



Lithium Metal Polymer battery: its specificities and its applications



www.blue-solutions.com
www.blue-storage.com
www.bluebus.fr

October 2, 2018-M.Deschamps

BOLLORÉ: A DIVERSIFIED FAMILY GROUP WITH THREE BUSINESS LINES

- **Established in 1822**, in Brittany – France, the Bolloré Group ranks amongst the 500 largest companies in the world
- **Diversified strategy based on innovation and international development** with strong positions in growing markets through its three business lines
- Family-owned company with the willingness to pursue a **long-term investment strategy**

85,000 employees in 143 countries
 Turnover in 2017: = €18,3 B
 EBIT in 2017: €1,2 B



TRANSPORTATION & LOGISTICS

- One of the leading groups in freight forwarding and logistics, **leader in Africa** with 26,000 employees
- **#1 Port and rail PPP** operator in Africa



COMMUNICATION & ENTERTAINMENT

- **World leader** in Entertainment and Advertising



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ELECTRICITY STORAGE & SOLUTIONS

- **Electromobility** : electric cars, buses, #1 car sharing service
- **BlueStorage: Energy storage solutions**
 Renewable integration
 Rural electrification
 Hybrid power unit
 Service system



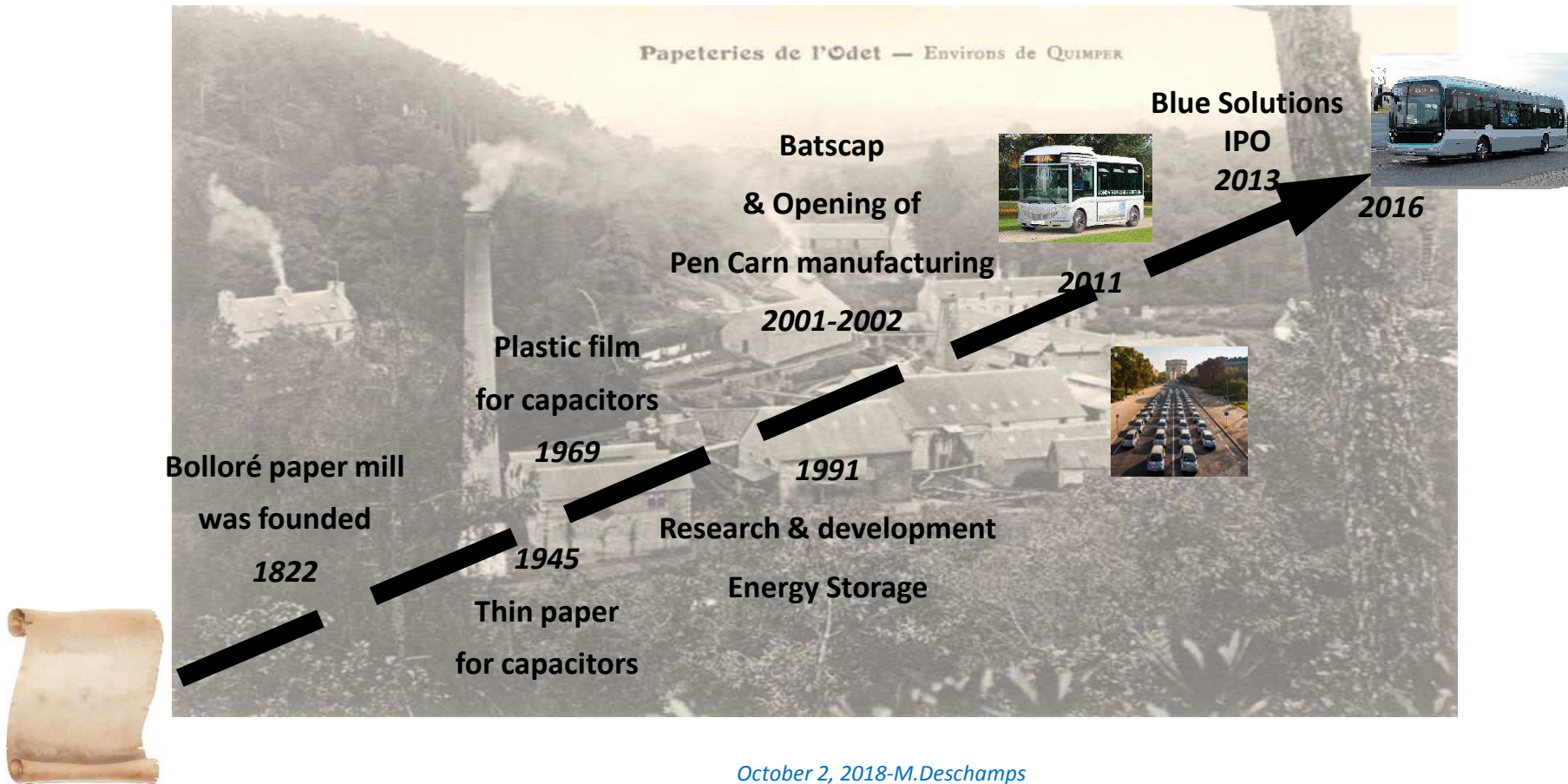


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**LITHIUM METAL POLYMER TECHNOLOGY
LMP®**

October 2, 2018-M.Deschamps

ENERGY HISTORICAL MILESTONES

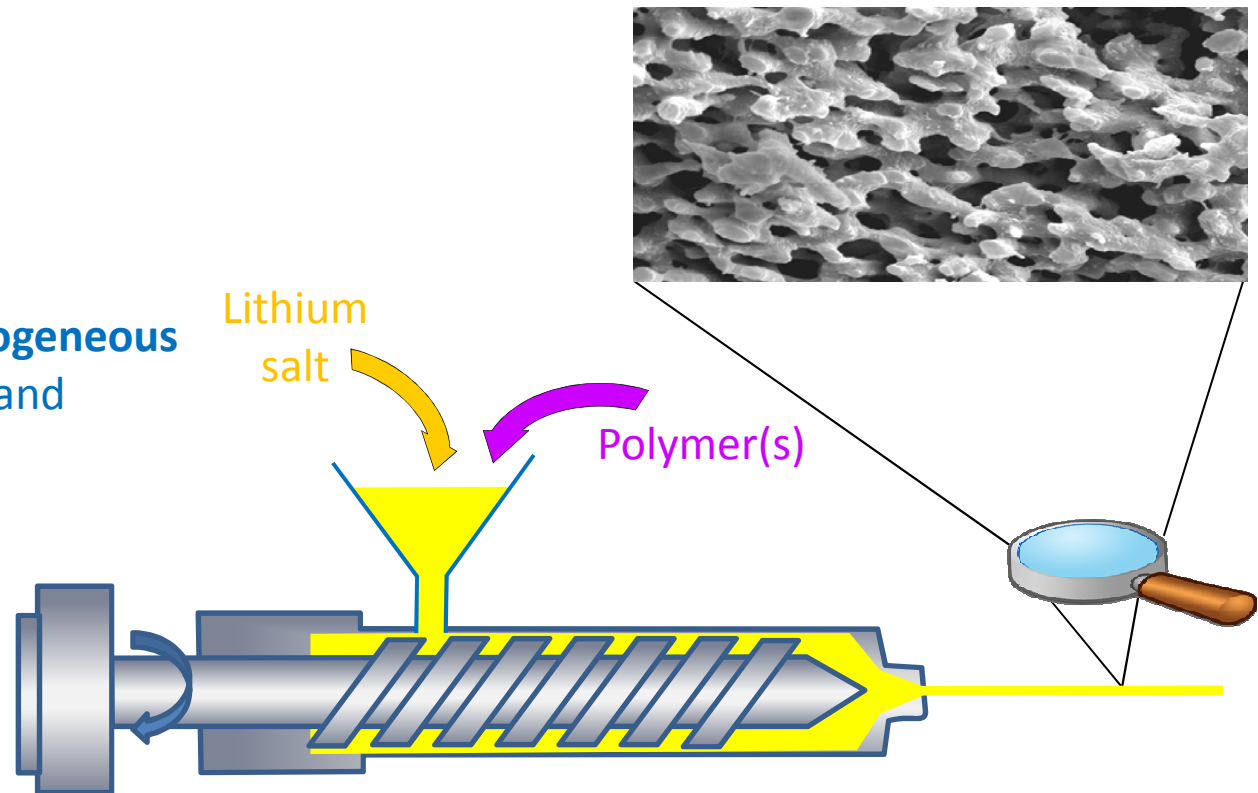


ELECTROLYTE

Made by extrusion
No organic solvent

Objectives :

- **Co-continuous** and **homogeneous** network for conductivity and mechanical strength (separator & electrolyte)
- High **conductivity**
- Mechanical **strength**
- **Thin**
- No pinhole

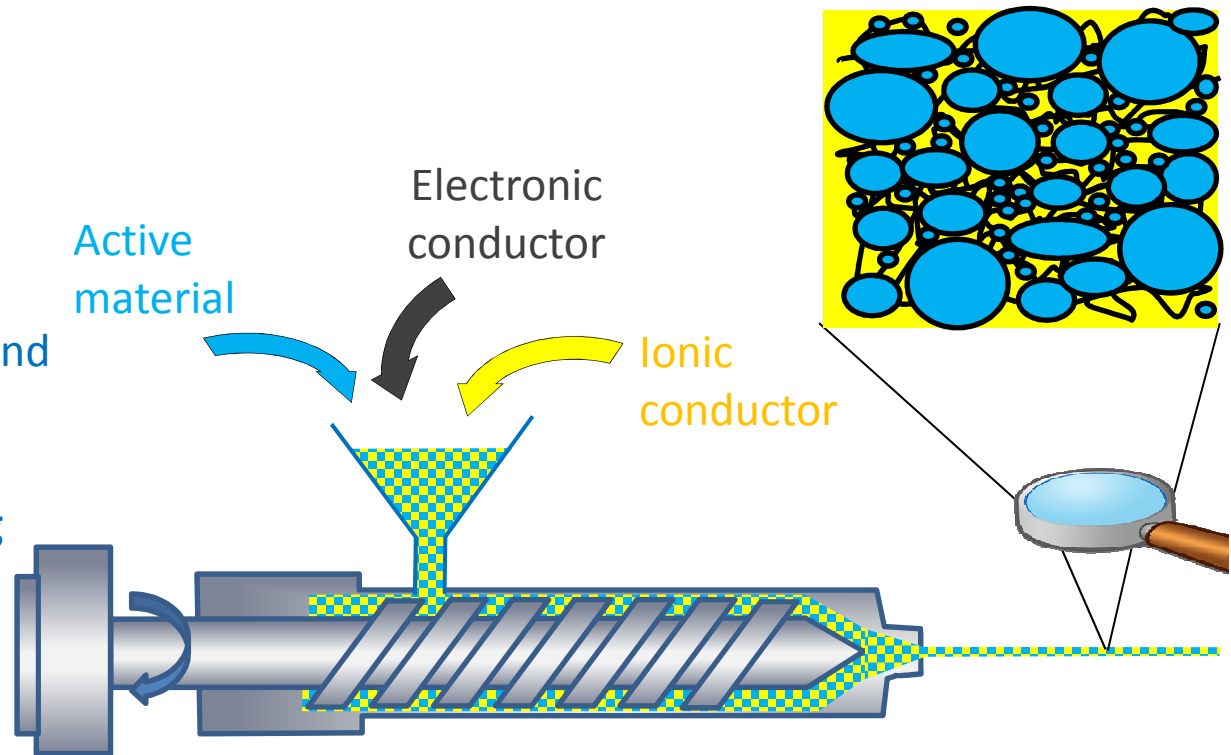


ELECTRODE

Made by extrusion
No organic solvent

Objectives :

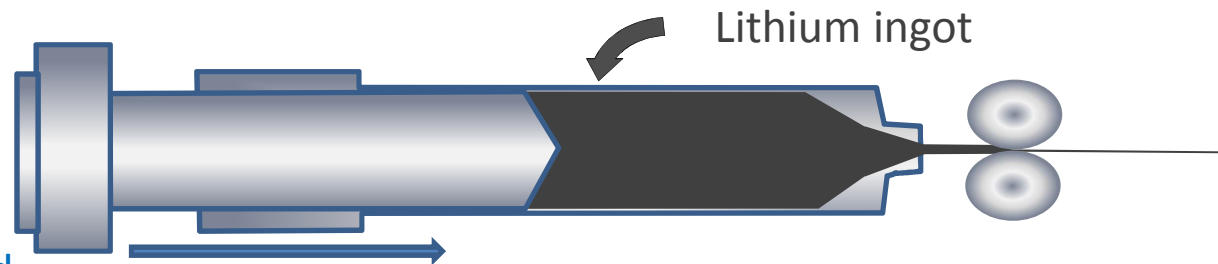
- **Active material is dispersed** homogeneously and is **connected** with both ionic and electronic network (no impregnation step)
- **High active material loading**
- **No porosity**
- Homogenous thickness



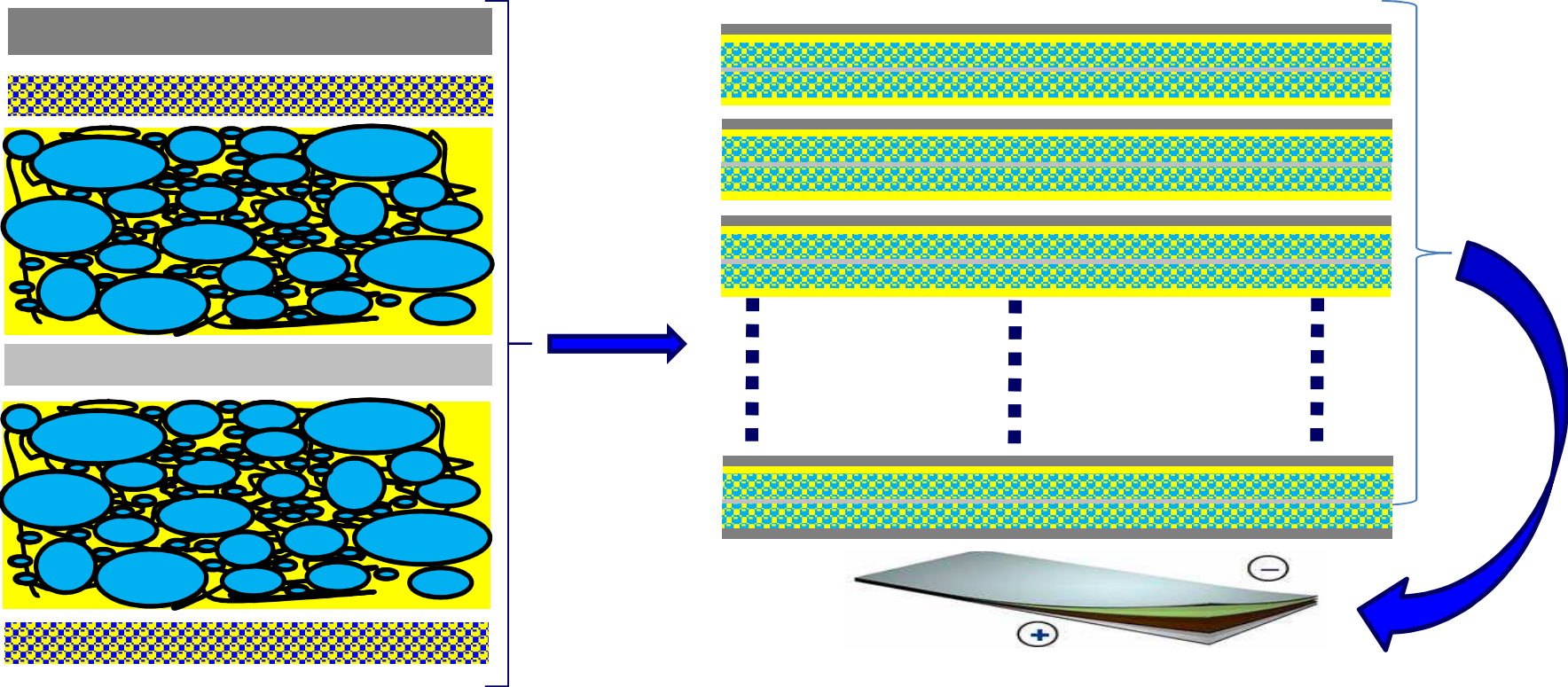
Made by extrusion

Objectives :

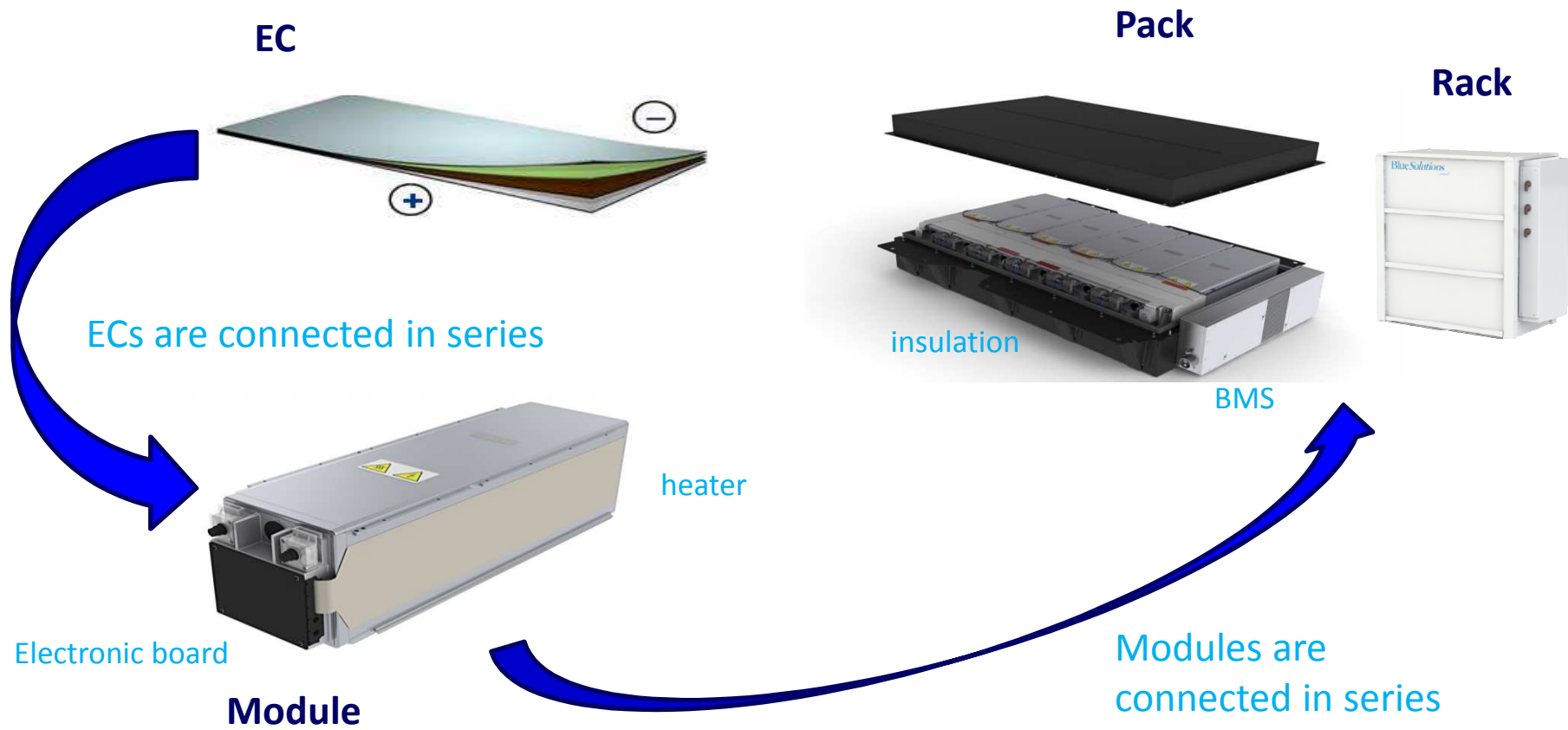
- Purity
- Thickness
- Homogenous thickness and **smooth** surface



The 4 foils are assembled and stacked to the desired thickness → capacity (Ah)



BATTERY PACK CONSTITUTION

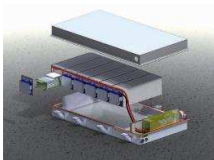


LMP® TECHNOLOGY: A UNIQUE AND INNOVATIVE BATTERY TECHNOLOGY

LMP® Module



LMP® pack



LMP® Block



A 100% solid battery

High calendar life (>15 years)
and cycle life (> 3 000 cycles)

No thermal runaway reaction
No risk of fire, explosion, leakage

Warranty: neither provision clause on
temperature nor average SoC⁽¹⁾

Highly stable in aggressive temperature
environment

No cooling system required
to manage batteries temperature

Full SoC⁽¹⁾ available, from 0 to 100%

Capacity remains constant during lifetime:
neither degradation mitigation strategy
nor initial oversizing needed

No cobalt
No solvent
No rare minerals

Easy spares management: battery in spares
only need to be charged once a year

(1) DoD: Depth of Discharge (2) SoC: State of Charge (3) SoH: State of Health



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**STATIONARY APPLICATIONS &
PRODUCTS**

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ON-GRID APPLICATIONS

Utility Services



SERVICE SYSTEM

- Large storage installations connected to the grid
- Delivering flexibility capacities such as frequency regulation and Transmission deferral services (avoiding investments on network extension).
- Grid flexibility enables the integration of large quantities of renewable energy.



RENEWABLE INTEGRATION

- Large scale storage capacities tied to solar power plants connected to the grid
- Smooth intermittency of renewable energies and provide load shifting to match power consumption peaks during the evening

OFF-GRID APPLICATIONS

Communities



RURAL ELECTRIFICATION

- Energy access for off-grid villages based on hybrid power unit with storage solutions
- Offering sustainable and affordable solution to enable local economic and social development

Commercial & Industrial



HYBRID POWER UNIT

- Hybrid power system combining renewable energy production, diesel generator and storage capacity in off-Grid areas.
- Hybrid system offers independence from rising diesel prices and reduces operating and maintenance costs of diesel generators

BLUE SOLUTIONS STATIONARY PRODUCT

MODULE



7 kWh/module

STRING



84 kWh/string

RACK



252/392 kWh per rack
3 or 4 strings

MULTIPLE



Scalable blocks from 252 kWh to several MWh

SCALABLE TO SEVERAL MWh TO ADDRESS THE MARKET NEEDS



Rural electrification



Hybrid power unit for industries



Renewables integration



Service system

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BLUE SOLUTIONS STATIONARY STANDARD PRODUCT

LMP-252 BATTERY BLOCK



Total Block Capacity (kWh)	252 kWh
Rated Voltage (V)	816 V
Width x Height x Depth	1,750 x 1,890 x 970 mm
Weight	2,080 kg
External Operating Temperature	-20°C to +60°C
Cooling of Battery	No need
Cooling of Control Electronics	Forced Air (Closed circuit ventilation)
Safety Standard	CE Conformity

MORE THAN 200 INSTALLED MWH ALL OVER THE WORLD

Odet (France)	Service system
Vaucresson (France)	Peak shaving
CdV (France)	Renewable Integration
Puy-en-Velay (France)	EV solar carport
Bluezone (West Africa)	x11 off-grid sites, powered by solar PV + storage
Canal Olympia (West Africa)	x14 off-grid cinema and live performance venues
Angkor (Cambodia)	EV solar carport



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MOBILITY APPLICATIONS & PRODUCTS

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ELECTROMOBILITY SOLUTIONS



Public transportation

- No noise nor smell, and easy access
- **Two models of Bluebus:**
 - › 6-meter bus: 120 km range – 90 kWh of on-board energy – capacity of 22 persons
 - › 12-meter bus: up to 250 km range – 240 -300 kWh of on-board energy – capacity of 91 to 101 persons
- **Bluetram:**
 - Charges up in about 20 seconds. No rail nor overhead wire. Quick deployment with a reduced and controlled investment



Carsharing

- One-way carsharing solution using 100% electric vehicles
 - France: Autolib' (Paris) in 2011, Bluely (Lyon) in 2013, Bluecub (Bordeaux) in 2014
 - International: Blueindy (Indianapolis, USA) in 2015, Bluetorino (Turin, Italy) in 2016
 - More recently: BlueSG (Singapore), BlueLA (Los Angeles) and Bluecity (London)
- This solution helps meeting the needs of towns and cities

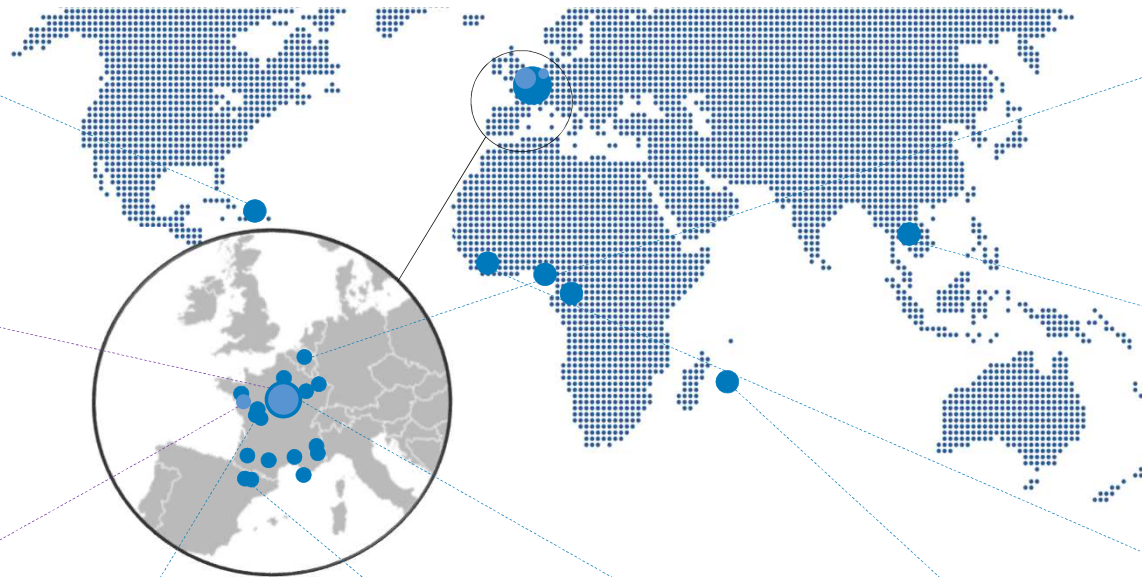
Bluecar®



- Electric cars used for carsharing services, companies, private users
- E-MEHARI produced by PSA with LMP® batteries

BLUEBUS: OUR CLIENTS TRUST US

+ 260 Bluebus currently operating in France and abroad



GUADELOUPE (2016)



RATP (2016): 1ST ALL-ELECTRIC LINE IN PARIS



RENNES-MÉTROPOLE (2017): INNOVATION PARTNERSHIP



TOURS (2012)



TARBES (2012)



VENTE-PRIVEE.COM (2015)



ISLAND OF REUNION (2012 & 2015)



BRUSSELS (2017) : BLUEBUS WIN THE INVITATION TO TENDER ISSUED BY THE STIB



ANGKOR (2013)



ABIDJAN (2012)

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OUR CARSHARING SERVICES IN FRANCE AND ABROAD

8 CARSHARING SYSTEMS

3 CONTINENTS

5,925 ELECTRIC VEHICLES

9,000 CHARGING POINTS

● AMERICA



280 electric vehicles – 450 charging points



Launch in 2018

● EUROPE



4,000 electric vehicles – 6,200 charging points



310 electric vehicles - 510 charging points



200 electric vehicles - 380 charging points



135 electric vehicles - 230 charging points

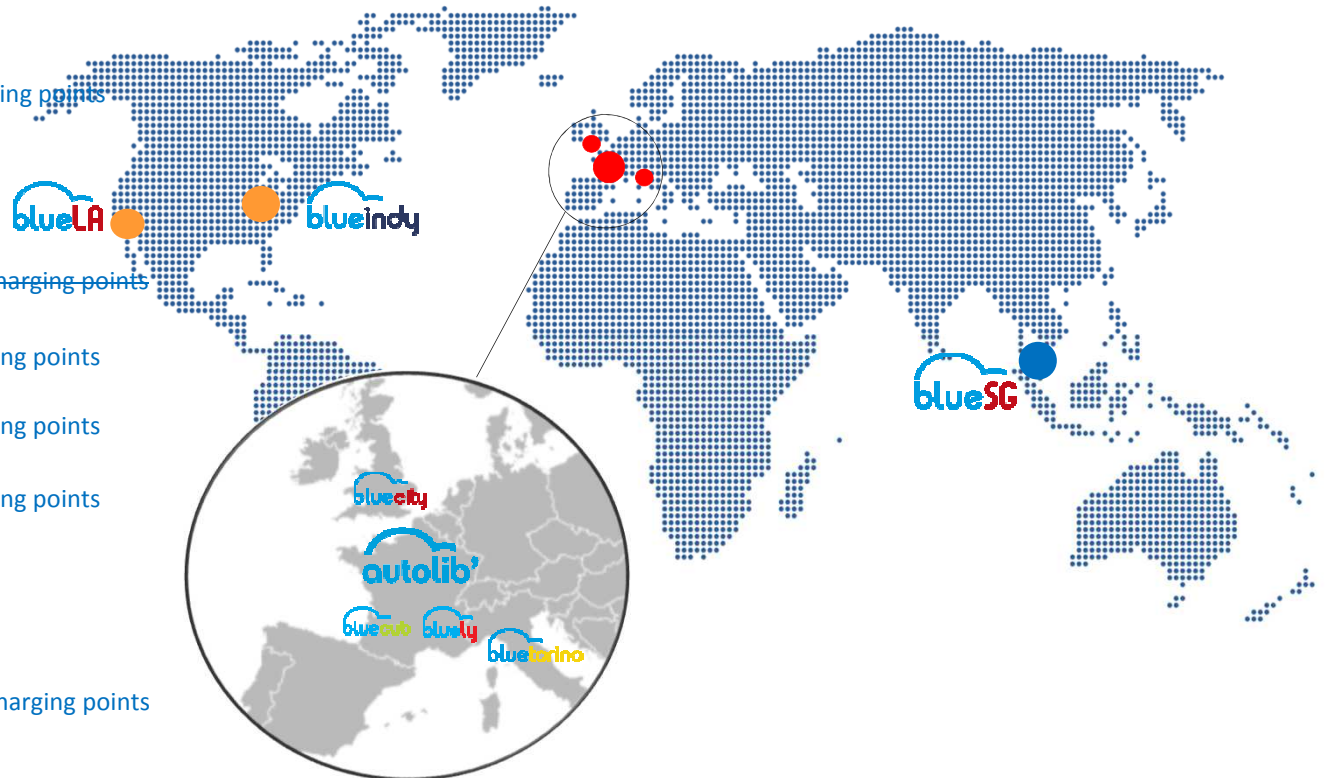


Launch in 2018

● ASIA



1,000 electric vehicles - 2,000 charging points



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New partnerships

GAUSSIN



- Blue Solutions and GAUSSIN Manugistique announce the success of the integration of Lithium Metal Polymer (LMP®) batteries in the APM HE vehicle, an electric tractor intended for port operations.
- Successfully tested this summer in Pointe Noir - Congo



DAIMLER



Daimler
Mercedes-Benz

- Bolloré and Daimler have entered into an agreement which may enable the E-Citaro buses manufactured by Daimler to be equipped with Lithium Metal Polymer (LMP®) produced by Blue Solutions

IN PARALLEL WE ARE PREPARING A SECOND STEP SOLID-STATE BATTERIES WITH EXTENDED LIFECYCLE

LITHIUM-POLYMER SOLID-STATE BATTERY - CAPABLE FOR:

- Enhanced energy density
- Not suitable for high performance charging
- Not compatible with NMC batteries

Net capacity

2018 243 kWh

2020 400 kWh

New technology - different operation strategy

New technology solid-state batteries

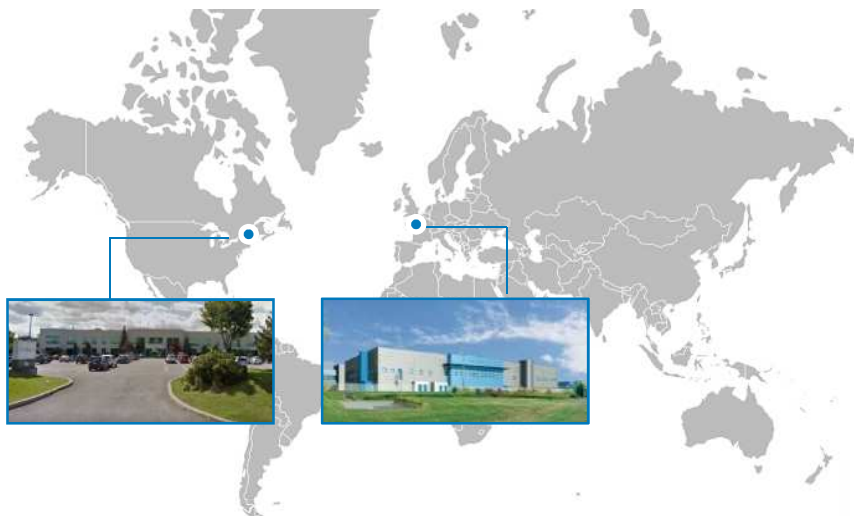
different pack design - more space needed

BLUE SOLUTIONS AT A GLANCE...

MOBILE & STATIONARY ACTIVITIES BASED ON OUR OWN LMP[®] BATTERIES

Current production's capacity of our Lithium Metal Polymer battery up to **1.5 GWh**

Three main factories in France to produce batteries and electric buses and one battery factory in Canada



+ 200 MWh

More than 200MWh installed all over the world

25 off-grid installations in Africa

Off-grid installations in operation West Africa

15 countries, 4 continents

Blue Solutions applications are deployed all over the world



210 million km

Traveled by our EVs and buses across the world using LMP batteries

260 electrical buses

From 22 to 100 passengers

#1 E-carsharing

Leader in carsharing services in Europe, Asia and USA

Thank you !

BlueSolutions
by Bolloré



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