PI System Applications in EV Battery Manufacturing

Presented by **Jean-Luc Monfort, General Manager**

BlueSolutions

Agenda

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- Intro to Blue Solutions
- LMP® challenges
- PI System dashboard exemples
  - Global Process Overview
  - Downtime tracking with Event Frames
  - Production dashbord with Asset Analytics driven yield calculations
  - Battery Cycle Monitoring for quality control using Element Relative displays
- Conclusion

A FAMILY GROUP WITH A LONG-TERM STRATEGY
in a diversified Group across 3 large sectors

TRANSPORT & LOGISTICS

- One of leading group in freight forwarding and logistics
- Leader in transport and logistics in Africa
- #1 port and rail concessions operator
- Leader in domestic fuel distribution in France with a strong presence in oil logistics in France and Europe

COMMUNICATION

- One of the world leaders in communication
- 2nd biggest French free daily newspaper
- 4G and WIFI operator

ELECTRICITY STORAGE & SOLUTIONS

- LMP batteries and supercapacitors

Blue*Applications*

- Mobility applications
- Stationary applications
- Intelligence and consulting service

KEY FIGURES H1 2016 (FY2015)

- **54,000** employees in **155 countries**
- Turnover: **€4.95bn (€10.8bn)**
- EBITDA: **€0.5bn (€1.1bn)**
- Net income: **€409m (€564m)**
- Net Debt: **€4.5bn (€4.3bn)**
- Market capitalization (march, 2016): **€10.7bn**

Participations
(~€4,2bn, June 30, 2016)

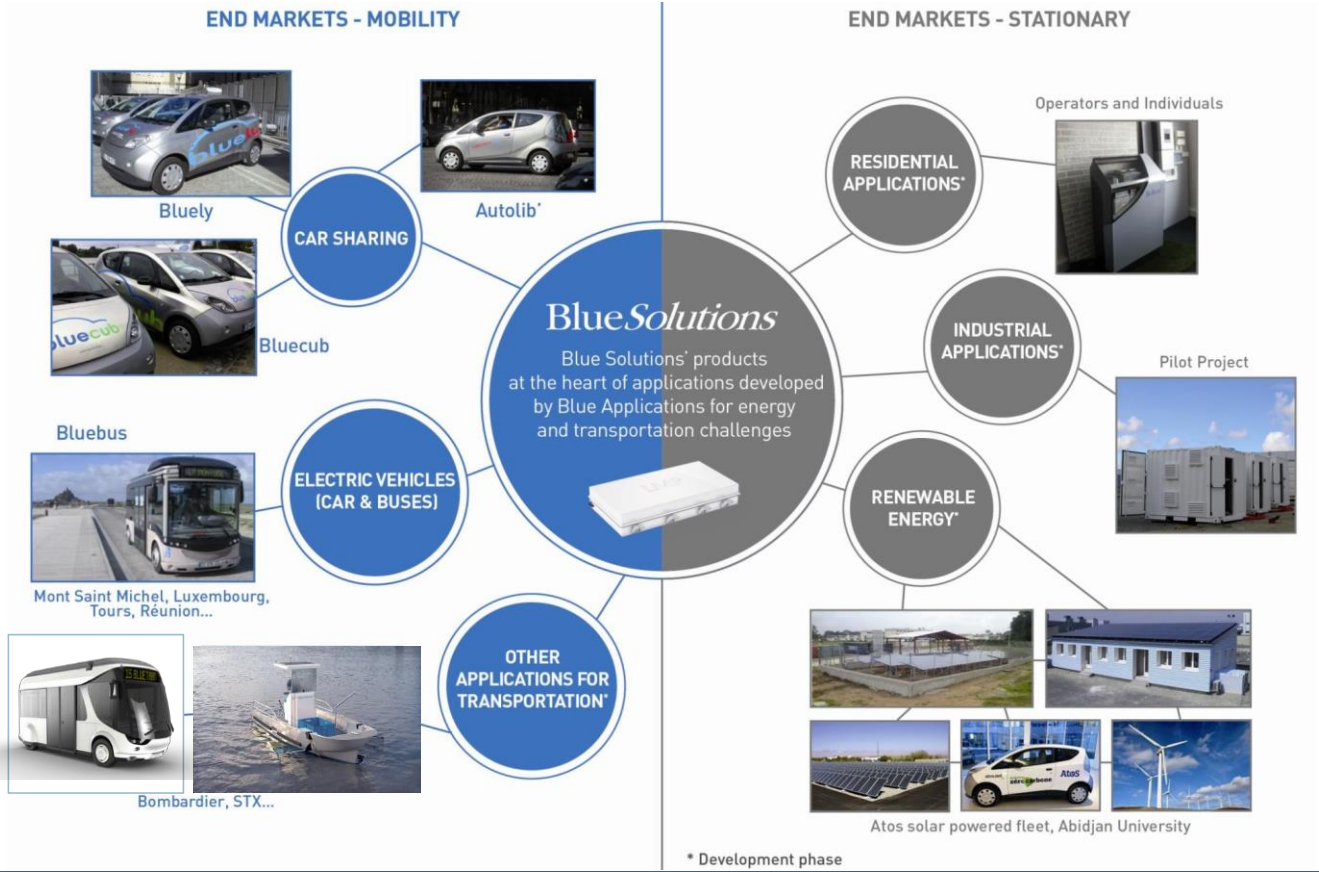
vivendi 14.5% (€3,6bn)
Represents €3bn investment in 2015

MEDIOBANCA 8.0 %

SOCFIN 38.7 %

Other participations ....

An integrated electricity storage solutions provider



Bolloré Strategical Approach

- Development of energy-storage technologies
- Integration in clean transportation systems
  - Scaps in tramways and stop-start systems
  - Batteries in electric vehicles and buses
- Development of Power train and electric vehicles
- Development of a complete clean electro-mobility solution based on :
  - Electric vehicles
  - Intelligent charging and renting stations
  - Supervision system for optimizing car availability
- Development of solutions for stationary businesses

Challenges of a New Technology

- LMP® technology is unique and Blue *Solutions* property
- Blue *Solutions* is developing both the product and the processes for films production and packs assembly.
- In order to optimize the product and manufacturing processes, data is key and as proven to be vital for success.
- Blue *Solutions* as therefore selected the PI System in order to accelerate process and product optimization.

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Objective: TRANSFORMING ENERGY STORAGE

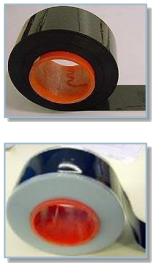
Nano-Structured Capacitive Energy Storage Devices…

- High energy density, no capacity fading
- Non-flammable & non-explosive
- Rapid charge and discharge
- Environmentally friendly and recyclable
- Low-temperature operation
- Solid-state, virtually unlimited lifetime

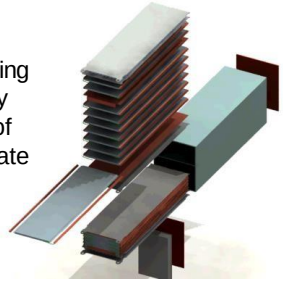
LMP battery: A unique, state-of-the-art technology and production tool...

BATTERY MANUFACTURING PROCESS

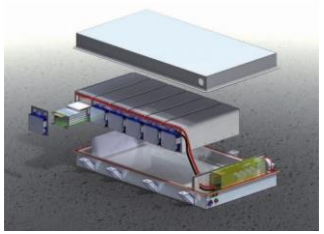
1. Extrusion of ultra thin films used as anodes, electrolytes and cathodes



2. Manufacturing of cells by stacking of films to create modules



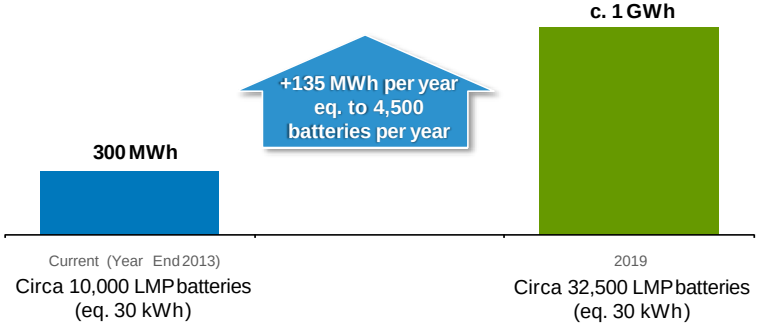
3. Assembly of modules in series to create battery packs



PRODUCTION CAPACITIES

Ergué-Gabéric (France)

Boucherville (Canada)



… with key strengths

TECHNICAL CHARACTERISTICS (LMPTECHNOLOGY)		
Specific energy density	~120 Wh/kg	• Strong energy density
Cycle life	circa 5,000 cycles	• Long cycle life
Capacity	Limited capacity decrease over time	
Key technological risk & safety	Solid-state	• Strong performance under extreme conditions • Strong safety track record (no significant incidents),

PRODUCT CHARACTERISTICS (35 KWH LMP BATTERY)	
Volume (l)	*300*
Weight (Kg)	*300*
Nominal voltage (V)	*410*
Internal temperature	*60° C/80° C*

Perspectives

Source: Company information

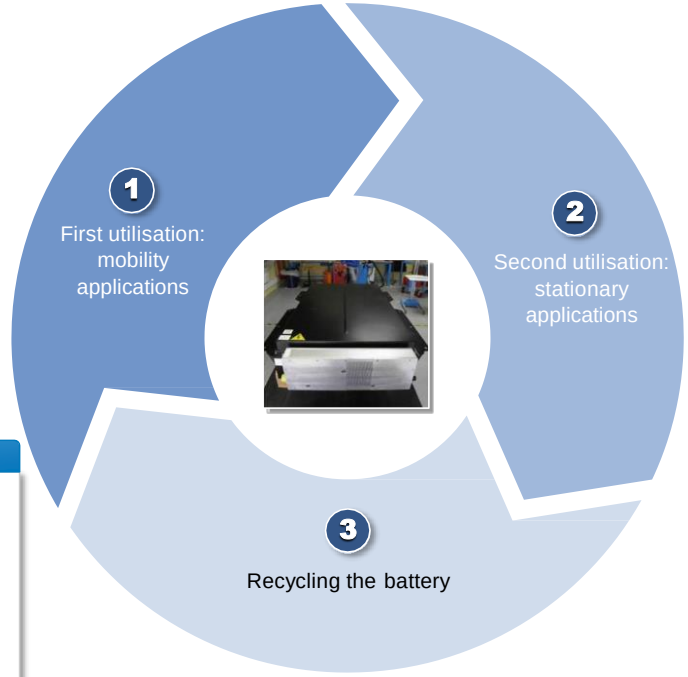
The expected lifecycle of the LMP battery

1 First utilisation: mobility applications

- The battery is first used for mobility applications
- In the first stages of its life, the battery delivers high power energy necessary for mobility needs

3 Recycling the battery

- Blue Solutions developed a specific process to recycle LMP batteries
- Enables Blue Solutions to recover a significant proportion of the polymers and metals used



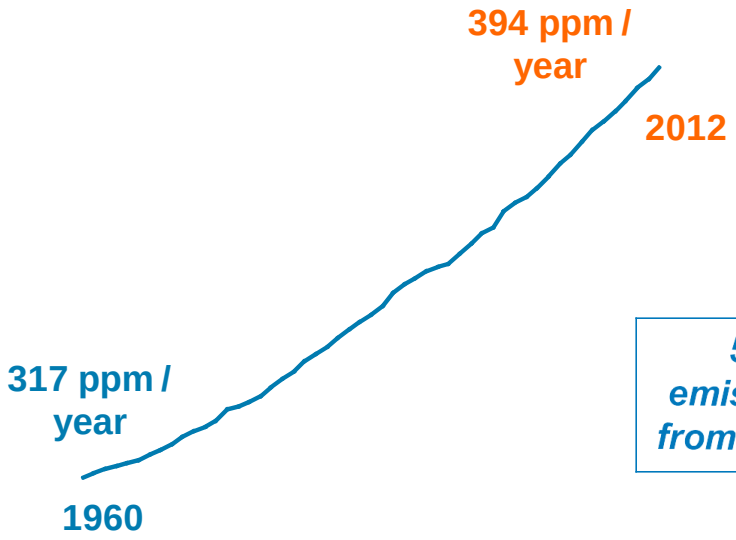
2 Second utilisation: stationary applications

- Once the battery has lost 20% of its power or capacity for mobility applications, it can be used for specific stationary applications which require less power demand

Optimised life cycle of LMP batteries enables to maximise efficiency of utilization

Increasing concerns about climate change and pollution…

Increasing level of atmospheric CO_2



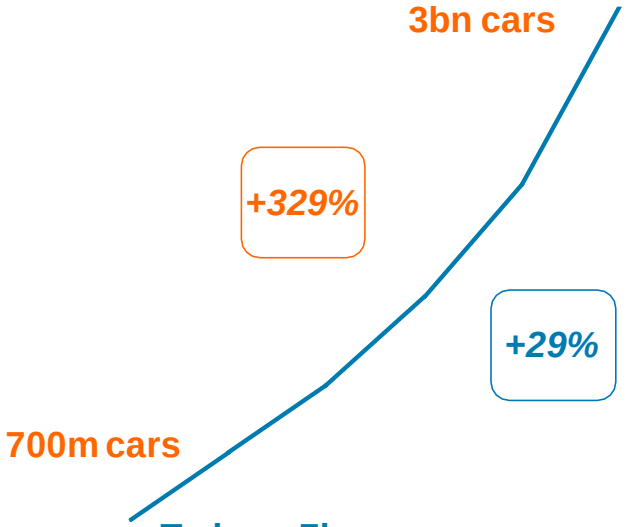
Source: NOAA – Atmospheric CO_2 at Mauna Loa observatory(1960-2012)

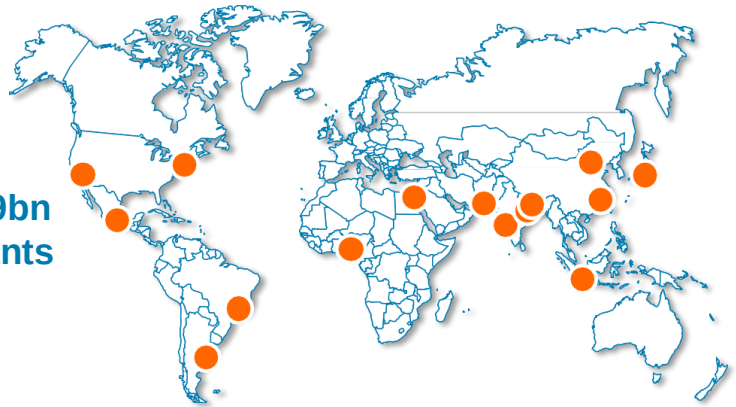
50% of CO_2 emissions coming from transportation

5 years life expectancy loss due to pollution in Pekin

…and environmental challenges coming from urbanization…

Global number of cars booming





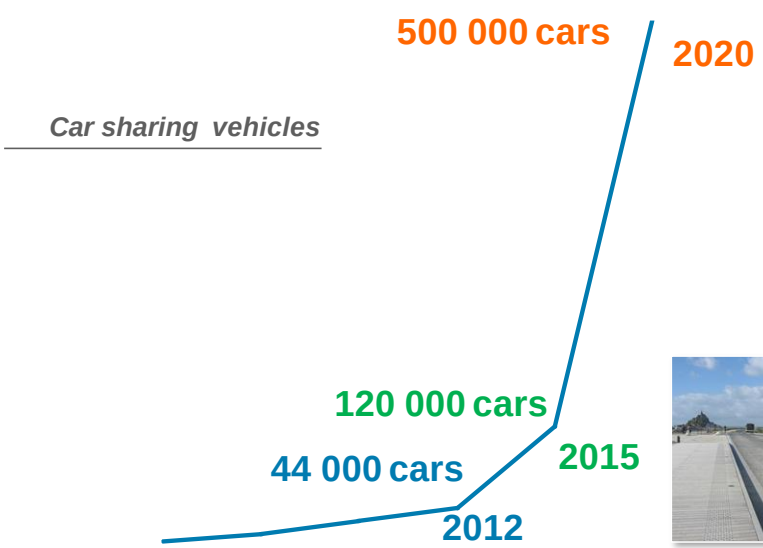
- ***Over 50 cities ~ 10 million inhabitants by 2025***
- ***4.6bn people living in cities by 2025 (vs. 3.6bn in 2010)***

Source: International EnergyAgency

…encouraging the development of new mobility solutions

1 out of 5 vehicles operated in car sharing schemes expected to be a battery-powered electric vehicle by 2016

Provider of eco-friendly transportation solutions



Source: Frost & Sullivan (February 2012)

Bluecar

Autolib

Bluebus

Bluetram

Autolib': a successful real-life test for the technology

Already c. 150,000,000 km cumulated and no major incident

Launch of Autolib' wth 250 cars

DECEMBER 2011

1,740 cars
600 stations
15,000 total subs

JUNE 2012

c. 1,800 cars
820 stations
84,348 total subs

>2,100,000 rental uses

c. 21,000,000 km cumulated

JUNE 2013

c. 4000 cars
1100 stations
6500 Charging points
300 000 total subs
125 000 yearly subs

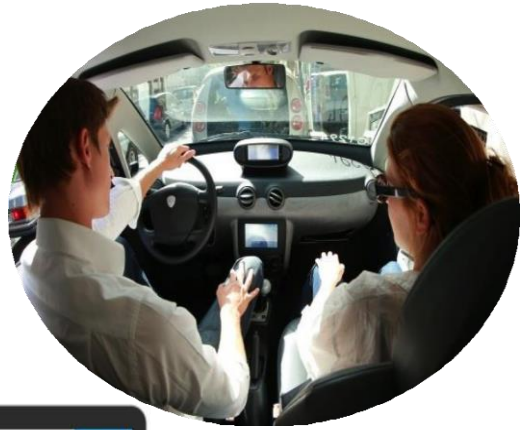
>16,500,000 rental uses

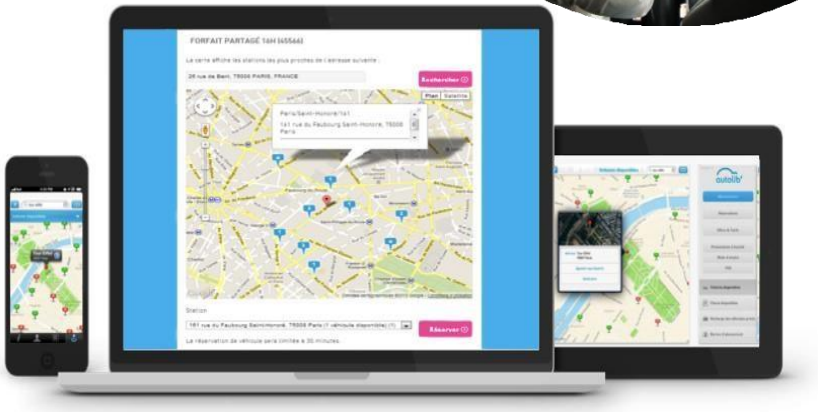
c. 150,000,000 km cumulated

AUGUST 2016

- *An in-depth real-life test, challenging the technology in tough conditions*
- *A commercial success reflecting public's interest for carsharing*
- *A success driving interest from other large cities*

‘Always Connected’ User Experience & Real Time availability





Deployment

autolib'

Paris (France)

- ✓4,000 Evs
- ✓Launched in Dec .2011

bluely

Lyon (France)

- ✓250 Evs
- ✓Launched in 2013

bluecub

Bordeaux (France)

- ✓200 Evs
- ✓Launched in 2014

blueindy

Indianapolis (USA)

- ✓500 Evs
- ✓Launched in 2015

source LONDON

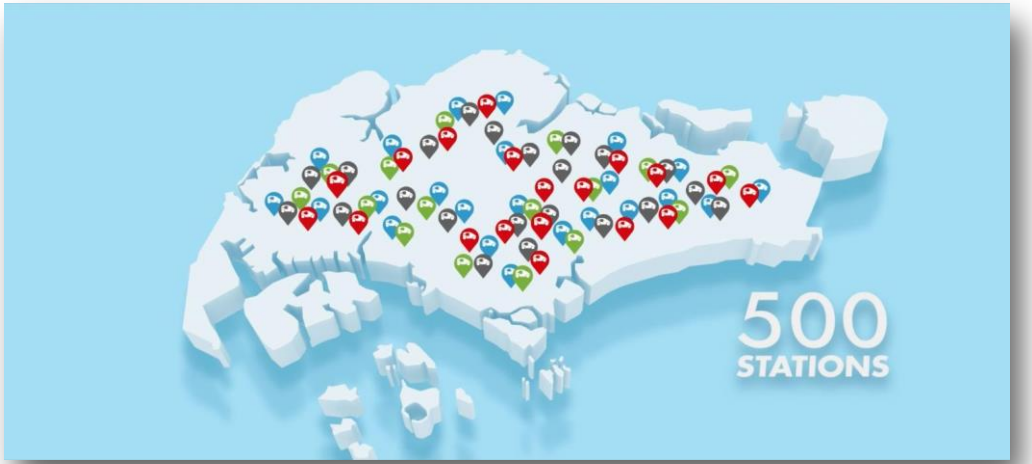
Source London & Bluecity Londres (UK)

- ✓ 2014: Took over of Source London, 1,400 charging points
- ✓ 2016: Launch of Bluecity, EV sharing

And in 2016 Roma and Turin in Italy

Our 100% EV car-sharing service for Singapore

- ✓Starting mid 2017 with tentatively 50 stations, 200 charging points, 100 EV Bluecars
- ✓Within 4 years : 500 stations, 2000 charging points, 1000 Bluecars
- ✓80% of the stations to be located in HDB and residential areas
- ✓20% of the charging points available for any EV



Bluezones

Bluezones integrate LMP battery and solar pannels for producing, storing and distributing clean electricity in locations without network connexions.

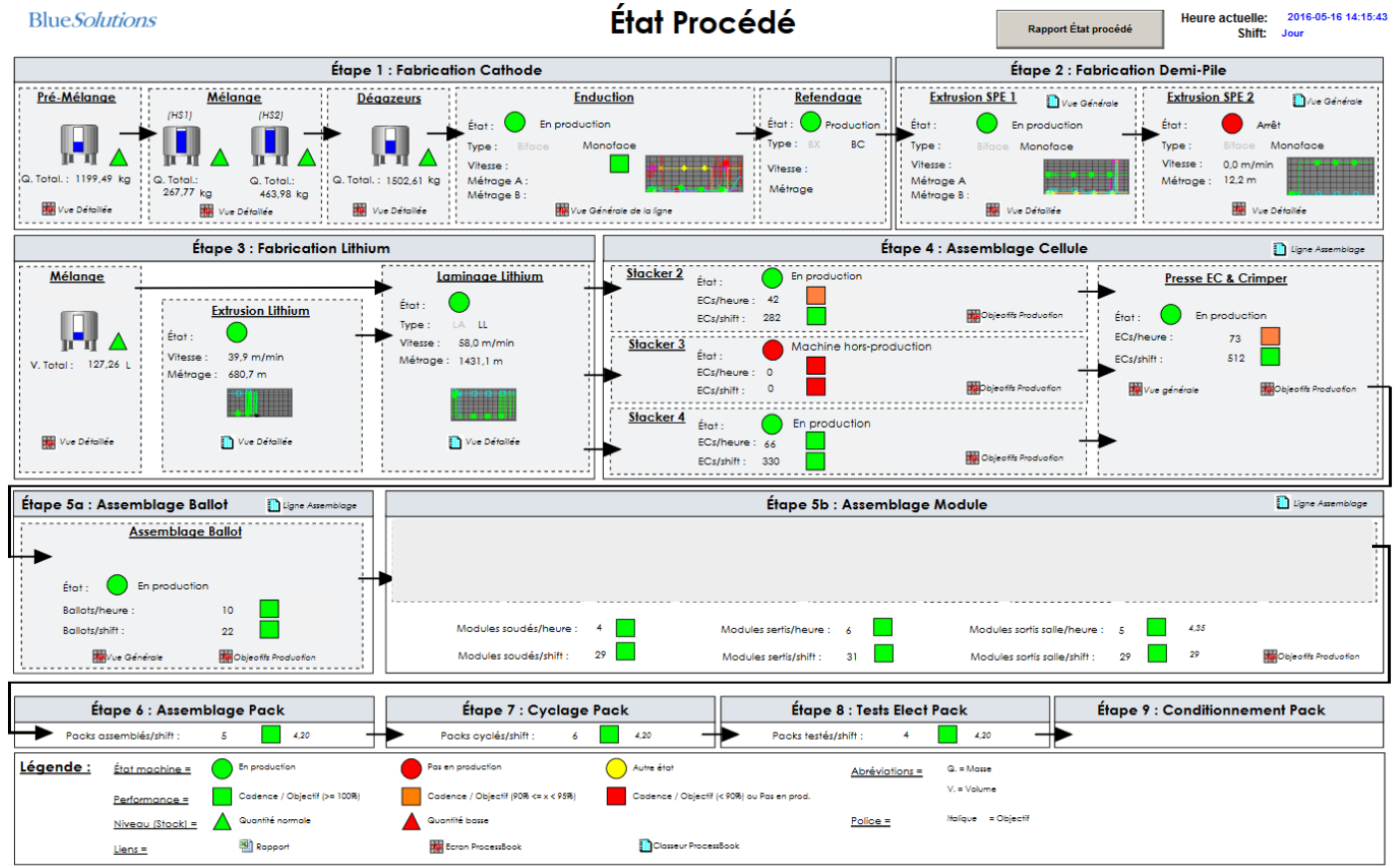
It will allow the feeding of Bluezones with buildings dedicated to health, education providing water and Internet access., as well as the development of usage of tools for the local benefit of the population.

Bluezones have been invested in Benin, Togo, Guinea, Congo and Niger.

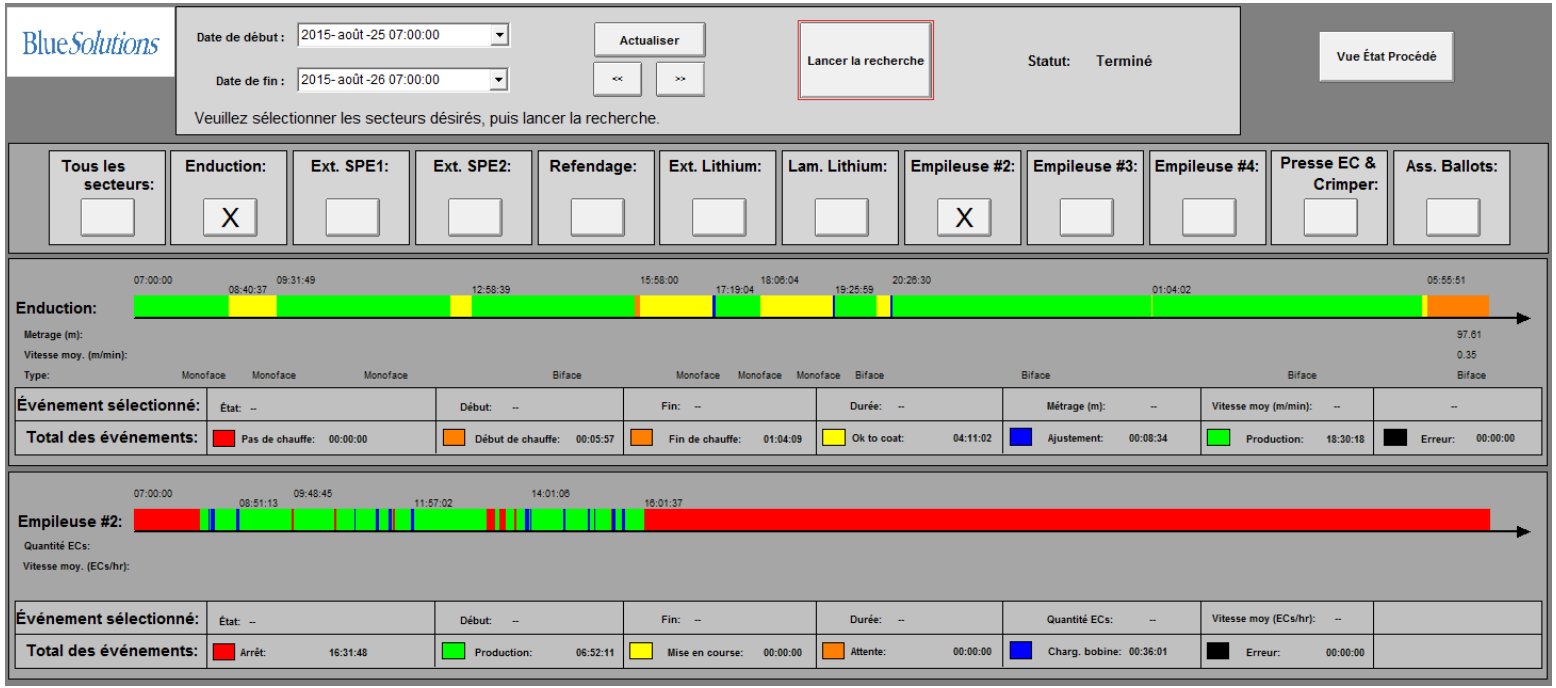
Use cases review

Global Process Overview

- Single page: provides information on the entire process
- Real-time production data



Downtime Tracking



- Production summary over a period of time (production start/stop, startup time, downtime, …)
- Leveraged in daily production meetings

Production Dashboard

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TABLEAU DE BORD
Empileuses #2 - #3 - #4

Heure actuelle: 10/02/2017 3:50:15 PM

PRODUCTION

Heure glissante: ECs / h: ** Objectif global (ECs) *

	Emp.2	Emp.3	Emp.4
ECs/h	*	*	*
ECs perdus en matiere	*	*	*
ECs perdus en temps	*	*	*
% Rejets	*	*	*

Total shift: ECs / shift: ** Objectif global (ECs) *
Objectif à jour (ECs):

	Emp.2	Emp.3	Emp.4	Total
ECs/shift	*	*	*	*
ECs perdus en matiere	*	*	*	*
ECs perdus en temps	*	*	*	*
% Rejets				

Total journée: ECs / jour: **
Objectif global (ECs) ** Objectif à jour (ECs)
= 3 Pack(s)

TEMPS MACHINES - SHIFT ACTUEL

	Premier EC	2 Empileuse(s) en production			Total en production	Total en arrêt	Dernier EC	
	8:13:45				08:42:47	14:47:12	15:49:46	
Emp. #2	8:20:40	En production depuis:	1	minute(s)	05:08:44	02:41:15	15:49:46	Emp. #2
Emp. #3	Pas de EC	Machine hors-production depuis:	0	minute(s)	---	07:50:00	---	Emp. #3
Emp. #4	8:13:45	En production depuis:	19	minute(s)	03:34:02	04:15:57	15:45:32	Emp. #4

Attentes cumulées:

Assemblage EC (Crimper) 02:28:22 — Temps d'attente du crimper pour des ECs

Assemblage Ballots 00:00:01 — Temps d'attente de l'assemblage ballots pour des ECs

CHANGEMENTS DE BOBINES - SHIFT ACTUEL

Temps total changements bobines* : 00:54:58

	Emp.2	Emp.3	Emp.4
Temps total*	00:37:34	00:00:00	00:17:23

*Incluant demi-pile, co-enroulement, lithium, lithium accolé, PP collant, bandelettes

Détails - Temps Ch. Bobine

	Demi-Pile			Lithium		
	Emp.2	Emp.3	Emp.4	Emp.2	Emp.3	Emp.4
Meilleur temps:	00:27:20	00:00:00	00:01:02	00:02:34	00:00:00	00:07:20
Dernier temps:	00:27:20	00:00:00	00:01:02	00:03:14	00:00:00	00:07:20
Temps moyen:	00:00:00	00:00:00	00:01:19	00:03:24	00:00:00	00:07:20

NOTE: Ces données ne sont pas mises à jour si on revient dans le passé. Les temps affichés sont toujours en temps réel.

- Digital Dashboard (production vs target, status, scrap, startup time)
- Real-time update

Battery cycling monitoring

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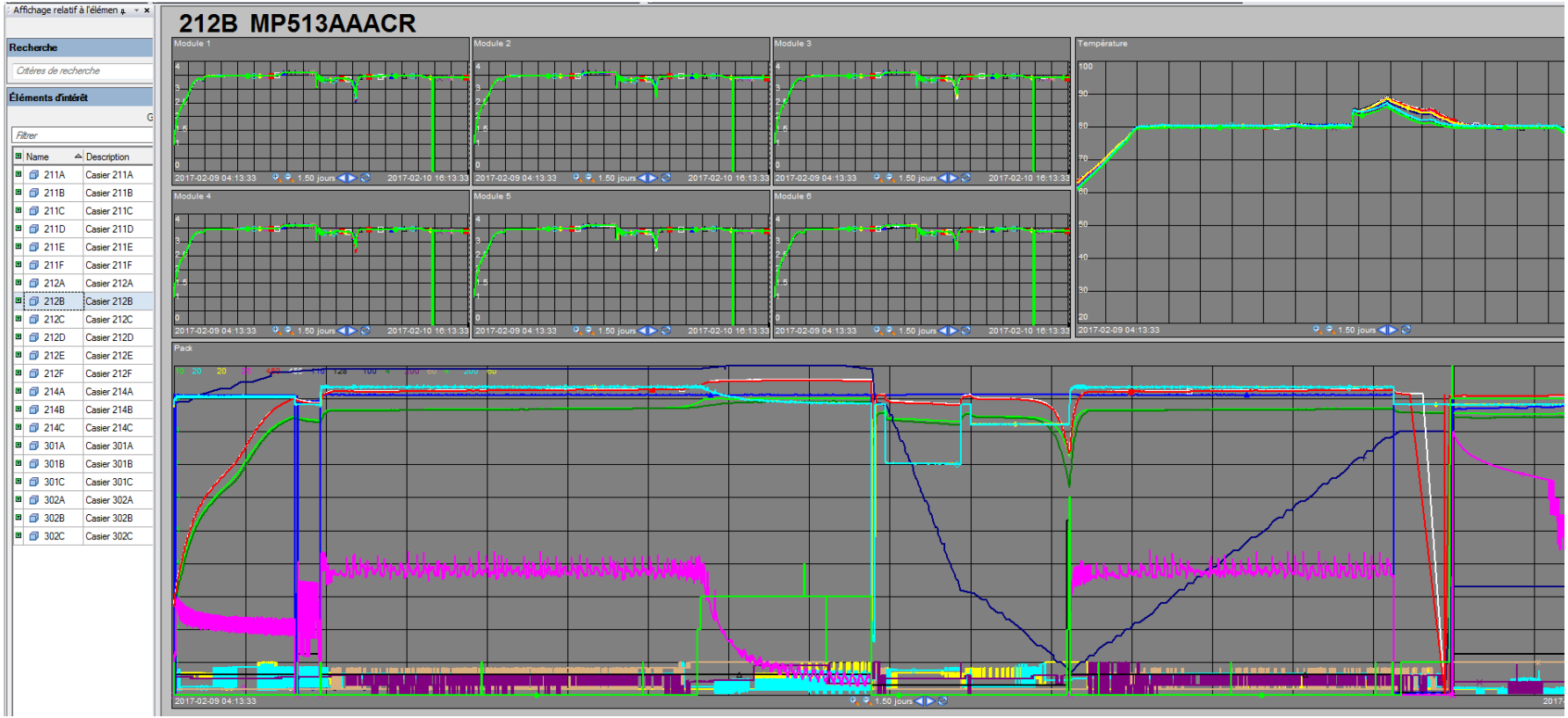

- AF and PI ProcessBook one page to monitor 21 differents bays cycling data.

PI ProcessBook SPE profile monitoring

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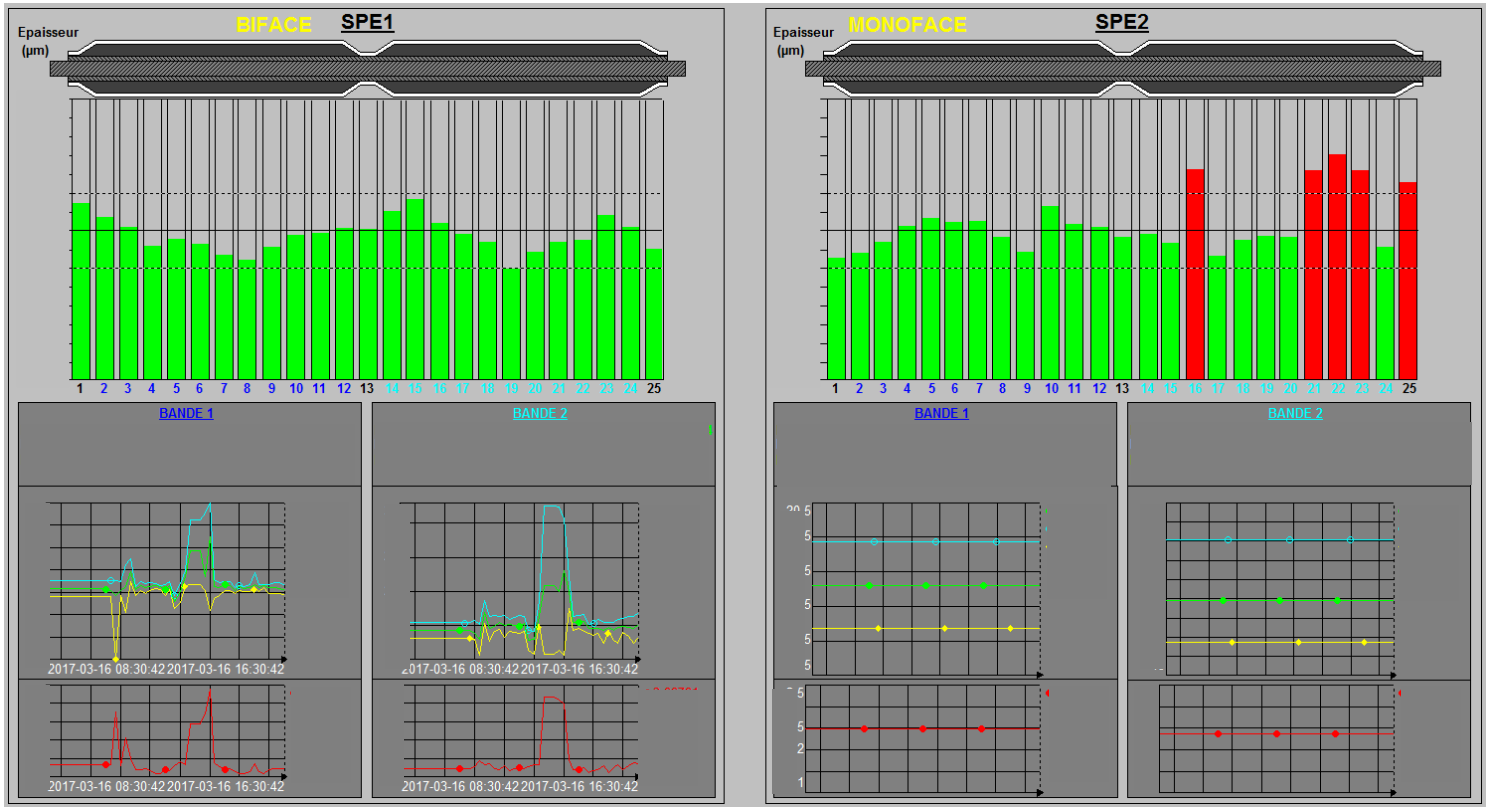
- Allows the operator to view the profile of the SPE in real time in order to adjust the production machine to produce a conforming product according to the specifications.



PI ProcessBook Control Card Viewing Screen

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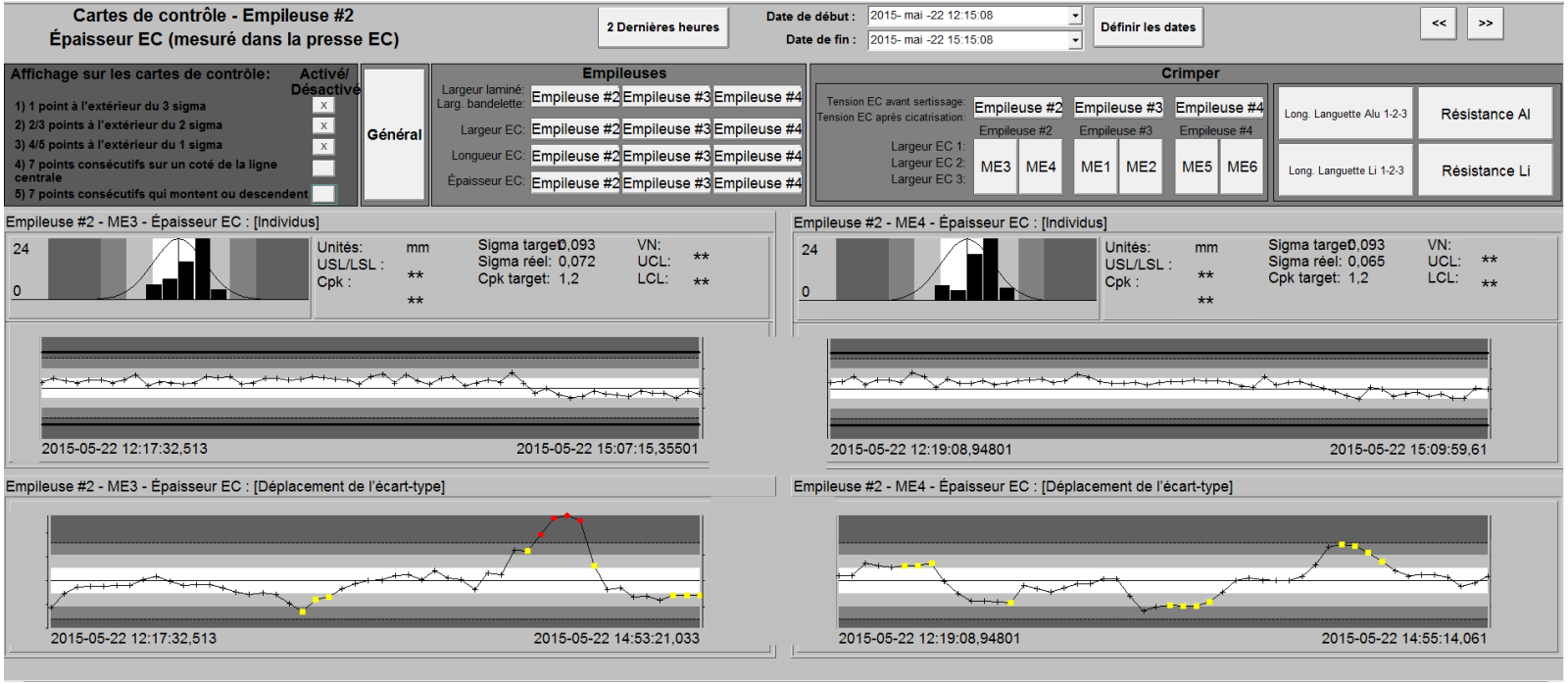

- Allows the operator to view real-time critical data in order to adjust the production machine to produce a compliant product within the specification limits.
- Screen developed according to ASM

PI System in EV Battery Manufacturing

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COMPANY and GOAL

Accelerate transition to a low carbon sustainable economy by developing new products and processes.

CHALLENGE

Develop the products, processes for films manufacturing and packs production, and battery applications all at the same time.

- Track production from raw material to end user application
- Lower production cost
- Support R&D and production

SOLUTION

In order to quickly optimize the product and process, data access is vital.

- The PI System was implemented to perform all data acquisition
- This enables process supervision, early problem detection and future investment priorities based on data-driven decisions.

RESULTS

The PI System is used on a daily basis by all the company and facilitates data analysis.

- Downtime tracking and cause and effect analysis as allowed the implementation of the most effective corrective actions to increase productivity.
- Event Frames reports are use for daily production planning.
- A continuous improvement team was implemented to keep up the pace.

Questions

Please wait for the **microphone** before asking your questions

State your **name & company**

Please remember to…

Complete the Online Survey for this session

http://bit.ly/uc2017-app

Contact Information

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감사합니다

谢谢

Danke

Merci

Gracias

Thank You

ありがとう

Спасибо

Obrigado