
- Operation from 5 to 95% SOC
- 1.8% ageing / year

Economics (call tender average)

- Additional impact over PV: Capex x 2
- Revenue: ~350 € / MWh

Island grid: renewable integration (wind)



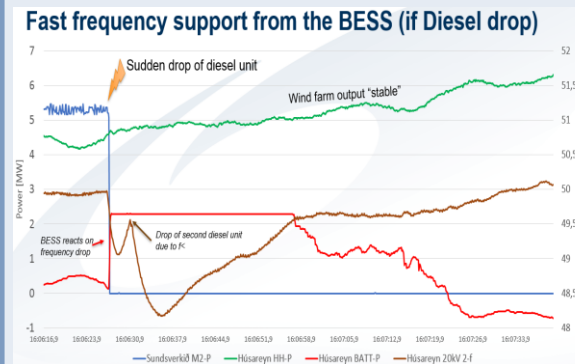
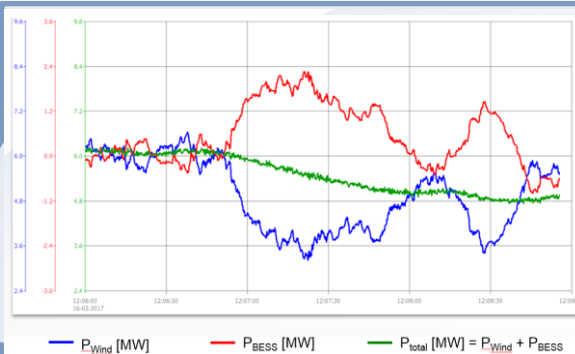
Island grids

- Spinning reserve
- ramp control



IM20P High Power

- 2* 350kwh-1.3MW-20ft –high speed bus



3mn recording!

Husahagi 12 MW wind farm Faroe islands
+
2MW/20mn Li-ion ESS

Application = ramp rate power control (1MW/mn)
+ curtailment reduction (>60%) + frequency support

Battery operation

400% daily cycling
1% capacity loss per year (expected)
15%<SOC< 60% SOC evolution

Economics

Additional impact over wind: Capex + 20%
Wind Generation: + 5GWh / year
Fuel savings: 1000t/year (0.1\$/kWh)
CO2 savings: 3500t/year
Estimated ROI : 4.5 years

Off grid in Artic: diesel optimization (hybrid with PV + genset+ Li-ion)



Arctic Microgrids

- Diesel optimization

IM20 cold climate package

- 1 IM20M with 240kW PCS ABB
- operation to -50°C



NTPC Colville (Canada -150 inhabitants) 30kW base load (150kW peak) with 350kW diesel and 50kW PV

+
230kWh/240kW Li-ion ESS
Opened May 2016

Application = PV shaping - spinning reserve - diesel fuel saving - grid forming

Battery operation

daily cycling: depend on PV
2.5% loss per year (expected)
30%<SOC<80% ; 95% if excess PV possible
20% SOC reserve for black start
ESS form the grid - genset dispatched vs SOC
Ongoing EMS optimization

Economics

fuel is 2.6\$/kwh !
>30000 liters fuel saving/year

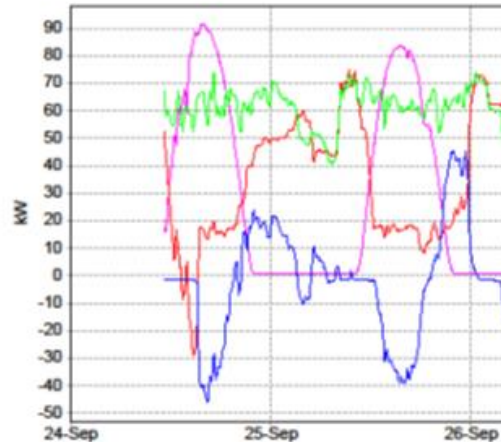
Commercial & Industrial : self-consumption – peak reduction



Industries

- Self consumption
- Peak reduction

- 2 Intensium mini 100kWh -90kW
- self-contained system



■ Battery.Plot	min:-45.935	avg:-2.206	max:49	last:17.7
■ Loads.Plot	min:10.7	avg:46.8	max:74.9	last:29.6
■ PCC.Plot	min:-28.828	avg:30.3	max:90.2	last:12.8
■ Photovoltaics.Plot	min:0.12	avg:20.1	max:91.5	last:0.12

Manufacturing of refrigeration systems in Navarra
rooftop solar PV : 130kWpc (158MWh/year)
Peak load: 270kW (420MWh year consumption)
Horizon 2020 subsidized

+
200kWh/50kW Li-ion ESS - 2017 installation

Application = self PV consumption improvement
+ peak shaving (to reduce peak
power demand to the grid)

Battery operation

60MWh/ yearly supplied
-20% energy use from the grid
-20% lower peak load
80% DOD daily cycling

Economics

8% lower energy bill expected

Conclusion - Evolving Saft's Li-ion Energy Storage Solutions

Units from **100kWh** to **2.5 MWh**

- Containerized DC system solutions
- High Power to High Energy
- Deployed in > 50 systems worldwide



More Energy !

- Longer discharge duration 4h +
- Larger projects 100MW +
- Limited space
buildings, industries, urban smart grids, ...

