

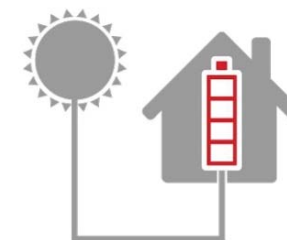
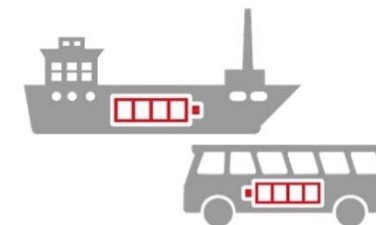
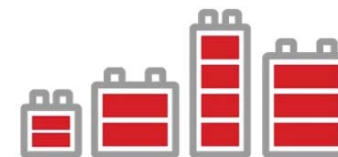


Leclanché

Energy Storage Solutions

13. Energielunch - Energie bewegt Winterthur
Company presentation and market overview
Projekt examples of Leclanché SA

22. September 2016



- Introduction Leclanché SA
- Situation of the Energy Storage Market 2016
- Role of Leclanché
- Overview energy storage market
- What will drive the market in the future?
- Project cases of Leclanché

Leclanché in numbers

100+ MWh

opportunity through 2017 from identified projects in advanced stages of our pipeline

> 100 patents

covering our proprietary Lithium-ion technology, our manufacturing processes and our systems expertise

\$18 billion

forecasted market size for Li-Ion energy storage for stationary, commercial & industrial and mass eTransport applications in 2020

> 150 FTEs

including 50 engineers (5 PhDs), with 20 in software development, operating from offices located in Switzerland, Germany and Belgium

> 100 years

company history, with rich heritage as one of the oldest battery manufacturers in the world

100% growth

revenue growth target for 2016

We are experts in energy storage



We have **over 100 years of energy storage expertise** with full solution capabilities including development, design, systems integration and management software for a wide array of storage and hybrid power configurations

We have the capability to deliver complete customer solutions



Our **customer references** across both stationary and transportation applications have been validated by **industry-leading implementations** in segments ranging from utility-scale power generation/microgrids and grid services to mass eTransport (*e.g. eFerry and eBus*) and commercial & industrial battery systems. Our focus is providing customers with **high-performance, infrastructure-grade, sustainable, safe, efficient and cost effective** energy storage solutions, demonstrating the turn-key delivery of complex projects

We have proprietary, market-leading cell technology



Our proprietary Lithium Titanate Oxide (LTO) cell technology is protected by more than **100 patents** and provides market-leading charging speed, cycle/calendar life and thermal stability for **lowest lifetime cost** and world class performance

We can integrate any battery chemistry with our software and systems



Our experience industrialising and integrating a diversity of battery electro-chemistries enables us to remain flexible to deliver best-in-class solutions, whatever the application. We are **expert system integrators** and are able to deploy our **advanced battery management system and cloud-based asset management software** to optimise for an array of end-customer use cases

We bring quality European engineering to global markets



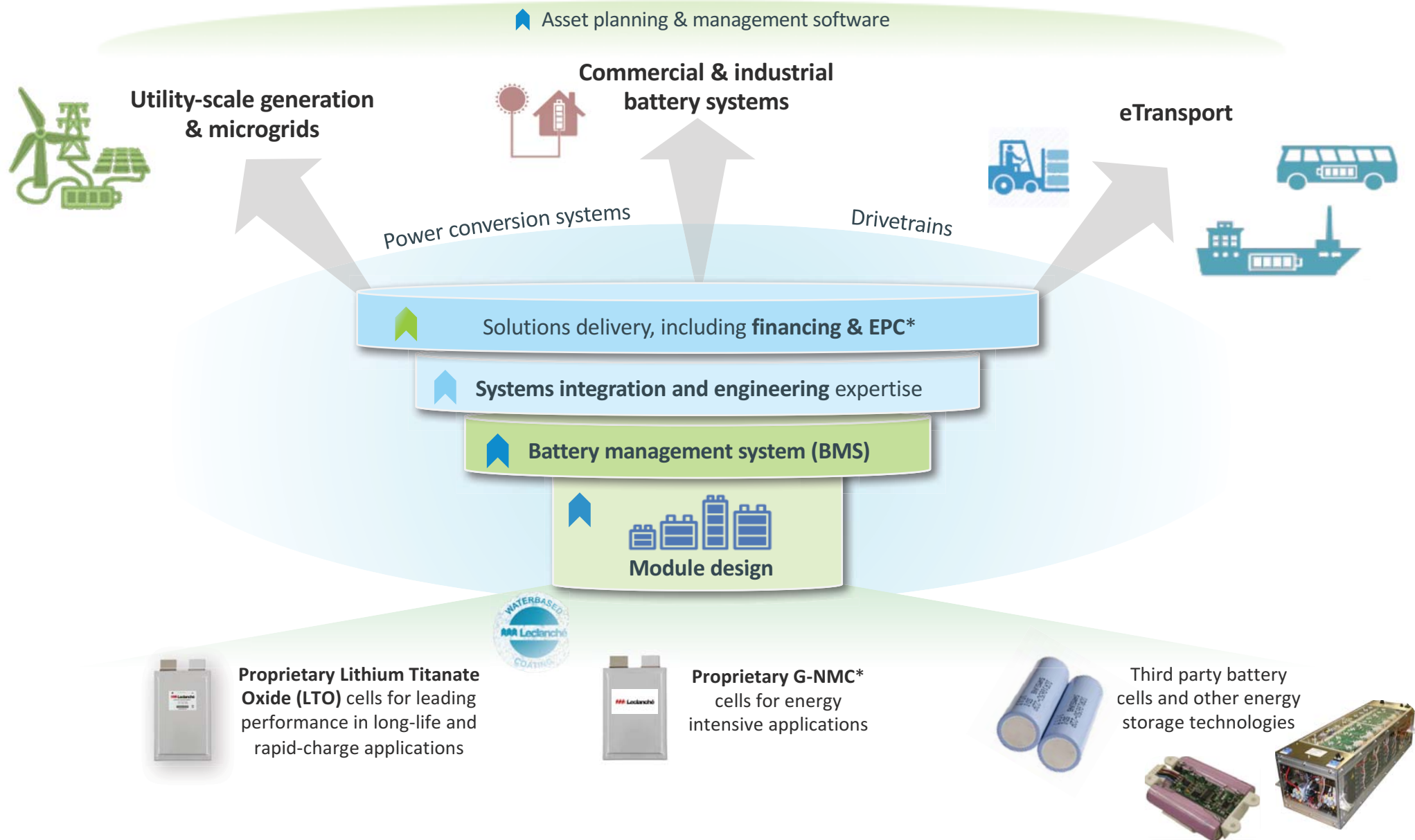
We have a heritage and culture of **high quality design engineering** and renowned Swiss precision, which feeds into efficient manufacturing and production through our global partners for growing markets worldwide.

We power clean, intelligent energy for the future



We are investing in our intelligent software, systems integration and power controls to deliver best-in-class storage solutions for **21st century applications**

Our common technology stack is applicable across multiple markets



*Graphite anode and Nickel-Manganese-Cobalt cathode
* Engineering, Procurement & Construction

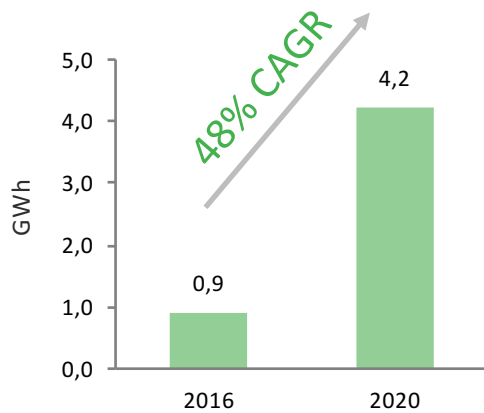
We have a sharpened focus on high growth end-markets



Utility-scale generation & microgrids



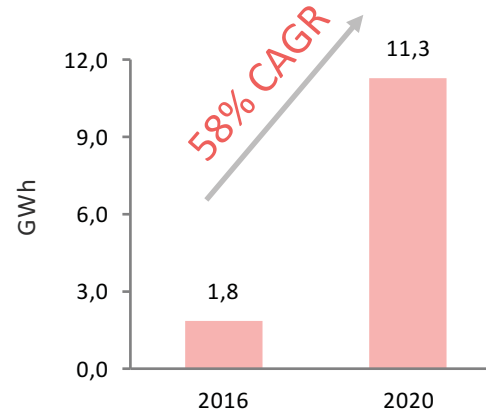
- Micro-grids: renewable integration
- Grid stabilization and peak shifting



Commercial & industrial battery systems



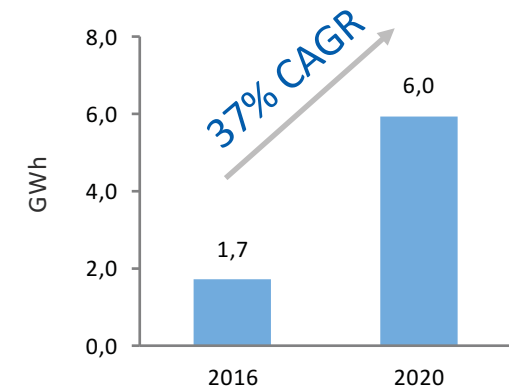
- Commercial, industrial & residential
- Solar lighting, medical, telecoms, security & defense
- Branded consumer (selected markets)



eTransport



- Fleets of buses, trains & trams
- Ferries and tugboats
- Forklifts, cranes, mining vehicles

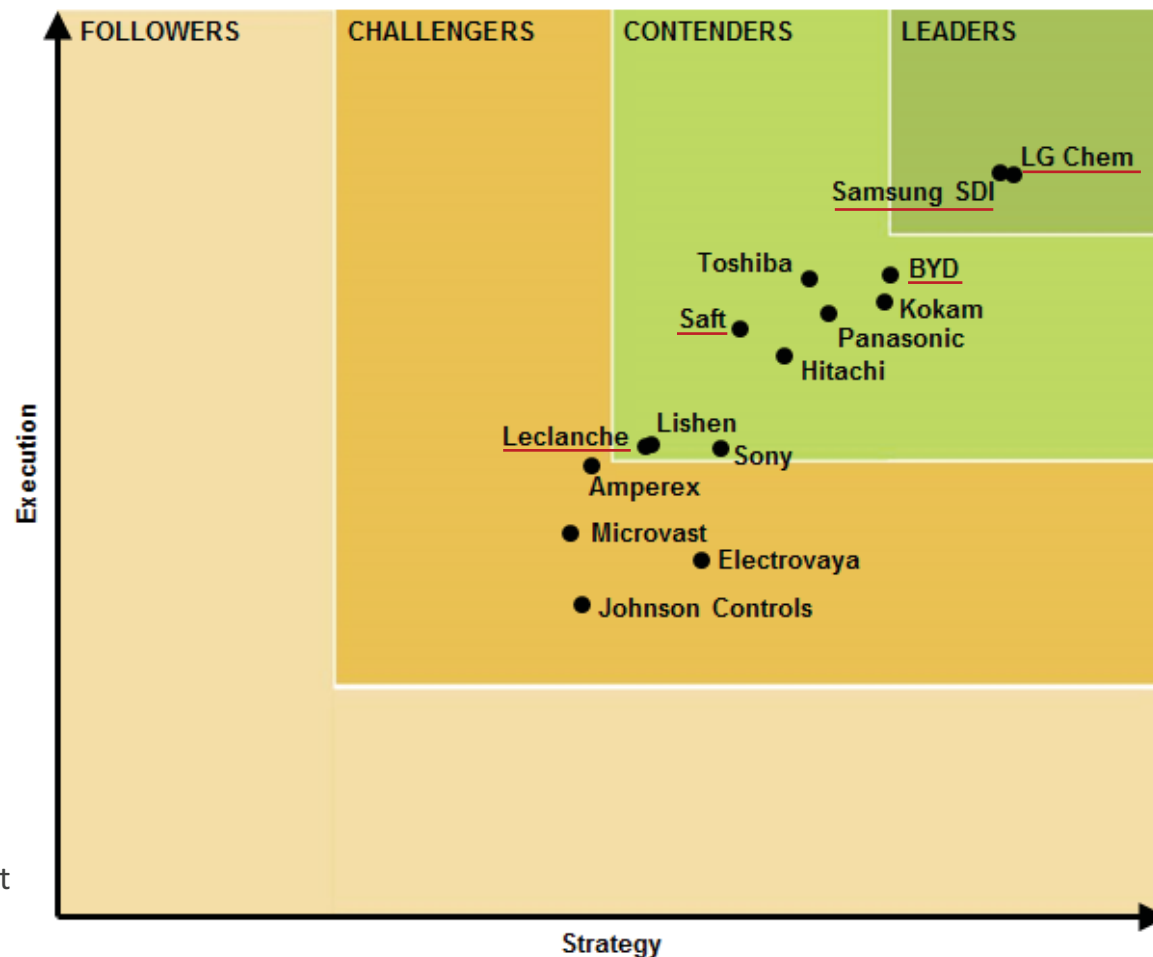


Source: Navigant Research

“Due to an attractive combination of energy density, efficiency, and price points, Li-ion is emerging as a go-to technology for many energy storage system developers.”

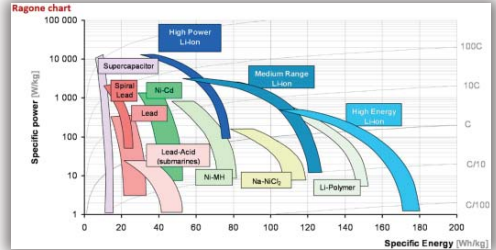
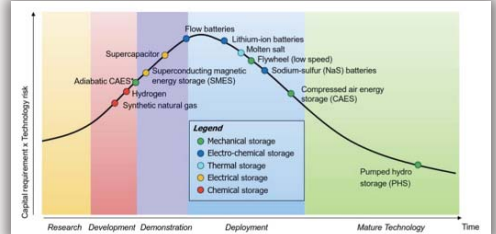
Leclanché among top 5 Vertically integrated Battery-based Energy Storage Systems (BESS) Provider

Leclanché is the only pure-play, non-consumer space, Industrial Storage Systems Provider in the top-ten.



Source: Navigant Research Leaderboard Report Li-Ion Grid Storage, June 2015

We deploy our proprietary LTO and G-NMC cells yet remain flexible to incorporate third party technologies for selected solutions

	Lithium Titanate Oxide (LTO)	Lithium Graphite/NMC (G-NMC)	Integrated 3 rd Party Technologies
Cycle life	15,000 @ 100% DoD >20,000 @ 80% DoD	4,500 @ 100% DoD 8,000 @ 80% DoD	<p><i>Examples could include:</i></p> <ul style="list-style-type: none"> Other battery chemistries (Ni-MH, Ni-Cd, PbA, Li-ion) Hydrogen fuel cells Vanadium redox / redox flow batteries Ultracapacitors  
Lifetime & warranty	Up to 20 years	Up to 10 years	
Charge time to 90% SoC	Less than 15 minutes (5C)	1 hour (1C)	
Energy Density	70 Wh / kg	160 Wh / kg	
Temperature range	-20°C to +55°C	0°C to +45°C	
Safety	Superior ceramic cell technology	Superior ceramic cell technology	
Ideal use case	<ul style="list-style-type: none"> Power intensive applications Long lasting applications Applications needing rapid response Grid stability projects 	<ul style="list-style-type: none"> Energy intensive applications Low- or micro- cycle applications Bulk storage or weight critical applications Renewable energy integration projects 	

The vast majority of applications use our technology...

...but we remain flexible to integrate

Our IP portfolio of over 100 patents protects our proprietary LTO technology and water-based processing methods



- We have built up a broad portfolio of IP to safeguard our business
- We continue to secure our technology with patents as an on-going part of our strategy

Coverage area	# of patent families	# patents granted	# patents filed
LTO specific	5	35	5
Manufacturing process	3	37	30
Separator technology ⁽¹⁾	1	-	5
System/module integration	2	-	3
	11	72	43

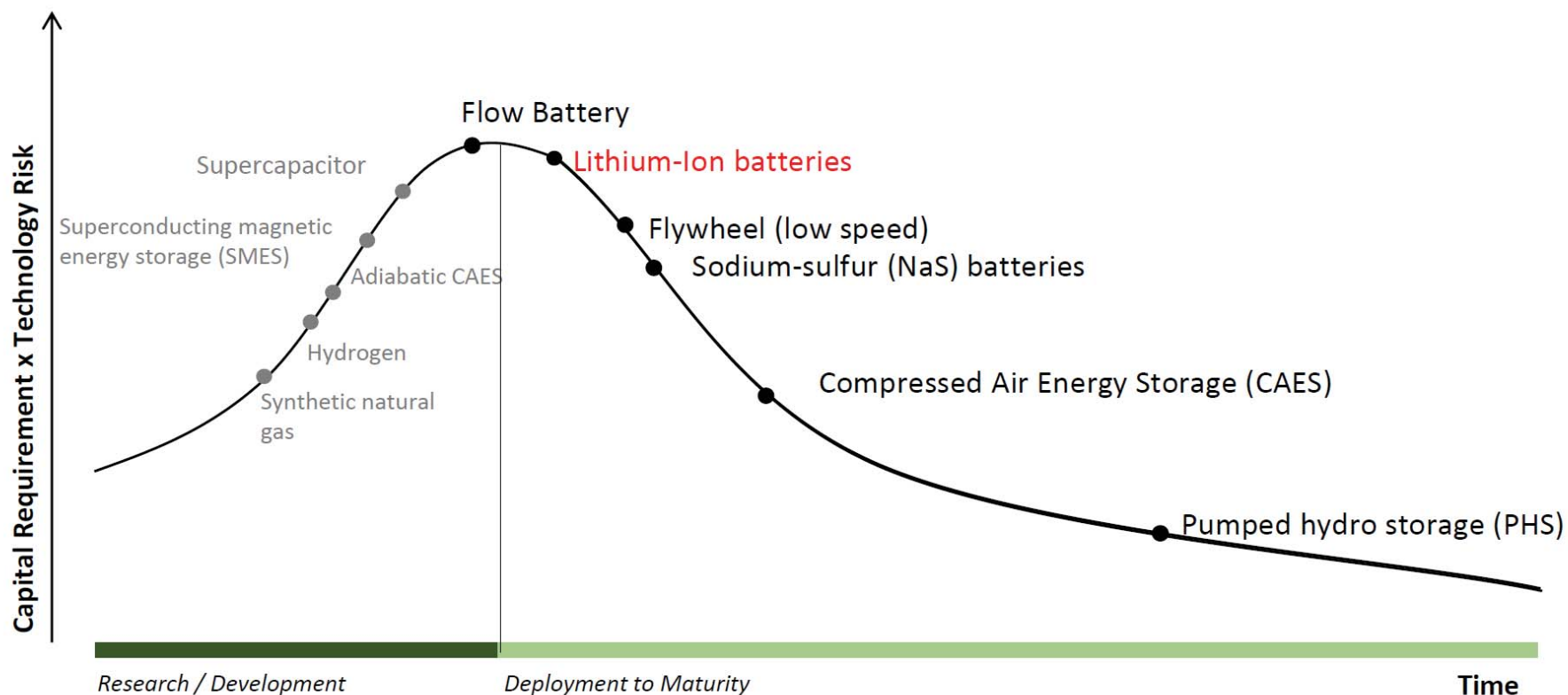
(1) Further separator patents are filed under our Fraunhofer license





- The first global Li-Ion battery producer with a water-based cell production process
 - In contrast to the chemical solvents, which have to be subsequently recycled or burnt, which are used by our peers in conventional industrial coating
- We are a member of the Swiss Inobat Interest Organization for the disposal of batteries and began with the recycling of batteries as early as 60 years ago
- Protection of the environment is given high priority in every phase of our product life cycle:
 - saving resources by reduction of waste in manufacturing
 - separation technology in all areas of chemical processing
 - gas and water treatment through to systematic recycling and recovery of raw materials
- ISO9001:2015 with ISO14001 underway
- Our best-in-class production, combined with the benefits that energy storage brings to integrating renewables and emission-free transportation, provides us with amongst the cleanest credentials in our commitment to sustainability





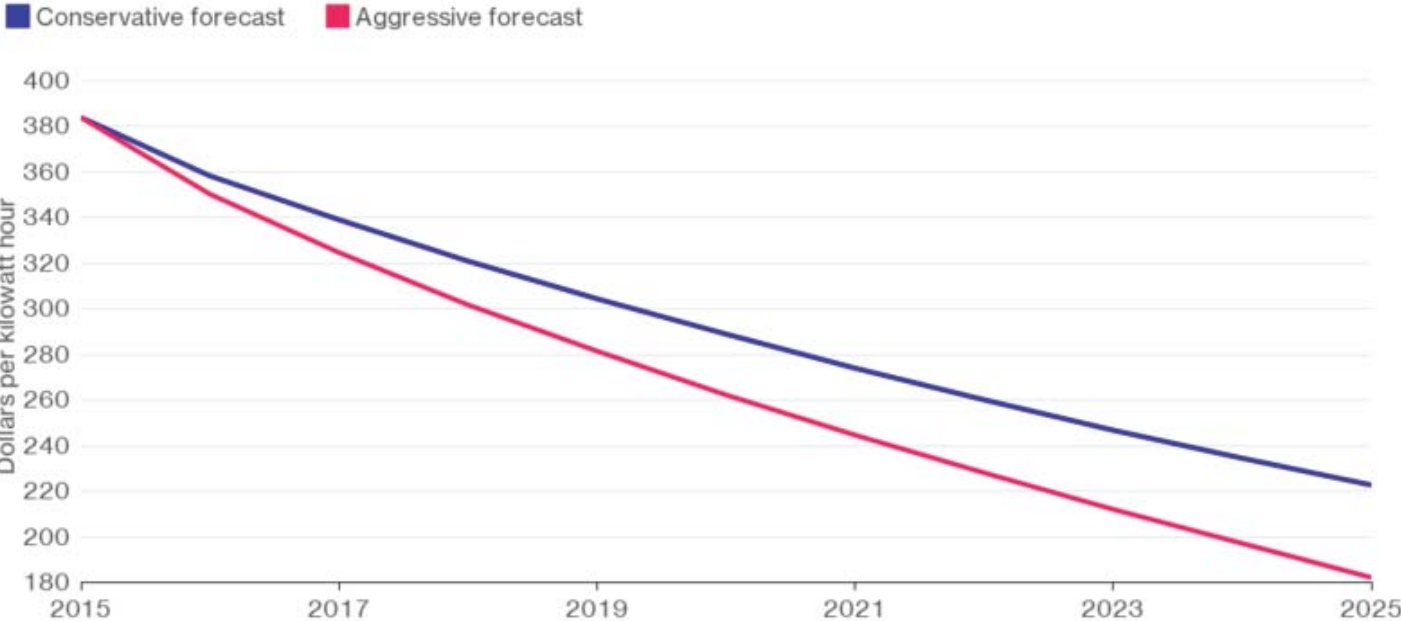
Source: SBC Energy Institute (2013)

- Cost declines have made a number of business models viable
- Lithium Ion becoming technology of choice for many applications
 - Fast to deploy
 - Flexible in usage for multiple applications

- Increasing capabilities of Lithium Ion enable higher power applications
- Decreasing cost of Lithium Ion → move into lower frequency applications

Lithium Battery Costs Are Set to Fall

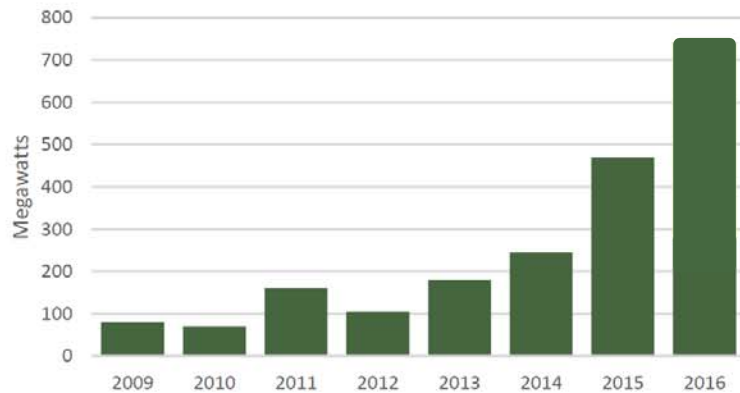
Battery pack costs could fall as low as \$182/kWh by 2025 using current technologies



Source: Bloomberg New Energy Finance
Note: Data presented in 2015 US dollars

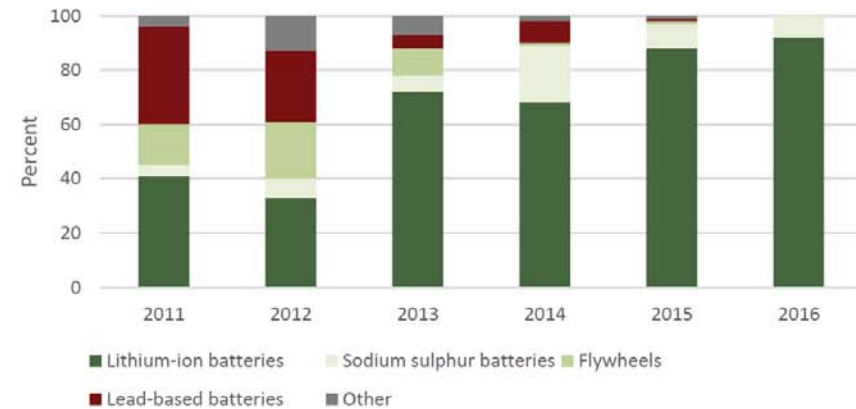


Global commissioned energy storage



- The installed Storage capacity tripled in 2 years.
- Reaching over 700MW in 2016 with a market almost non-existent before 2010

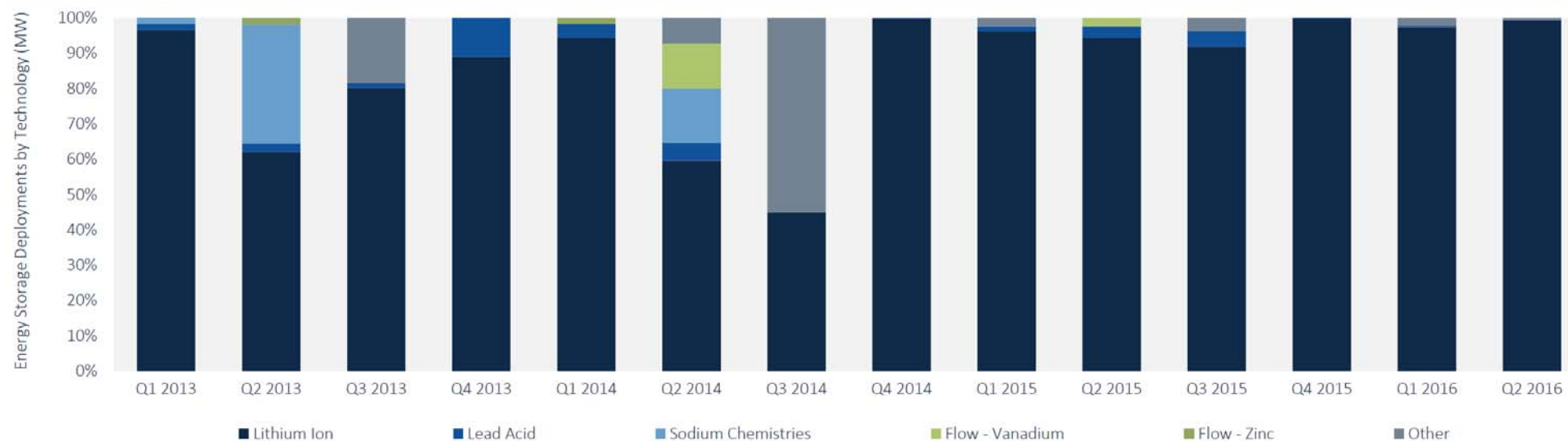
Technology mix of energy storage projects



- The decreasing price of Li-ion Batteries has made them the first storage media in 2016
- Old technologies like lead batteries to disappear

Lithium-Ion Chemistry dominates grid-tied storage deployments at 99% in Q2 2016

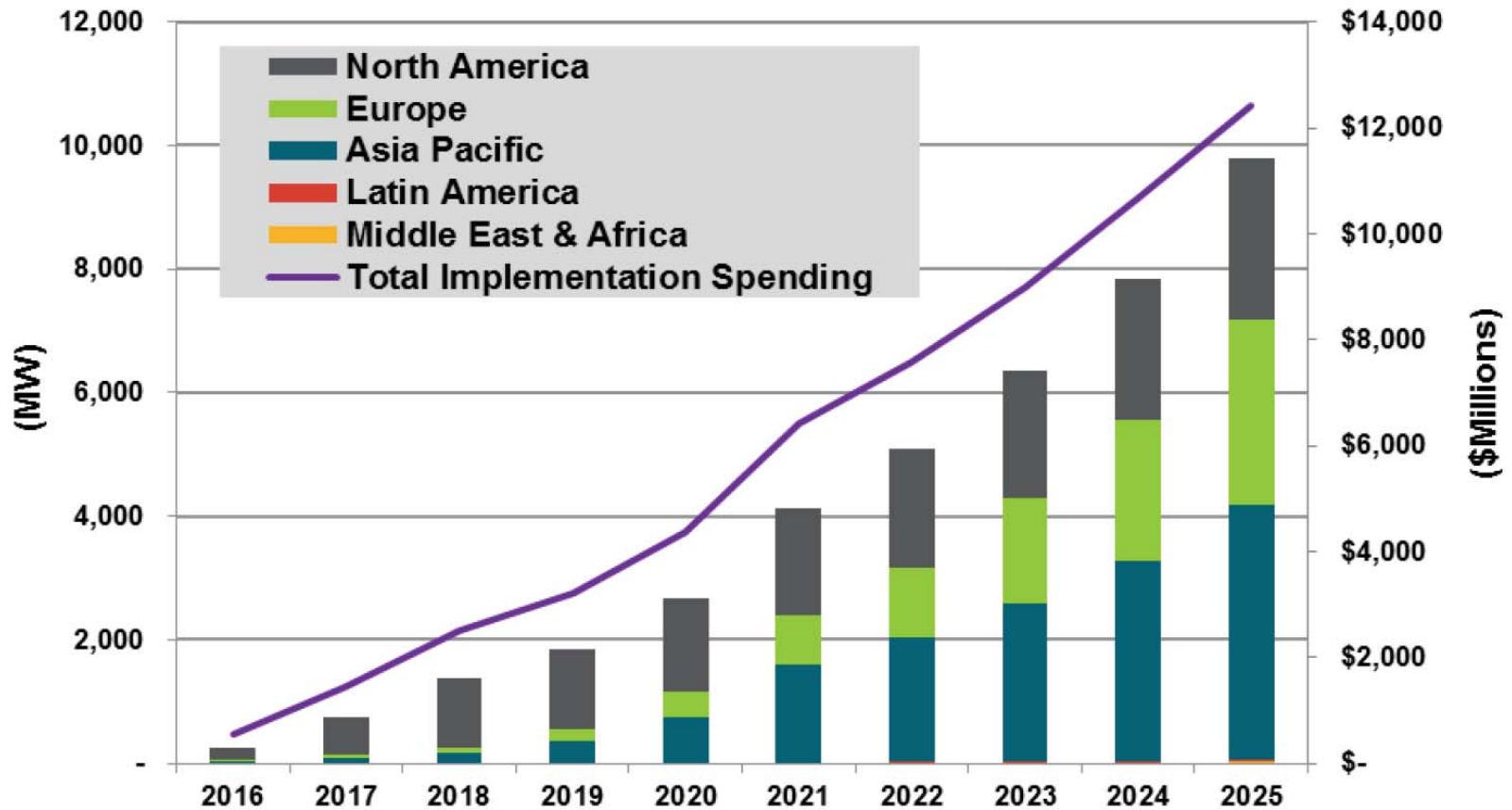
Quarterly Energy Storage Deployment Share by Technology (MW %)



- Following the trend in the last seven quarters, Q2 2016 deployments were dominated by lithium-ion batteries, which held 99% market share with 40.9 MW deployed.
- The category “Other Technologies” came in second with 0.3MW of aqueous batteries deployed in Q2 2016.

Source: GTM Research/ESA; US Storage Monitor; Q3 2016

- Total energy storage mixed asset VPP capacity & implementation spending by region

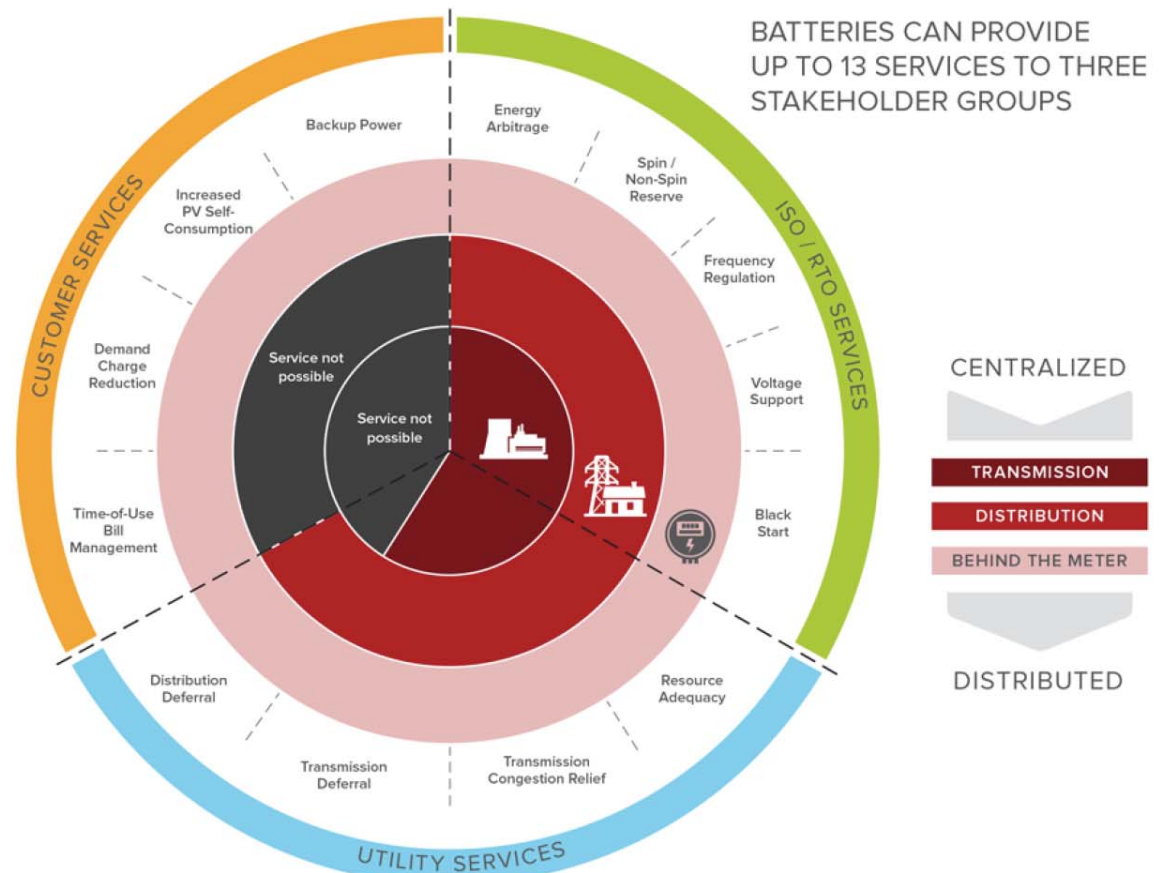


(Source: Navigant Research, Virtual Power Plant Enabling Technologies Report, 3Q 2016)

What will drive the distributed energy market in the future?

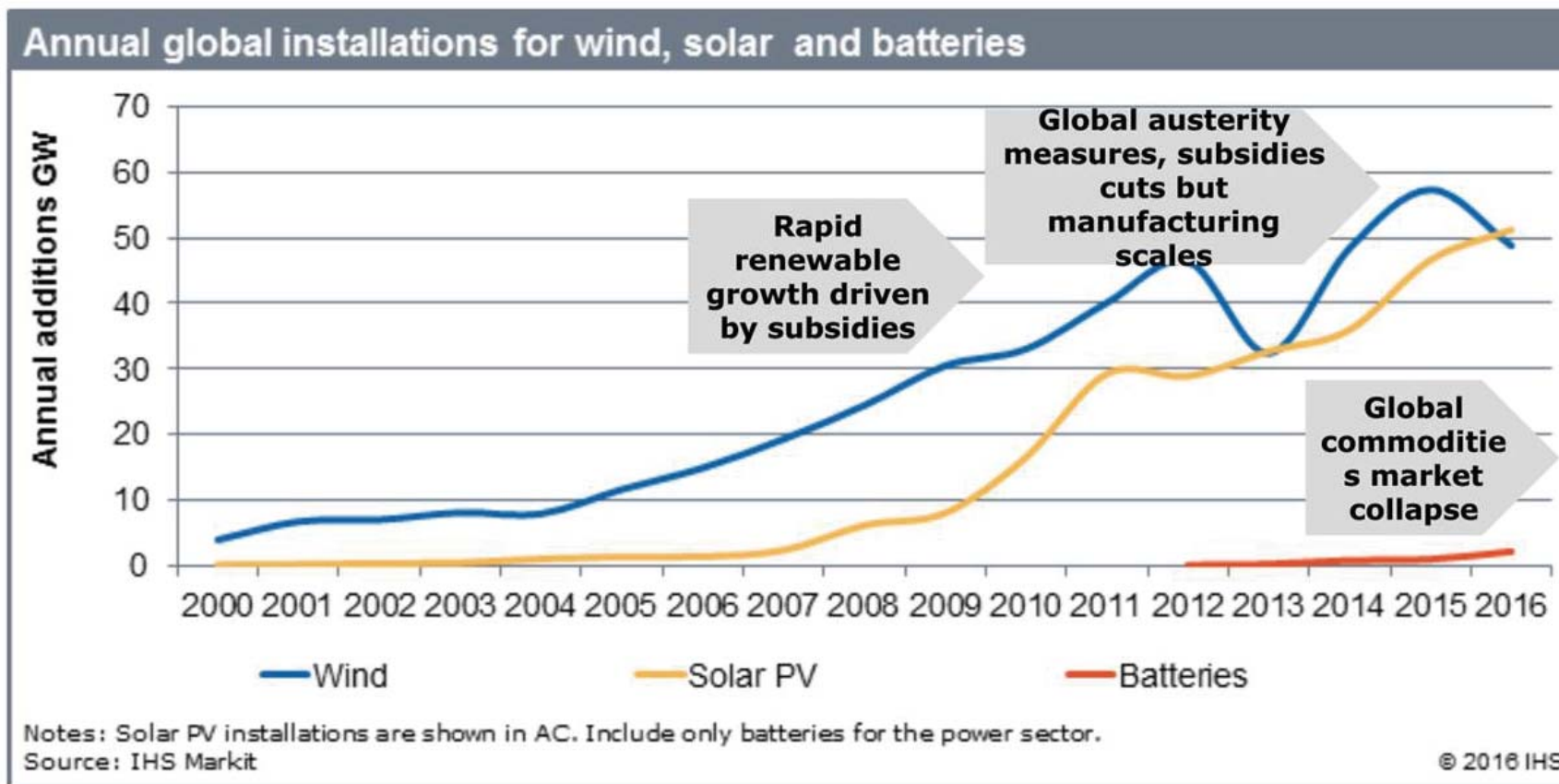
- Software platforms that analyze, operate and optimize energy storage enabled Virtual Power Plants

- Energy storage sector stakeholders now recognize that behind-the-meter (BTM) battery energy storage systems (ESSs) can deliver grid benefits to RTO/ISOs and distribution system and utility customers.
- This evolution is driving the development of software and hardware platforms that can analyze, control, and optimize aggregated ESSs, giving rise to VPPs.
- VPPs that can analyze, control, and optimize BTM nanogrids systems to provide multiple benefits across the grid will be at a competitive advantage.
- It will take regulators and power market rulemakers time to take advantage of these technology developments.
- Navigant Research believes that battery energy storage-enabled VPPs will emerge as necessary integration solutions as BTM DERs proliferate distribution grids in the U.S. and worldwide



Source: Rocky Mountain Institute's *The Economics of Battery Energy Storage*

It's still a small market but on track to follow the solar PV curve



- Following the trend of the wind and photovoltaic business, batteries can follow the same curve
- Same effects as funding mechanisms, market consolidations and matured industrial deployment

Customer case studies: eTransportation and commercial applications

Brugge eBus

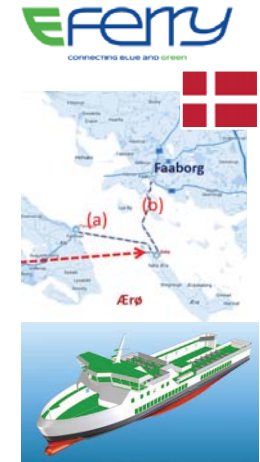
Location: Brugge, Belgium
System: 38kWh LTO
COD: Oct-2015



- First wirelessly charged fully electric buses to enter public operation in Belgium
- Three VanHool A308E buses equipped with an LTO battery delivered by Leclanché.
- Project partners included VanHool, De Lijn (Belgian bus operator) and Bombardier

ÆRØ Ferry Project

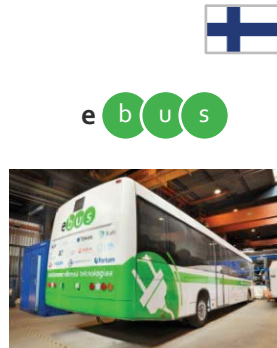
Location: Denmark
System: 4.2MWh G-NMC
COD: Jun-2017



- 56m x 12m public eFerry to replace one of the diesel-powered ferries on route between Denmark mainland and Ærø Island.
- Will be largest electric ferry in the world with planned energy savings up to 50% and major emission reductions
- Full electric drivetrain provided in partnership with Visedo

VTT eBus

Location: Espoo, Finland
System: 55kWh LTO
COD: Feb-2016



- Ranked #1 in TransDev energy consumption test, which included several European and Chinese bus designs; eBus achieved as low as 0.7 kWh/km consumption vs typical consumption of 1.1-1.3 kWh/km.
- Full electric drivetrain provided in partnership with Visedo

Off-grid street lighting

Location: Saudi Arabia
System: 3x700Wh LTO modules
COD: Oct-2015



- In March 2015 Leclanché delivered 200 battery modules for the project, certified to CE and UN38 safety standards
- Each module consists of 10 A4 LTO cells and is supported by a 10-year performance warranty
- Fully integrated design, specified with capacity for two full consecutive nights of autonomy, heat resistant (to over 50°C) and maintenance-free

Customer case studies: utility-scale and microgrid storage applications

École polytechnique fédérale de Lausanne

Location: Lausanne, Switzerland
System: 500kWh LTO BESS
COD: Sep-2015



- Turnkey BESS for ancillary services, solar PV solar integration, peak shaving, load management and fast frequency response
- 10 years performance warranty by Leclanché on its LTO batteries
- Largely co-financed by the Canton of Vaud

Ontario IESO / grid ancillary services

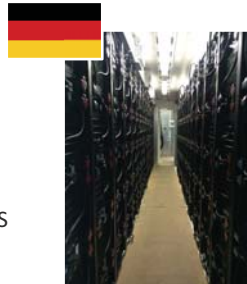
Location: Ontario, Canada
System: 53MWh G-NMC BESS
COD: Q1-2017



- Fast frequency response for grid reserve / voltage control services
- 15 years performance warranty by Leclanché on its G-NMC batteries
- Partners include Deltro Energy (electrical and civil work and PCS) and Greensmith (EMS); Leclanche providing development Capital and arranging Swiss Expert Credit (SERV)

Primary control reserve

Location: North Germany
System: 33MWh BESS
COD: Q3-2016



- Turnkey BESS to provide grid frequency control via the German primary control reserve (PCR) market
- 10 years performance warranty by Leclanché on its BESS
- 2-MW capacity being built by Leclanché on the basis of Build-Own-Operate-Transfer- while the Company is actively seeking long term strategic owners of this Asset
- Project partner and DSO: ENERTRAG AG

Graciosa energy island / micro-grid

Location: Graciosa, Azores Islands, Portugal
System: 3.2MWh LTO BESS
COD: Dec-2015



- Micro-grid supplying power for 4,500 inhabitants; turnkey solution for energy storage plant and distribution management integrating solar PV, wind park and diesel genset technologies
- Increase in proportion of renewable generation used from 15% to 65% of annual consumption
- 20 years performance warranty by Leclanché on its LTO batteries
- Project management and EMS by Younicos, financing provided by local grants and Leclanché's shareholder, Recharge



Thank you for your attention!

Contact information:

Daniel Föhr

VP System Engineering

Phone: +41 24 424 65 34

Email: daniel.foehr@leclanche.com

