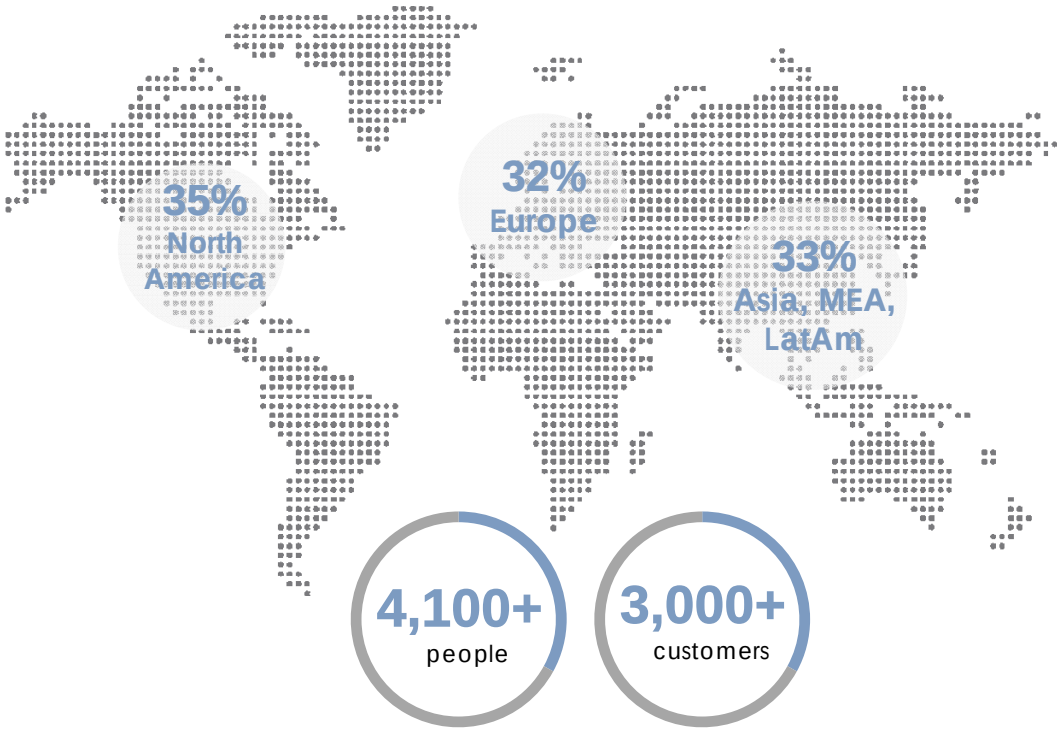
UIC Energy Efficiency Workshop
Li-ion trackside energy storage
Pierre Prenleloup, 2017-10-04

Who is Saft today?

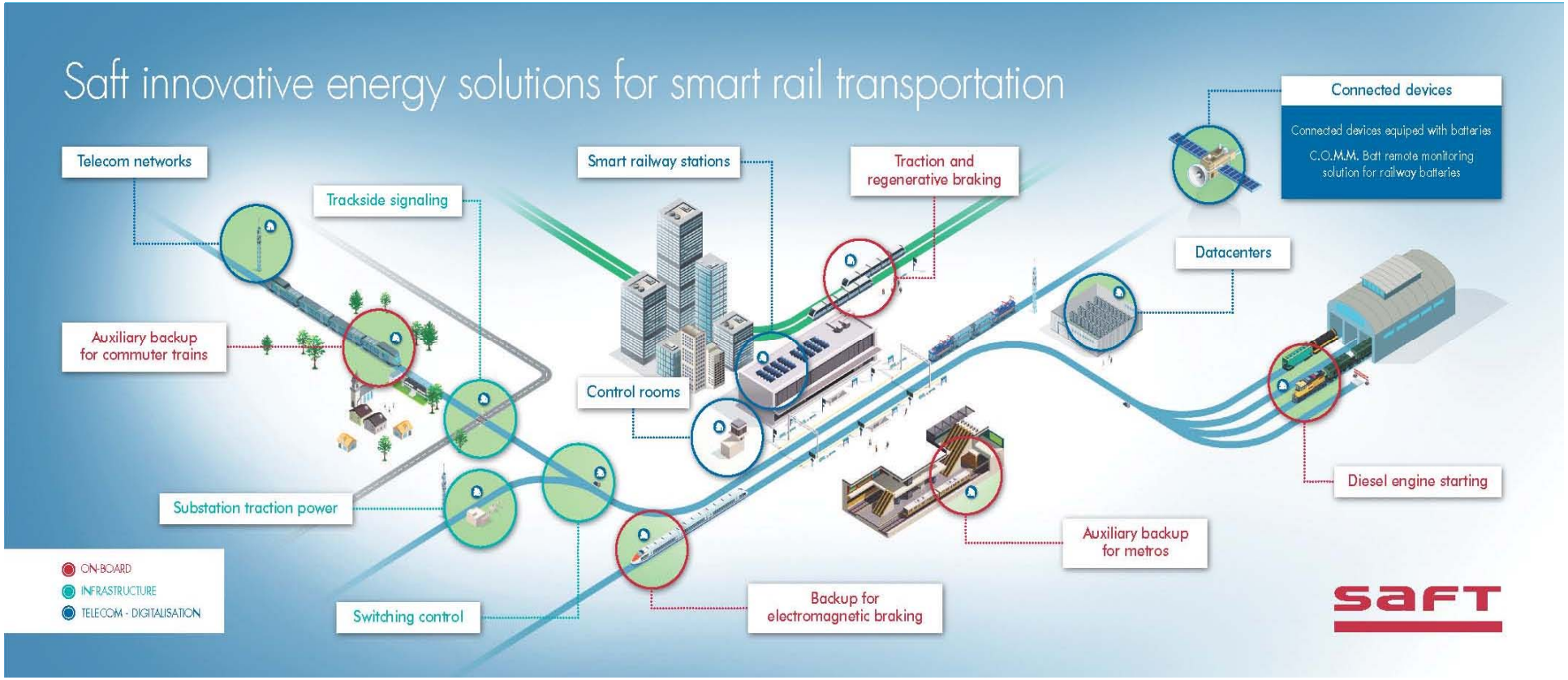
GROUP PROFILE

- **~100** years of history
- **Leadership position on 75-80%** of revenue base
- **9%** invested in **R&D** with **3** main technologies
- **€738m** revenue FY 2016

INTERNATIONAL PRESENCE



Saft innovative energy solutions for smart rail transportation



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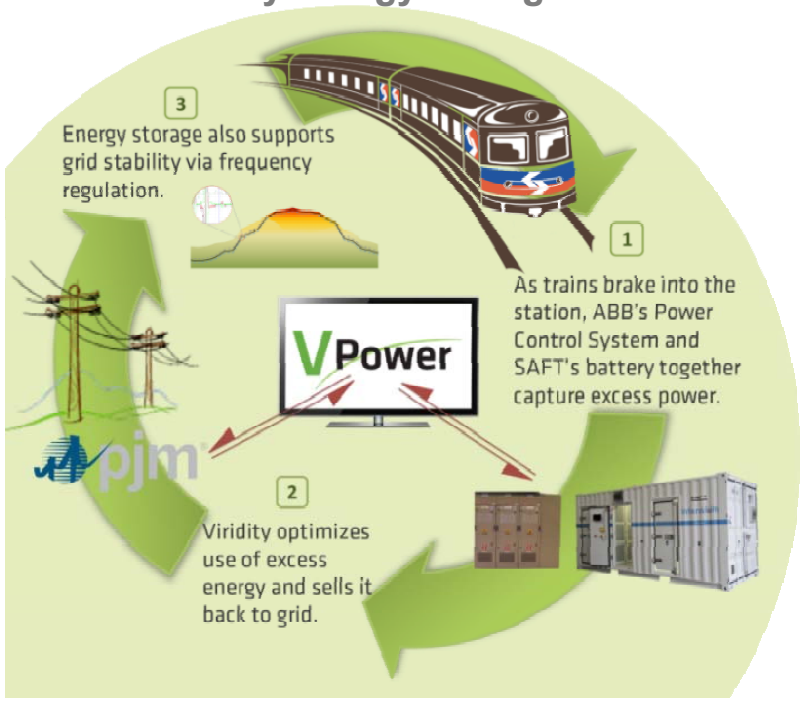
SEPTA 1 – Letterly substation (Philadelphia)

The first installation for trackside Li-ion battery energy storage



- High Power Intensium Max 20P container
  1,5 MW - 420 kWh
- Partners: ABB, Viridity
- Applications:
  - Recovery of braking energy
  - Participation in the frequency regulation market (PJM)

Started operation in April 2012

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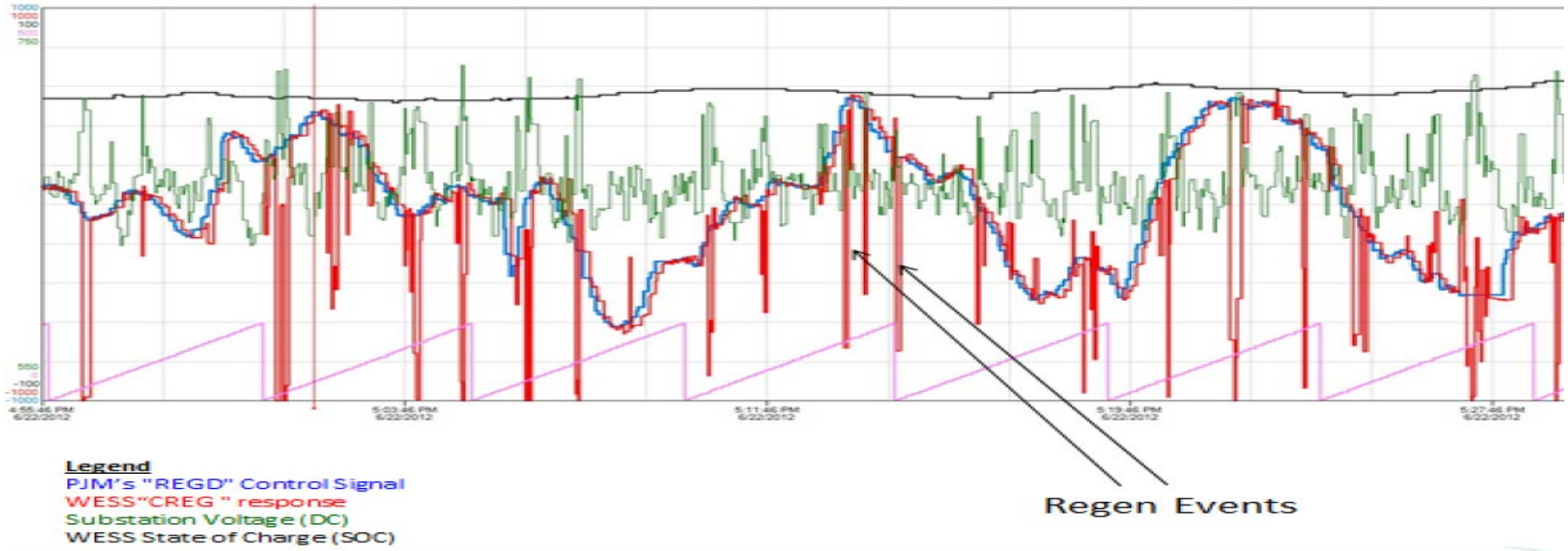
SEPTA 1 : Operation principle

- The superposition of 2 services (illustration on 30 minutes)
  - regulation (red line) of 1MW according to PJM control requirement (blue line)
  - pulses in charge to recover trains braking energy (« *Regen* »)

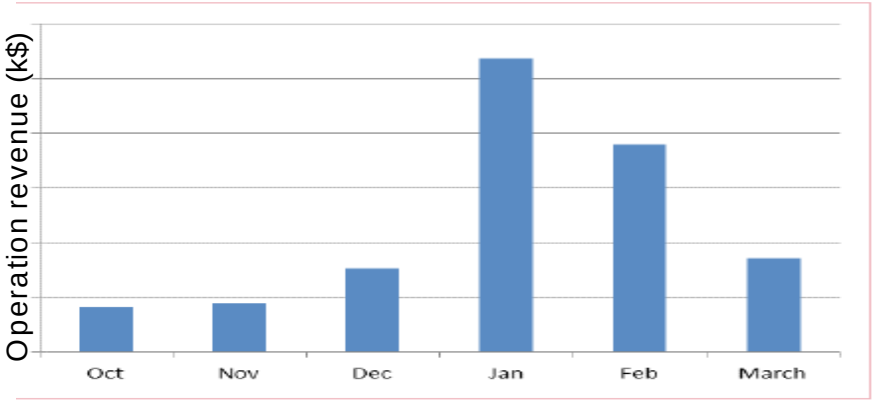


SEPTA 1 : Economic model

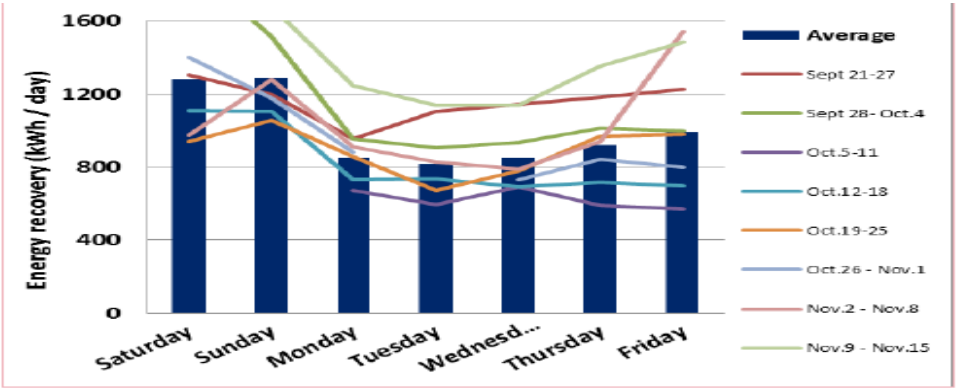
- The revenues are around 200 k$/year, providing a ROI < 5 years
  - ~25%: Braking energy recovery
    - 800kWh/day (≈2000 peaks of 0.4kWh in average)
  - ~75%: frequency regulation (PJM)

Total energy throuput: 4/5 times a day

Regulation part is seasonnal



Braking part follow day usage



SEPTA 2 : Griscom substation (Philadelphia)

The first installation for trackside Li-ion battery + supercapacitors as hybrid energy storage

- Medium Power Intensium Max 20M container
  1,1 MW - 580 kWh
- Partners: ABB (conversion 1.5MW + supercapacitors Maxwell), Viridity

Started operation in August 2014

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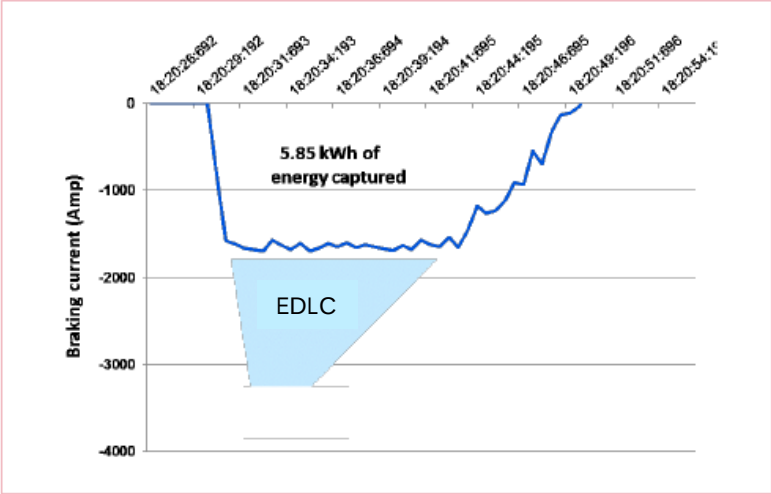
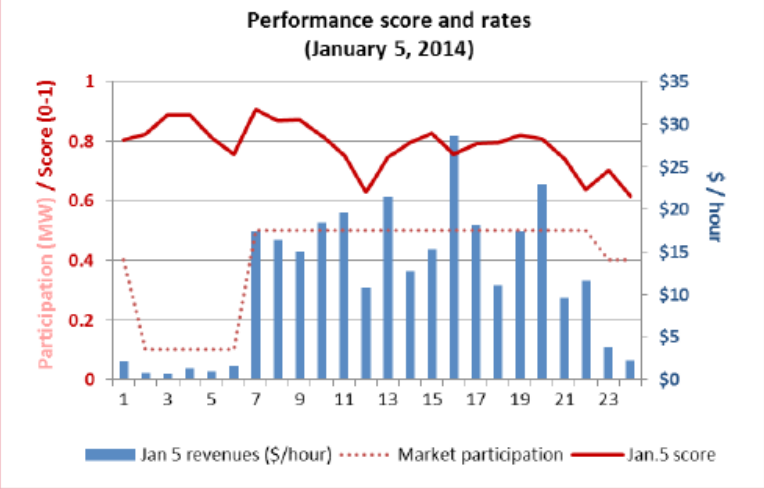
SEPTA 2 : Evolutions on ESS operation

- Expected evolutions:
  - Increase braking energy recovery (~15%)
  - Increase the « performance score » for the frequency regulation (from ~0.7 on Septa 1).





  - … but the hybrid solution in too expensive!

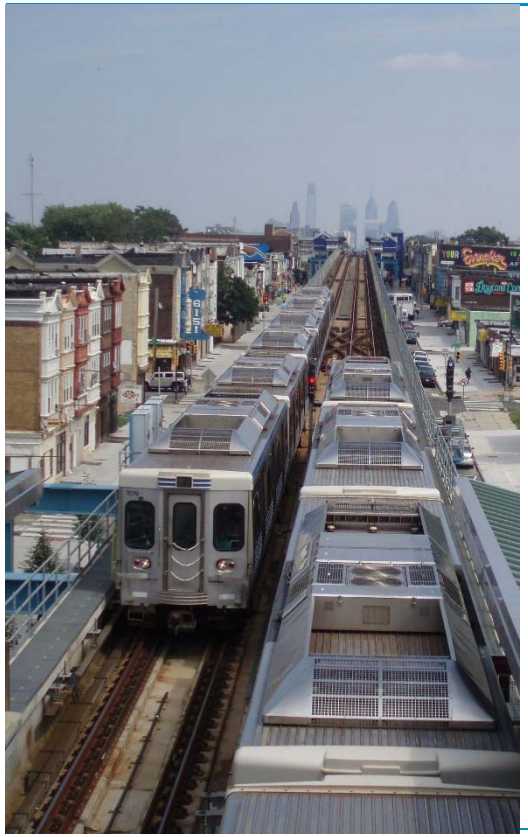
SEPTA 3 : 7 substations (Philadelphia)

Li-ion racks instead of containers to fit available space in the substations

Started operation from end of 2016

- High Power Li-ion ESU: 29 syn24P gen3
  - 42kWh/210kW
  - Dimensions: 2.23m x 1.74m x 0.65m
  - Mass: 911kg
- Distribution cabinet (MBMM)
  - Dimensions: 2.23m x 0.76m x 0.65m
  - Mass: 318kg
- ***Operation***: Recovery of braking energy when combined with charge for frequency regulation
- 8,7MW additional battery capability (>10 MW in total)

Takeaways



- ROI can be optimized by combining several value streams (braking recovery, participation to grid regulation), additional services depends upon operation (increased headway without infrastructure reinforcement, emergency traction back-up when grid power loss,…)
- Combination of different technologies can increase the system performance, still high power Li-ion technologies can be fine tuned to answer your global need (Saft will select with you the most adapted electrochemistry)
- Battery sizing is key in the process: define your best location and condition of use, and we'll identify together the most adapted solution to bring you the energy efficiency you are looking for

Thanks for your attention

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Stay tuned!