Our business scope

- IoT
- Solar
- Energy
- LED technology
¿Where to find us?

- Spain Headquarters
- China
- Hong Kong
- Mexico
- Colombia
- Chile
Always in movement

Participation in the ELA2019 fair held in Mexico City

NextCity Labs sales team at ELA2018 in Mexico City

NextCity Labs silver sponsor of Exposolar – Medellín, Colombia 2021.

NextCity Labs in Expoiluminacion and Smart Cities – Medellín, Colombia 2021.
1. NextCity Labs Technology introduction.
2. Lithium iron phosphate LiFePO$_4$ technology and its advantages.
3. Product and solution portfolio for energy storage.
4. Small, medium and large-scale applications.
5. Highlight Project: Medium-Scale Energy Storage System-EES.
   - Project Overview
   - Justification
   - Technical Solution
   - Implementation
This a secondary battery (rechargeable) derived from Li-ion technology, which implements a cathode based on a phosphate of lithium-iron: LiFePO$_4$. This mixture helps to improve the chemical stability resulting in an increased safety and long shelf life.
2. Lithium Iron-Phosphate - Advantages

NMC: Nickel, manganese, cobalt.
NCA: Nickel, cobalt, aluminium.
LMO: Lithium metal-oxide.
LFP: Lithium iron-phosphate.

2. Lithium Iron-Phosphate - Advantages

- Life cycle > 6,000 cycles (DoD 80%).
- Lastest Battery Management System BMS generation.
- Compatibility with top brands.
- Extense experience and technical support.
- Specialized in LiFePO$_4$.
- Lower usage of heavy metals (Cobalt, Manganese, Nickel).
2. Lithium Iron-Phosphate - Advantages

- Cycle life > 6,000 cycles
- High-resistance to temperature variations
- Safety
- Constant discharge voltage
- Memory
- Autonomy to the end
- Sustainable
- High quality cells
- Warranty
2. Lithium Iron-Phosphate - Advantages

Sonnenschein – OPzV – EXIDE vs. NCL-LFP

DoD 30% - 6,000 cycles.

DoD 80% - 6,000 cycles.

Standards: IEC 60896-2, IEC 60896-21 e IEC 61427
2. Lithium Iron-Phosphate - Advantages

A600 SOLAR
- Life expectancy: 12 to 15 years at standard test conditions STC (20° C).
- Aprox. 6,000 cycles Aprox. 30% DoD.
- Charge and discharge current shouldn’t exceed 35% of nominal current.
- Tend to lose the half of life cycle when exposed to temperatures 10° C above STC (20° C).
- Self discharge curve with greater downhill.
2. Lithium Iron-Phosphate - Advantages

BMS: Monitoring and protection functions.

<table>
<thead>
<tr>
<th>Feature</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cell voltage</td>
<td>System operation</td>
</tr>
<tr>
<td>Cell temperature</td>
<td>State of Charge (SOC)</td>
</tr>
<tr>
<td>Battery voltage</td>
<td>State of Health (SOH)</td>
</tr>
<tr>
<td>Battery temperature</td>
<td>Charge/discharge Control</td>
</tr>
<tr>
<td>Battery operation</td>
<td>Prevention and fault detection</td>
</tr>
<tr>
<td>System voltage</td>
<td></td>
</tr>
<tr>
<td>System temperature</td>
<td>Fault protection</td>
</tr>
</tbody>
</table>
BMS (Battery Management System)

BMS monitors, balances and protects batteries during charge and discharge (operacion).

- **MONITORING AND CONTROL**
  - SOC (State of Charge).
  - Keep a balanced system, under parameters of voltage, temperature and current flow.

- **CHARGE AND DISCHARGE**
  - Keep voltages within normal limits.
  - Keep a balanced system, under parameters of voltage, temperature and current flow.

- **CELL BALANCING**
  - Voltage level in cells.

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2. Lithium Iron-Phosphate - Advantages

- [LiFePO4](#) - Advantages
2. Lithium Iron-Phosphate - Advantages

IEC 62619:2017

- External short circuit test at cell level
- Cell level impact test
- Cell level drop test
- Cell level thermal abuse test
- Cell level overload test
- Cell level forced discharge test
- Internal short circuit test at cell level

IEC 62619
Secondary cells and batteries containing alkaline or other non-acid electrolytes - Safety requirements for secondary lithium cells and batteries, for use in industrial applications
3. Products and Solutions

LiFePO₄ BATTERIES
LiFePO4 BATTERIES

Voltage ranges: 12.8, 25.6 and 51.2 Vdc.
# 3. Products and Solutions

**LiFePO4 BATTERIES**

<table>
<thead>
<tr>
<th>Nominal Voltage</th>
<th>12.8V</th>
<th>25.6V</th>
<th>51.2V</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internal resistance</td>
<td>≤20mΩ</td>
<td>≤20mΩ</td>
<td>≤30mΩ</td>
</tr>
<tr>
<td>Max. Charge Current</td>
<td>= Nominal Capacity</td>
<td>= Nominal Capacity</td>
<td>= Nominal Capacity</td>
</tr>
<tr>
<td>Recommended Charge Current</td>
<td>=50% Max. Charge Current</td>
<td>=50% Max. Charge Current</td>
<td>=50% Max. Charge Current</td>
</tr>
<tr>
<td>Max. Discharge Current</td>
<td>= Nominal Capacity</td>
<td>= Nominal Capacity</td>
<td>= Nominal Capacity</td>
</tr>
<tr>
<td>Recommended Discharge Current</td>
<td>=50% Max. Charge Current</td>
<td>=50% Max. Charge Current</td>
<td>=50% Max. Charge Current</td>
</tr>
<tr>
<td>Range Voltage</td>
<td>12-14.2V</td>
<td>24-28.4V</td>
<td>48-56.8V</td>
</tr>
<tr>
<td>Discharge Voltage</td>
<td>&lt;12V</td>
<td>&lt;24V</td>
<td>&lt;48V</td>
</tr>
<tr>
<td>Work temperature</td>
<td>-20°C to 60°C discharge / 0°C to 45°C charge</td>
<td>-20°C to 60°C discharge / 0°C to 45°C charge</td>
<td>-10°C to 50°C</td>
</tr>
<tr>
<td>Cycle life</td>
<td>&gt;2,500 Cycles / &gt;5,000 Cycles</td>
<td>&gt;6,000 cycles</td>
<td>&gt;6,000 cycles</td>
</tr>
</tbody>
</table>
3. Products and Solutions

Energy Storage Systems (ESS): SERIE MESR
## 3. Products and Solutions

### Energy Storage Systems – ESS: SERIE MESR

<table>
<thead>
<tr>
<th>System Parameters</th>
<th>Cell 100Ah</th>
<th>Cell 210Ah</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Technology</strong></td>
<td>Lithium iron phosphate (LiFePO4)</td>
<td>Lithium iron phosphate (LiFePO4)</td>
</tr>
<tr>
<td><strong>Cell</strong></td>
<td>100Ah 3.2V</td>
<td>210Ah 3.2V</td>
</tr>
<tr>
<td><strong>Module</strong></td>
<td>51.2V 100Ah</td>
<td>51.2V 210Ah</td>
</tr>
<tr>
<td><strong>Rack</strong></td>
<td>512V 100Ah 768V 100Ah</td>
<td>512V 210Ah 768V 210Ah</td>
</tr>
<tr>
<td><strong>Modules per rack</strong></td>
<td>10 15 10 15</td>
<td>10 10 10 10 15</td>
</tr>
<tr>
<td><strong>Energy per rack</strong></td>
<td>51.2kWh 76.8kWh 51.2kWh 76.8kWh</td>
<td>107.52kWh 161.28kWh 107.52kWh 161.28kWh</td>
</tr>
<tr>
<td><strong>System</strong></td>
<td>8 racks</td>
<td>8 racks</td>
</tr>
<tr>
<td><strong>Energy</strong></td>
<td>0.41MWh</td>
<td>0.615 MWh</td>
</tr>
<tr>
<td><strong>Nominal Voltage</strong></td>
<td>512V</td>
<td>768V</td>
</tr>
<tr>
<td><strong>Voltage Range</strong></td>
<td>375-547V</td>
<td>562-820V</td>
</tr>
<tr>
<td><strong>Altitude</strong></td>
<td>3000m (scalable)</td>
<td>3000m (scalable)</td>
</tr>
<tr>
<td><strong>Life Span</strong></td>
<td>&gt;6000 cycles (@80%DOD)</td>
<td>&gt;6000 cycles (@80%DOD)</td>
</tr>
<tr>
<td><strong>Other equipment</strong></td>
<td>DCP/ FPS</td>
<td>DCP/ FPS</td>
</tr>
<tr>
<td><strong>Dimensions</strong></td>
<td>10ft container 10ft container 20ft container 20ft container</td>
<td>10ft container 10ft container 20ft container 20ft container 40ft container 40ft container</td>
</tr>
<tr>
<td><strong>Weight</strong></td>
<td>3.1Tn</td>
<td>5.5Tn</td>
</tr>
<tr>
<td></td>
<td>4.6Tn</td>
<td>8.2Tn</td>
</tr>
<tr>
<td></td>
<td>7.7Tn</td>
<td>13.65Tn</td>
</tr>
<tr>
<td></td>
<td>11.56Tn</td>
<td>20.5Tn</td>
</tr>
<tr>
<td></td>
<td>28Tn</td>
<td>41Tn</td>
</tr>
</tbody>
</table>

[www.nextcitylabs.com](http://www.nextcitylabs.com)  
info@nextcitylabs.com
4. Applications

- **Off-Grid**
  - Rural electrification
  - Competitive costs
  - Improve reliability

- **On-Grid**
  - Hybrid systems
  - Competitive costs
  - Improve quality

- **Demand Response**
  - Back-up
  - High reliability

Photovoltaic Power Plant

Grid
4. Applications: Small-Scale

![Diagram of applications in small-scale energy systems](image-url)
4. Applications: Small Scale

1) PV generation \(\approx\) LOAD consumption (\(\Delta P < 100\)W), system will stay in Standby state.

2) PV generation > LOAD consumption, the surplus power will be stored in the battery.

3) When the battery is full (or already at Max Charge Power), excess power will be exported to the grid.

4) PV generation < LOAD consumption, system will discharge the battery to supply power to load.

5) If PV generation + Battery < LOAD consumption, system will import power from the grid.
4. Applications: Medium-Scale
4. Applications: Large-Scale

- PLL Dynamics
- Virtual Inertia control
- Energy Storage Systems (ESS)
- Wind Power Plant
- DC/AC Inverter
- AC bus
- Thermal Power Plant
- Industrial/residential loads
- Photovoltaic Power Plant
5. Highlight Project: Medium-Scale ESS

Project Overview

This project is oriented to supply the electricity required for a Printer Plant and also offering a high level of reliability because traditional connection to EPS increases CAPEX and OPEX.

The load has an energy consumption of 250 kWh/day (on average). Their pick load is close to 100 kVA and it’s fed by a three phase circuit 120/227 Vac – 60Hz.

It was proposed a system composed by 106 kWp of Photovoltaic Generation, 120 kVA of power in Inverters and an Energy Storage System of 491.5 kWh (0.49 MWh). Last experiences determine the technical viability for this engineering solution.

Some tax incentives apply to this type of projects in Colombia. They took advantage of those savings.
5. Highlight Project: Medium-Scale ESS

Justification

Within and industrial area placed in the surroundings of Bogotá D.C. (Colombia), there is a Customer (Printing Plant) that produces several products such as: books, magazines, newspapers, and so on.

During the phase of construction of its facility the Owners weren’t sure about the access point to connect this plant to electrical power system EPS (public grid). Once the facility has been built and put into operation, it provisionally was connected to a circuit provided for Grid Operator Company (GOC).

Then, this GOC denied to this Customer the possibility to be connected from a close substation or circuit. In constrast, they gave a connection point acces so far from the plant and also determine the construction for their own substation. They claimed the electrical node was full loaded.

This new project substantialy increased the CAPEX to get ready their operation phase. It was the situation that encouraged Owners to chose for an Off-Grid application.
5. Highlight Project: Medium-Scale ESS

Technical Solution

EES 491.5 kWh (0.49 MWh)

Location: Bogotá D.C., Colombia.

Technical description: 96 batteries NCL-LFPO-48100 (51.2Vdc/100Ah), cabinets, communication HUB y power wires and electrical protections.

Other features:
- Nominal Voltage: 51.2 Vdc
- Total ampacity: 9,600 Ah
- Cycle life: 6,000 cycles 80% DoD. 15-20 years.
- Layout: 6 cabinets (16 batteries per cabinet), and a main panel with HUB and protections.
- Operative temperature: 0 - 45° C.
5. Highlight Project: Medium-Scale ESS

Technical Solution

[Diagram showing technical solution with labels for RACK A, RACK B, CABINET, DC PANEL, and HUB]
5. Highlight Project: Medium-Scale ESS

Technical Solution
5. Highlight Project: Medium-Scale ESS

Technical Solution

Source: VICTRON ENERGY
5. Highlight Project: Medium-Scale ESS

Technical Solution

Most sensitive issues

*Precise communication*

- Communication within batteries: Modbus RTU – Master and slaves per rack.
- Communication within Masters and HUB: CANbus. Six (6) masters must be connected to HUB.
- The HUB groups six (6) master batteries. HUB only send main parameters to controller.

*Impedance balance (resistance)*

- Whole batteries must be at 100% SOC before commissioning.
- Power wires for each rack must ensure the same impedance for each battery.
- Power wires between racks and main panel must be equal in length and cross section.

Cross section **2x2/0 AWG / pole * rack**  **Length 6,300 [mm]**

*Electrical protection*

- BMS
- Circuit breakers at battery level.
- Circuit breakers at rack level.

*Fire system*

NFPA 111 – NFPA 855 – Early detection
5. Highlight Project: Medium-Scale ESS Implementation

- Charge Controllers
- Inverter / Charger
- Batteries
- Cabinets
5. Highlight Project: Medium Scale ESS Implementation

BMS CHECK

CHARGE PROCESS
Conclusions

The concept of “Smart Cities” relates to this Energy Storage technology (LiFePO₄) in the sense that the easy usage and huge technical advantages respected to predecessor technology (lead-acid) provide a tool which can support the requirements of operative challenges in Electrical Power Systems EPS.

The Grid Operator Company might have developed a “Demand Response” strategy in order to tackle this issue associated with an overloaded electrical node. This strategy could have involved and Energy Storage System ESS and distributed generation as well.

Communication compatibility between battery bank and power electronic devices is a sensitive subject that must be checked and monitored periodically.

The right usage of Energy Storage Systems ESS entails good engineering practices but also good safety and environmental practices.
Q&A

Personal information
Pablo Bedoya
Mobile: +57 3016889451 (Colombia)
Email: pbb@nextcitylabs.com
URL: www.nextcitylabs.com
Thank you for your attention

Personal information
Pablo Bedoya
Mobile: +57 3016889451 (Colombia)
Email: pbb@nextcitylabs.com
URL: www.nextcitylabs.com