

# GOVECS GROUP

DESIGNING MOBILITY



## **Supporting Role of IT for Lithium Ion Batteries Transportation and SOH monitoring**



# Przemek Kasiński

## Supply Chain & Operations Director



**BIO** - 15 years executive managerial experience in automotive and electric scooters industry where he has been in charge to build and implement purchasing, logistics and manufacturing strategy within 2 startups. Within GOVECS group he is responsible for oversight of the company's manufacturing operations and supplier management functions, including implementation of advanced manufacturing technologies and global supply chain strategies. Prior to electric 2 wheelers business he held managerial positions in logistics and world wide purchasing department in DELPHI Automotive. Przemek holds Master of Science in Mechanical Engineering from the University of Technology in Poznan. He studied Industrial Management and Engineering at Technical University in Porto. He holds as well Master of Business Administration from Georgia State University in Atlanta.

# **Supporting Role of IT for Lithium Ion Batteries Transportation and SOH monitoring**

## **Agenda:**

- **GOVECS GROUP introduction**
- **Information about Lithium Ion batteries**
- **Safety regulations for Lithium Ion batteries transportation**
- **Supporting role of IT for Lithium Ion batteries transportation. ERP and cloud base system**
- **Data analysis**
- **End**



## VISION



**5.5 B**

**HOURS SPENT IN TRAFFIC JAMS ONLY IN U.S. CITIES PER YEAR**



**3.7 M**

**DEATHS WORLDWIDE DUE TO RESPIRABLE DUST PER YEAR**



**5.5 B tons**

**17% OF WORLDWIDE CO2 EMISSION IS CAUSED BY ROAD TRAFFIC**

**“You believe in what you see and it is our objective to let you experience a new way of intelligent and sustainable mobility, which offers solutions to the world rather than complaining about our problems.”**

Thomas Grübel, CEO



**6.3 B**

**PEOPLE LIVING IN „MEGA-CITIES“ IN 2050**



# OUR MISSION

GOVECS - as a pioneer within the fast growing electric mobility sector, understands the market and consumers' needs and offers customized solutions.

While electric drivetrains for cars are still facing major difficulties and restrictions, new vehicle concepts within the "L" category segment are the only existing solutions so far.

Know-how and service portfolio are the core competences of GOVECS GROUP and the secret of the company's success.

By constantly developing our competences, we were able to prevail over our competitors and establish our name and products in the fast-growing market.

An aerial night view of a city, likely New York City, showing a large bridge over a river. The city lights are vibrant, and the bridge is illuminated. A blue hexagonal graphic is overlaid on the image, containing text.

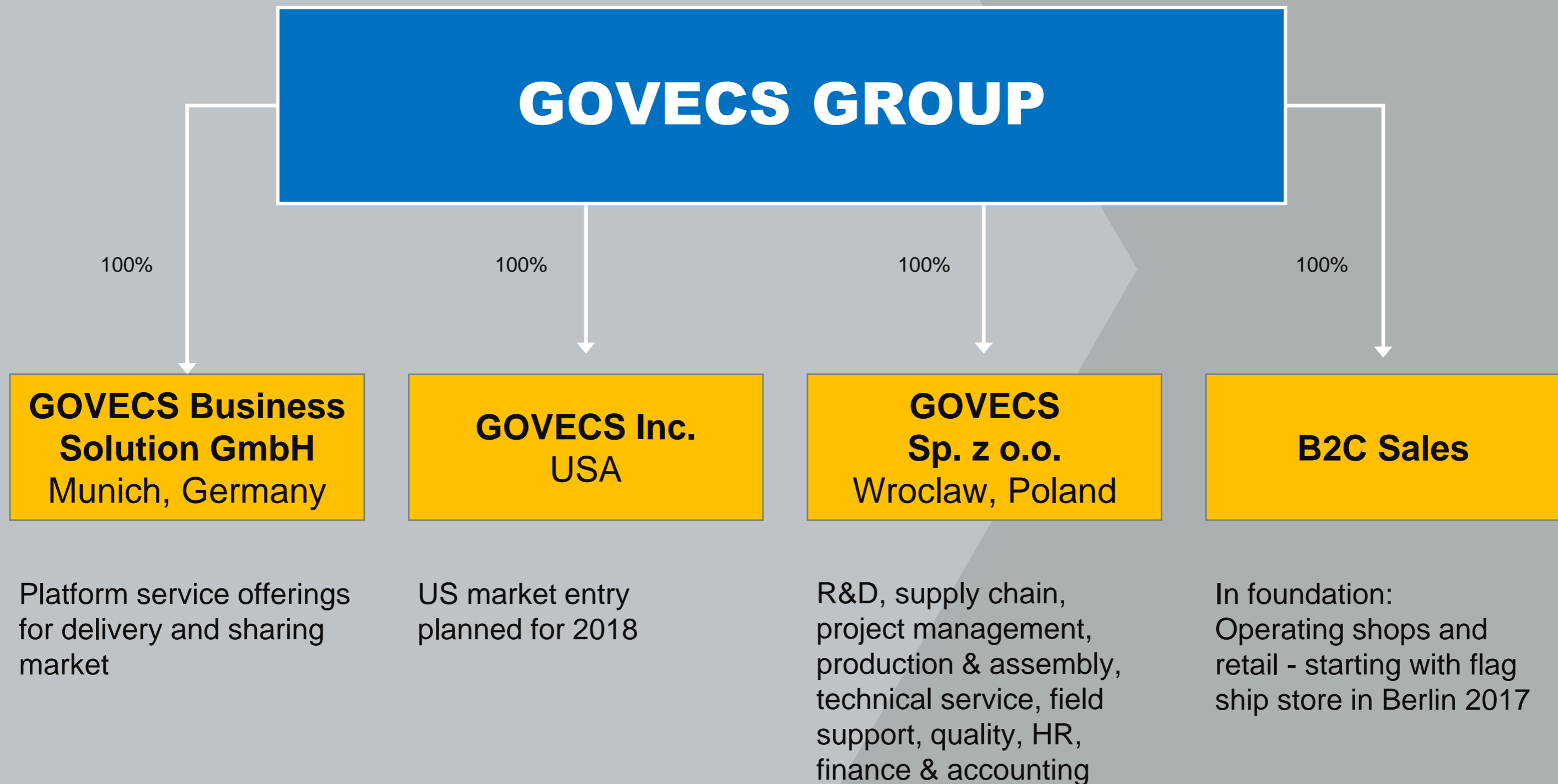
60%

of the world's population  
will live in urban areas  
by 2030



# GROUP STRUCTURE

International sales  
International marketing & PR  
Finance & accounting  
Retail & business development  
Legal affairs, M&A







## HEADQUARTERS, MUNICH/GERMANY

- Hub for all national and international sales activities (direct and indirect)
- In-house development, roll out and coordination of all national and international marketing, trade fairs & press activities
- Own department for retail (on- and offline)
- Business Development
- Finance & Administration





# EUROPE'S LARGEST PRODUCTION FACILITY FOR ELECTRIC VEHICLES

- 4,000 sq m production area with actual 2 production lines
- Capacity: Up to 20,000 vehicles per year
- In-house R&D department
- In-house project management team



**GOVECS GROUP**  
DESIGNING MOBILITY



# DESIGNING MOBILITY



## **B2B – Renting, Sharing & Delivery**

The growing population and concentration of urban areas, causes a need for delivery services and transportation solutions which are efficient and sustainable. The demand for those solutions will grow rapidly till 2030.

## **OEM**

With its unique set-up, GOVECS is already a appreciated OEM partner. Five OEM products are ready for mass production - the first product will still be launched in Q4 2016.

Further, the Group paves the way for intelligent vehicles and self-propelled mobility solutions, including 4-wheelers in the L7E category.

## **B2C**

In 2017, GOVECS will launch a lifestyle oriented consumer product – a step closer to conquer the B2C segment and become the European market leader.



# HISTORY



Product launch of the GOVECS S series

European e-scooter of the Year Award won by GOVECS in 2011, 2012 and 2013



eCarTec Award\* won by GOVECS in 2011 and 2012



Development start of Sway (OEM project)



2018 enter the consumer market Elly

2 new OEM contracts signed  
Introduction of GO! Rent  
Entry to sharing market



2017/2018

2016

Enter the consumer market with the SCHWALBE and further exciting products



Q2 2015

Production start of a cargo postal mobility solution

Take-over of efw-Suhl and Vectrix – both via asset deal



MBO supported by German Family Office

Q3 2014

Start of the OEM cooperation



Q4 2013

First Li-ION powered Scooter in Europe



Cargo Scooter



2011 – 2013

06/01/2009

Founding GOVECS



Homologation of the first electric scooter in Europe by Thomas Grübel

1999

H1 2010



# PRODUCTS & BRANDS



**GOVECS GO! T Series**



**SCHWALBE**



**GOVECS GO! S Series**



**B2C Product**



# MARKET PORTFOLIO



## DELIVERY & TRANSPORT

- Special developed transport vehicles secure an enormous payload compared to competitors due to smoothest acceleration and best maneuverability
- GOVECS GO! scooters are especially designed for heavy usage (more than 20,000 km/year)
- Efficient drivetrain for low variable costs
- Reference clients :  
Joey's Pizza, Domino's Pizza, Takeaway.com (NL), Burger King, Green Guru's, Post NL, Securitas



## SHARING & RENTING

- Strongest growing market
- Preferred partner in the leading international two-wheeler projects:  
**eCooltra:** Barcelona, Madrid, Rome, Milan  
**Scoot Networks:** San Francisco  
**Cityscoot:** Paris  
**Emmy:** Berlin – Negotiations
- Market leadership and deep business knowledge
- Customized adjustments and hardware integrations are part of GOVECS' DNA



## B2C (from 2017 on)

- World-class driving experience and acceleration set new standards in the two-wheel industry
- The first lifestyle consumer product to be launched in Q4 2016
- Further electric motorized vehicles and concepts are in planning
- Reference product: SCHWALBE



# GOVECS GO! T SERIES

- Designed for the purposes in the delivery sector
- Special frame construction for direct fixation of any cargo box. This leads to perfect driving conditions even with maximum payload
- The only scooters homologated for a maximum payload up to 180 kgs
- Flexible battery solutions with distance range up to 130 kilometers per charge
- More than 50,000 km estimated battery lifetime
- Low maintenance solution thanks to mono-frame construction and usage of high-quality components





# GO! RENT

- Innovative renting model for delivery services
- Available w/o maintenance, service inspections and insurance (comprehensive coverage or battery insurance)
- Unique mobility solution and most cost-efficient alternative to extending the fleet
- Flexible contract periods and transparent costs
- GOVECS takes over fleet management
- Full transparency of costs
- Daily fee starting from 5,90 €





# GOVECS GO! S SERIES

- New state-of-the-art batteries and high torque for more driving fun
- Flexible battery solutions with distance range up to 130 kilometers per charge
- Available as L1E and L3E version
- Integrated charger allows easy charging on every household plug
- 2 passengers / 150 kgs permissible maximum weight
- Preferred model for sharing projects





# SCHWALBE

- A cult item is back as the first GOVECS consumer lifestyle product. Market entry summer 2017
- Features the most cutting-edge drivetrain system in the world
- In cooperation with technology partner BOSCH
- Extremely dynamic and agile driving characteristics
- Innovative service concept: Own on-site service instead of local workshops
- Individual configuration with online configurator
- Distance range higher than 100 kilometers\*
- Distribution by own online and offline channels

\* Depending on weather conditions and size/weight of the load







# SHARING – THE KEY FOR URBAN MOBILITY

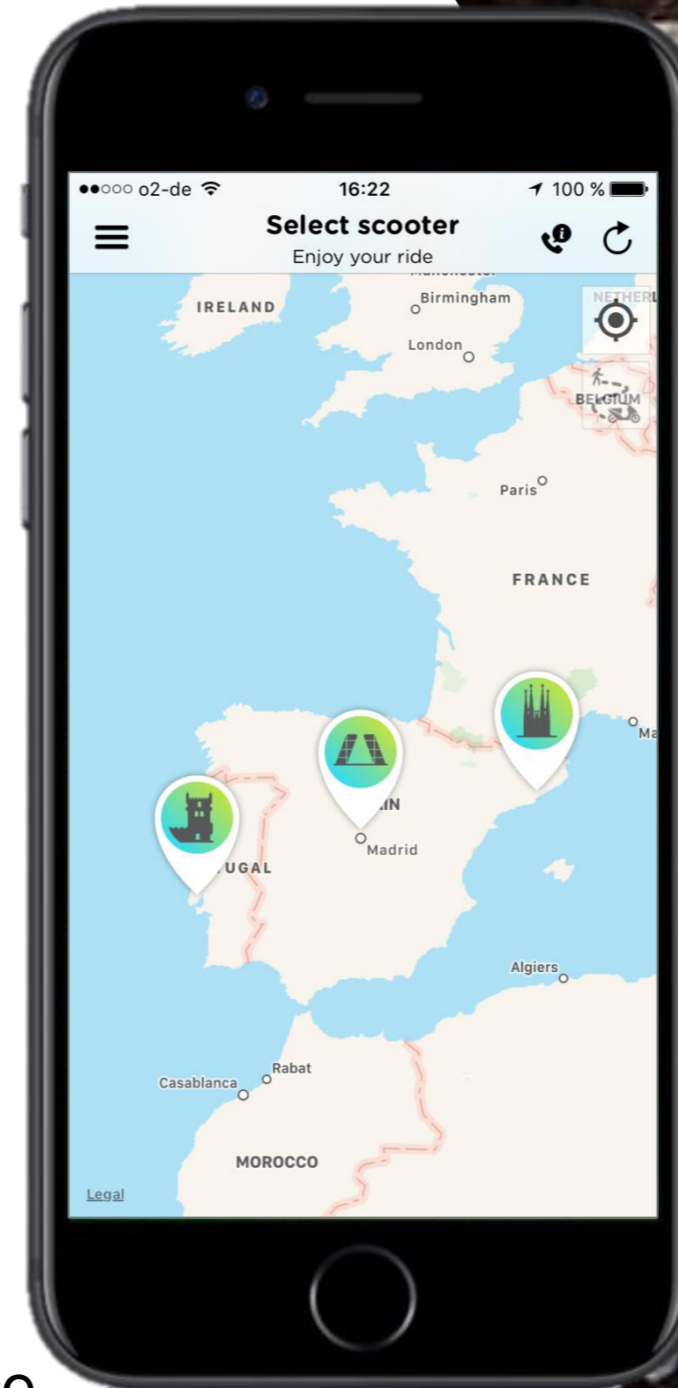


# SHARING CHALLENGES

Actually 5,9 mio people world wide are using vehicle sharing projects. Thereof 36 % only in Europa. The market is expected to grow by factor 6 until 2021.

## ADVANTAGES OF SCOOTERS VS. CARS:

- The key to success for e-scooter sharing is the simplicity of the operations
- Municipals do not dedicate special parking areas for car sharing operators
- 50-60% of booking time in car sharing is spent for searching parking slots
- Less operative cost for service and maintenance

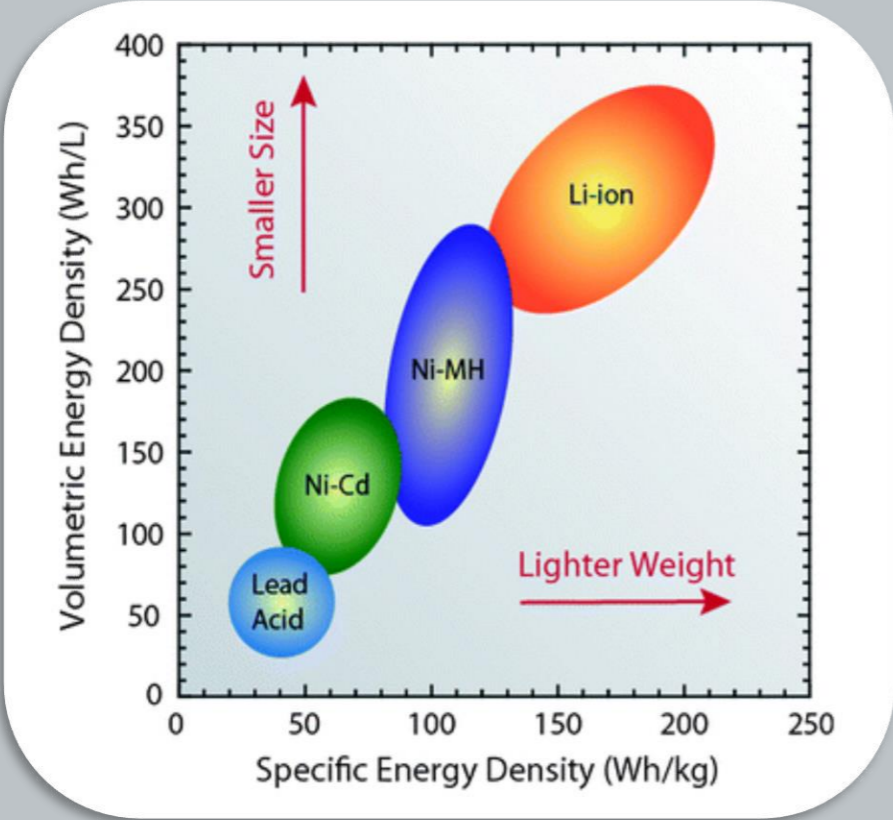




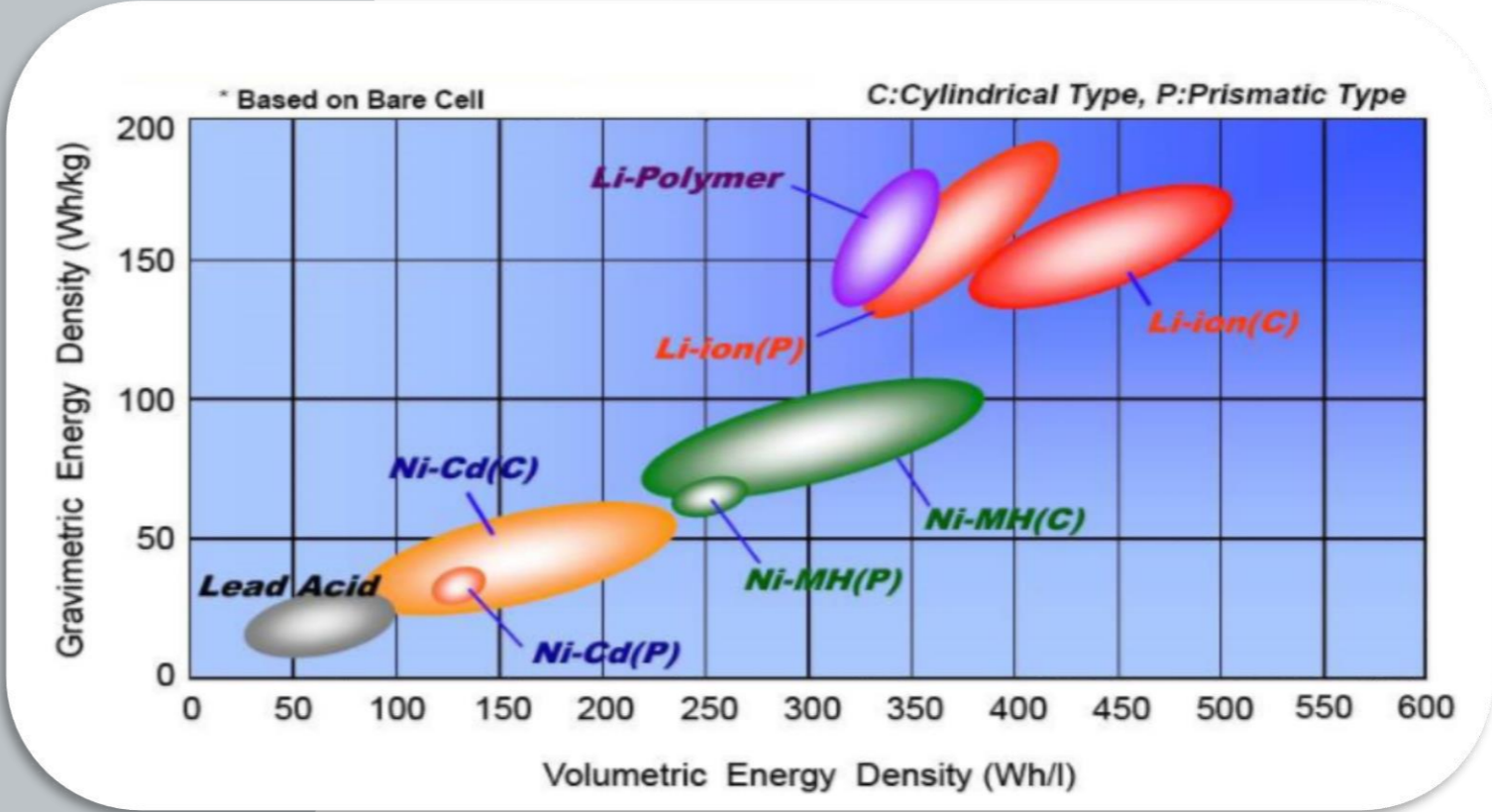
# Informations about Lithium Ion batteries

## Why Lithium Ion?

## All about Energy density



Energy density size and weight



Source: [www.epectec.com](http://www.epectec.com)



# Informations about Lithium Ion batteries

## Cell types



**CYLINDRICAL**



**COIN**



**PRISMATIC**



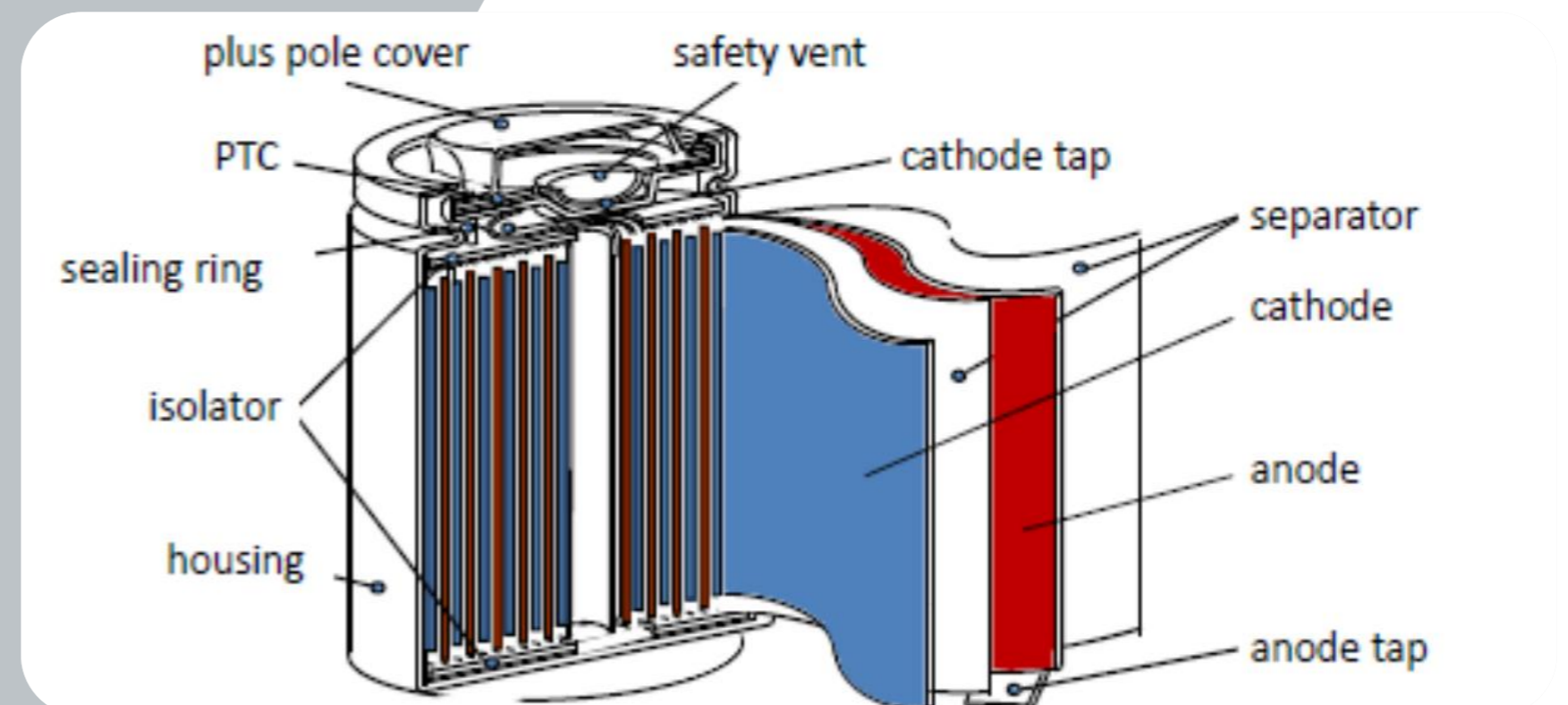
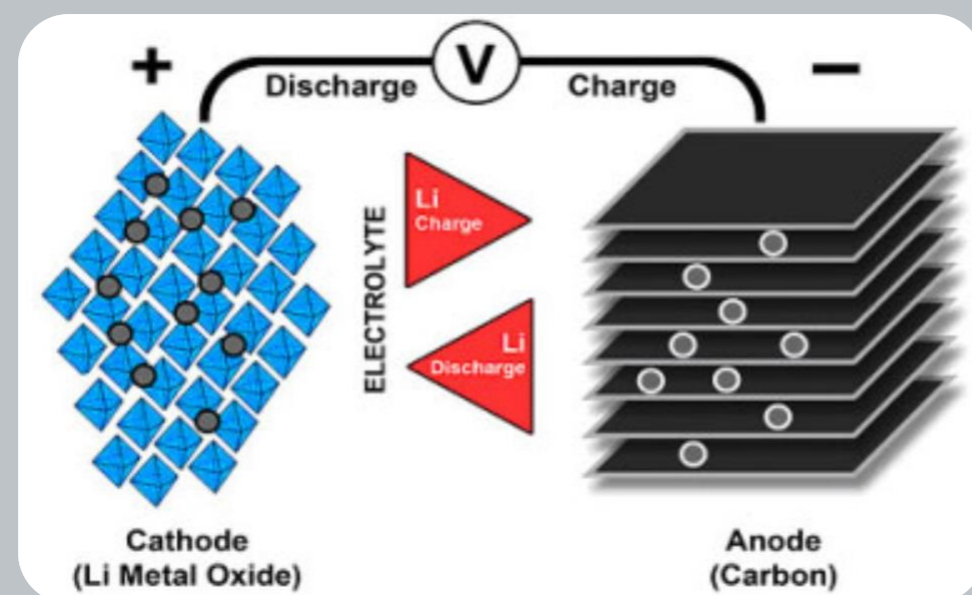
**POUCH**



# Informations about Lithium Ion batteries

## Chemistry (6 most common types)

1. **Lithium Cobalt Oxide** (*popular choice for mobiles, laptops*)
2. **Lithium Manganese Oxide** (*power tools, medical instrument*)
3. **Lithium Nickel Manganese Cobalt Oxide** (*power tools, e-bikes*)
4. **Lithium Iron Phosphate** (*portable and stationary with high load*)
5. **Lithium Nickel Cobalt Aluminum Oxide** (*Medical devices, industrial, electric powertrain (Tesla)*)
6. **Lithium Titanate** (*UPS, electric powertrain*)





# Informations about Lithium Ion batteries

## Battery pack – Energy management

- **2 or more cells connected together**
- **Connected parallel and in series  
ie: 20s10P**
- **Connecting cells into the battery pack in series and parallel, batteries voltage and its capacity goes up**
- **For example 36V, 48V, 72V....capacity depends on cell specification**



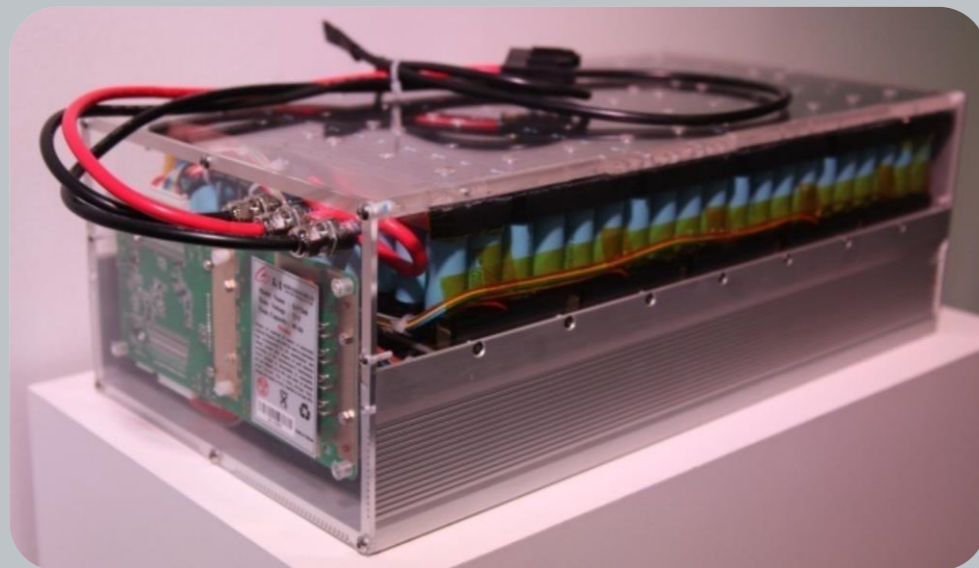


# Informations about Lithium Ion batteries

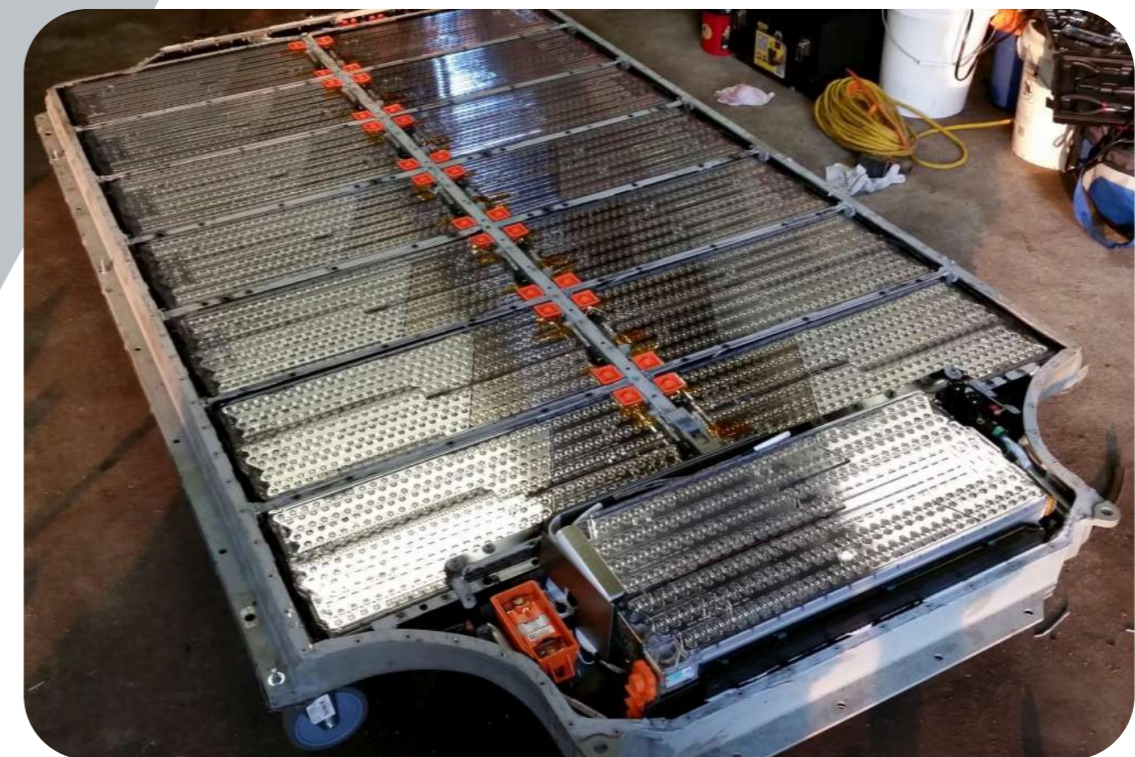
## Battery pack – Energy management

- **Increasing battery pack size (number of cells) - stored Energy goes up**

**GOVECS** battery 72V 4.2kWh 400 cells



**TESLA 85;** battery 400V 85kWh 7104 cells



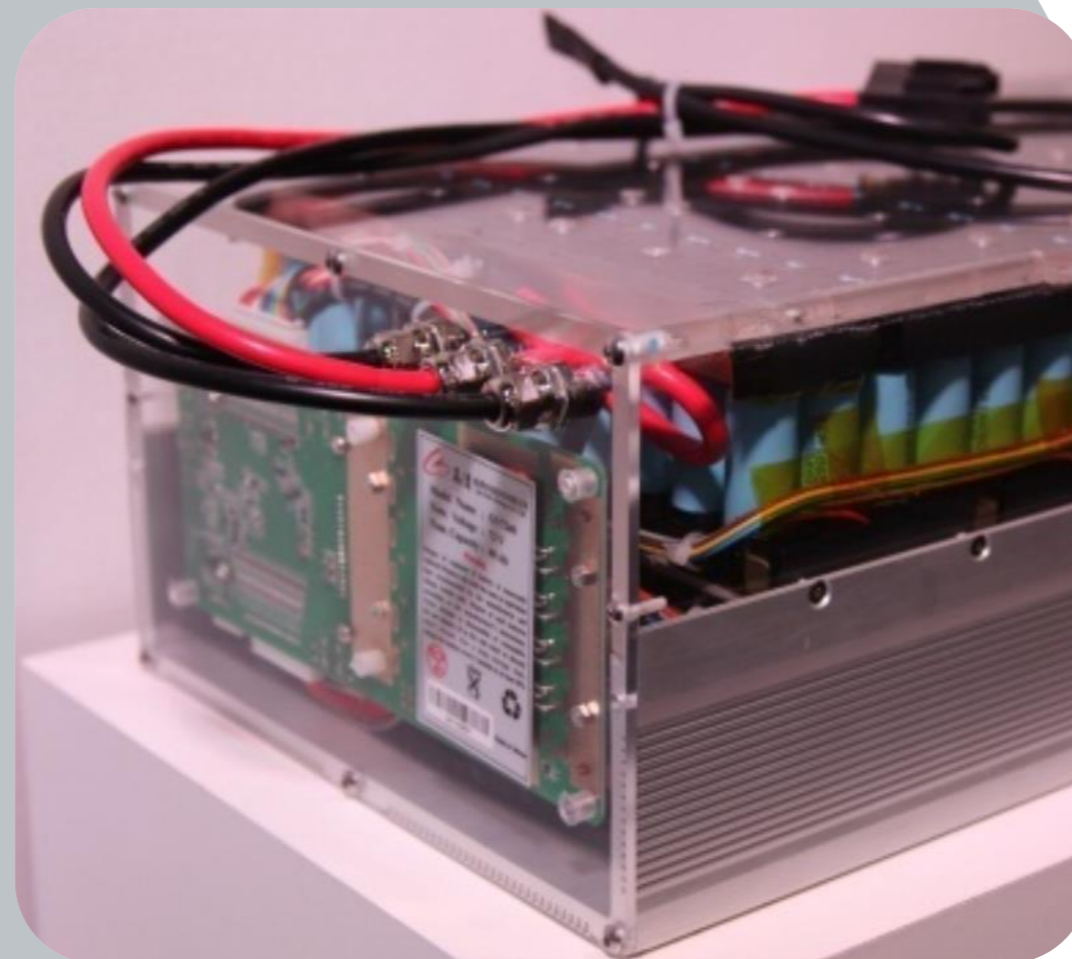
- **Cells are grouped in modules**



# Informations about Lithium Ion batteries

## Battery pack – Energy management

- **By increasing battery size (amount of Energy) we are increasing as well complexity of Energy management**
- **BMS – battery management system responsible for State of Health of the battery**





# Informations about Lithium Ion batteries

## Battery pack – Energy management

- **One of the key role of Battery Management System is balancing battery pack**



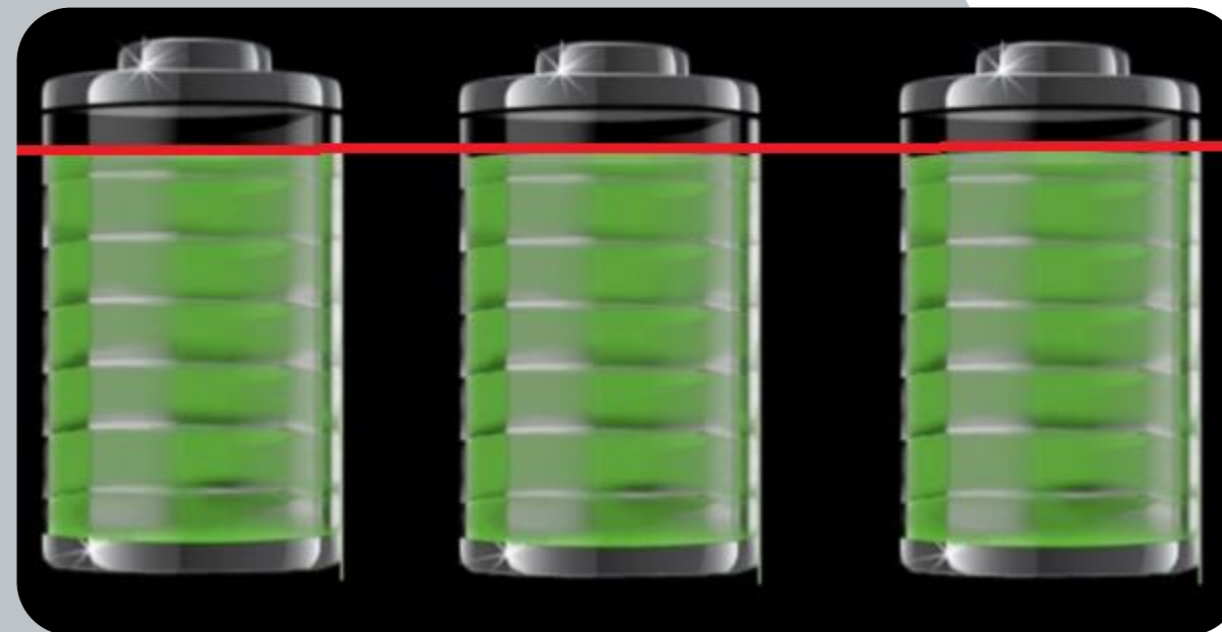
- **Balancing battery pack usually is done on the level of the sections**



# Informations about Lithium Ion batteries

## Battery pack – Energy management

- **The condition of the battery pack, its Quality and lifetime depends on well/equally balanced cells**



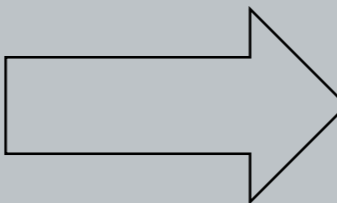
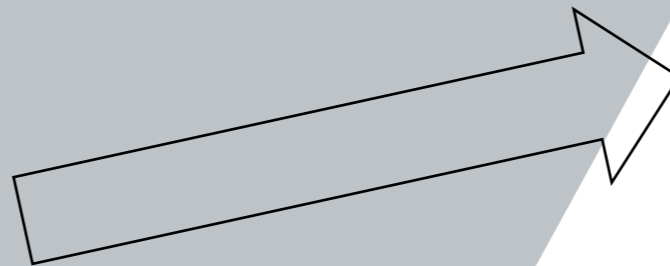
- **Properly designed BMS makes this happen and BMS monitors battery State of Health (SOH)**



# Informations about Lithium Ion batteries

## Battery pack – Unbalanced cells/Safety

- **Unbalanced cells means Voltage difference between cells/sections**
- **Unbalanced cells decreases lifetime of the battery pack and battery health (Quality)**
- **In extreme, unbalanced cells due to the current flow heats up the cells and might create fire**
- **It happens to big brands too ☹️**





# Informations about Lithium Ion batteries

## Battery pack – Energy management

- **Key parameter to control battery SOH is monitoring delta voltage in between the cells/sections**
- **Delta Voltage monitoring helps to understand battery Quality and provides key information for a preventive action**



- **Battery should be taken from the market (scrapped)**



# **Safety regulations for Lithium Ion batteries transportation**

## **Lithium Ion as a Dangerous Goods**

- **Dangerous Goods called by abbreviation of DG are these one which under specific conditions can create harm to human health and life**
- **Any company whose activities includes DG transportation, packing, filling, unpacking or handling should appoint one or more trained safety advisor for supporting and preventing risk of harm/damage to human health/life or environment.**



# **Safety regulations for Lithium Ion batteries transportation**

## **What are the regulations?**

- **United Nations recommendations on the test criteria for Lithium Ion batteries transportation**
- **Manual of Tests and Criteria, Part III, Sub-section 38.3  
ST/SG/AC.10/11/Rev.5, Amend. 2**
- **All batteries transportation should comply with UN transport test for air (ICAO-TI/IATA-DGR), road (ADR), rail (RID) and maritime transport (IMDG Code)**



# Safety regulations for Lithium Ion batteries transportation

UN tests. Long lasting test, usually minimum 16 weeks

| Test Criteria/Standard       | UL      |         |                 |                 |         | IEC       |           | NEMA        | SAE   | UN          | IEEE      |           | JIS       | BATSO    |
|------------------------------|---------|---------|-----------------|-----------------|---------|-----------|-----------|-------------|-------|-------------|-----------|-----------|-----------|----------|
|                              | UL 1642 | UL 2054 | UL Subject 2271 | UL Subject 2580 | UL 2575 | IEC 62133 | IEC 62281 | C18.2M, Pt2 | J2464 | PLIIS, 38.3 | IEEE 1625 | IEEE 1725 | JIS C8714 | BATSO 01 |
| External short circuit       | •       | •       | •               | •               | •       | •         | •         | •           | •     | •           | •         | •         | •         | •        |
| Abnormal charge              | •       | •       | •               | •               | •       | •         | •         | •           | •     | •           | •         | •         | •         | •        |
| Forced discharge             | •       | •       | •               | •               | •       | •         | •         | •           | •     | •           | •         | •         | •         | •        |
| Crush                        | •       | •       | •               | •               | •       | •         | •         | •           | •     | •           | •         | •         | •         | •        |
| Impact                       | •       | •       | •               | •               | •       | •         | •         | •           | •     | •           | •         | •         | •         | •        |
| Shock                        | •       | •       | •               | •               | •       | •         | •         | •           | •     | •           | •         | •         | •         | •        |
| Vibration                    | •       | •       | •               | •               | •       | •         | •         | •           | •     | •           | •         | •         | •         | •        |
| Heating                      | •       | •       | •               | •               | •       | •         | •         | •           | •     | •           | •         | •         | •         | •        |
| Temperature cycling          | •       | •       | •               | •               | •       | •         | •         | •           | •     | •           | •         | •         | •         | •        |
| Low pressure (altitude)      | •       | •       | •               | •               | •       | •         | •         | •           | •     | •           | •         | •         | •         | •        |
| Projectile                   | •       | •       | •               | •               | •       | •         | •         | •           | •     | •           | •         | •         | •         | •        |
| Drop                         | •       | •       | •               | •               | •       | •         | •         | •           | •     | •           | •         | •         | •         | •        |
| Continuous low rate charging | •       | •       | •               | •               | •       | •         | •         | •           | •     | •           | •         | •         | •         | •        |
| Molded casing heating test   | •       | •       | •               | •               | •       | •         | •         | •           | •     | •           | •         | •         | •         | •        |
| Open circuit voltage         | •       | •       | •               | •               | •       | •         | •         | •           | •     | •           | •         | •         | •         | •        |
| Insulation resistance        | •       | •       | •               | •               | •       | •         | •         | •           | •     | •           | •         | •         | •         | •        |
| Reverse charge               | •       | •       | •               | •               | •       | •         | •         | •           | •     | •           | •         | •         | •         | •        |
| Penetration                  | •       | •       | •               | •               | •       | •         | •         | •           | •     | •           | •         | •         | •         | •        |
| Internal short circuit test  | •       | •       | •               | •               | •       | •         | •         | •           | •     | •           | •         | •         | •         | •        |



# Safety regulations for Lithium Ion batteries transportation

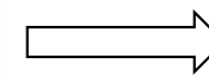
## UN Regulation

- **Lithium Ion batteries are classified as class 9 in the transport sector under the Miscellaneous sector**

**UN 3480 LITHIUM-ION BATTERIES**

**UN 3481 LITHIUM-BATTERIES INSTALLED IN EQUIPMENT**

**Labeling change from 2017**








# Safety regulations for Lithium Ion batteries transportation

UN Regulation - Labels

**SOC ≤ 30%**

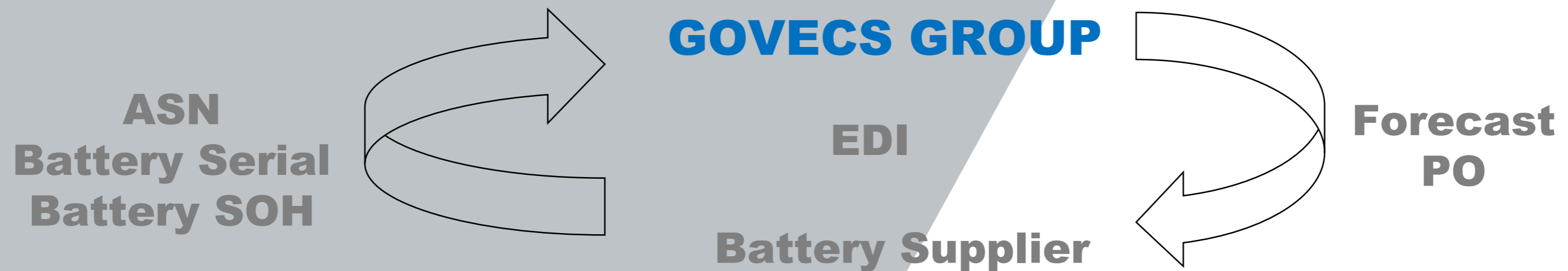
| UN3481 >5kg   |   |  |
|---|---|--|
| Section 1   | Section 2   |  |
| <br>A diamond-shaped hazard label with black and white vertical stripes and the number '9' at the bottom, indicating a highly flammable liquid. | <br>An orange rectangular label with the text 'CARGO AIRCRAFT ONLY' at the top and 'FORBIDDEN IN PASSENGER AIRCRAFT' at the bottom, with an illustration of a cargo plane. | <br>A rectangular label with a red dashed border, showing an illustration of a battery with a flame and a lightning bolt, indicating a flammable liquid hazard. |



# Supporting role of IT for Lithium Ion batteries transportation. ERP and cloud base system

How do we utilise ERP and cloud for battery safety monitoring?

- EDI connectiond between GOVECS and its supplier



# Supporting role of IT for Lithium Ion batteries transportation. ERP and cloud base system

How do we utilise ERP and cloud for battery safety monitoring?

## EDI message data

```
Device name: BMS
Hardware version: V2.10
Software version: 0.37
Cell 1: 4147mV  coeffa: 2,124774          coeffb: 1469,736328
Cell 2: 4138mV  coeffa: 2,100940          coeffb: -0,486552
Cell 3: 4141mV  coeffa: 2,107495          coeffb: 6,810513
Cell 4: 4142mV  coeffa: 2,112100          coeffb: 5,307435
Cell 5: 4138mV  coeffa: 2,102642          coeffb: 6,820329
Cell 6: 4140mV  coeffa: 2,107062          coeffb: 11,071412
Cell 7: 4140mV  coeffa: 2,109071          coeffb: 7,505012
Cell 8: 4140mV  coeffa: 2,110458          coeffb: 8,406975
Cell 9: 4142mV  coeffa: 2,104781          coeffb: 6,765154
Cell 10: 4144mV coeffa: 2,114978          coeffb: 7,215586
Cell 11: 4142mV coeffa: 2,117379          coeffb: 7,291262
Cell 12: 4141mV coeffa: 2,105220          coeffb: 4,811733
Cell 13: 4142mV coeffa: 2,104203          coeffb: 3,937625
Cell 14: 4138mV coeffa: 2,108959          coeffb: 0,791144
Cell 15: 4142mV coeffa: 2,117750          coeffb: 10,594744
Cell 16: 4138mV coeffa: 2,109874          coeffb: 9,061022
Cell 17: 4143mV coeffa: 2,112989          coeffb: 3,042330
Cell 18: 4139mV coeffa: 2,105187          coeffb: 8,700367
Cell 19: 4143mV coeffa: 2,102972          coeffb: 9,244531
Cell 20: 4142mV coeffa: 2,111763          coeffb: 7,519598
```

## Delta monitoring 9mV

-----  
Delta cell (cell 2 : cell 1) 9mV

-----  
Delta cell (cell 5 : cell 1) 9mV  
-----



# Supporting role of IT for Lithium Ion batteries transportation. ERP and cloud base system

How do we utilise ERP and cloud for battery safety monitoring?

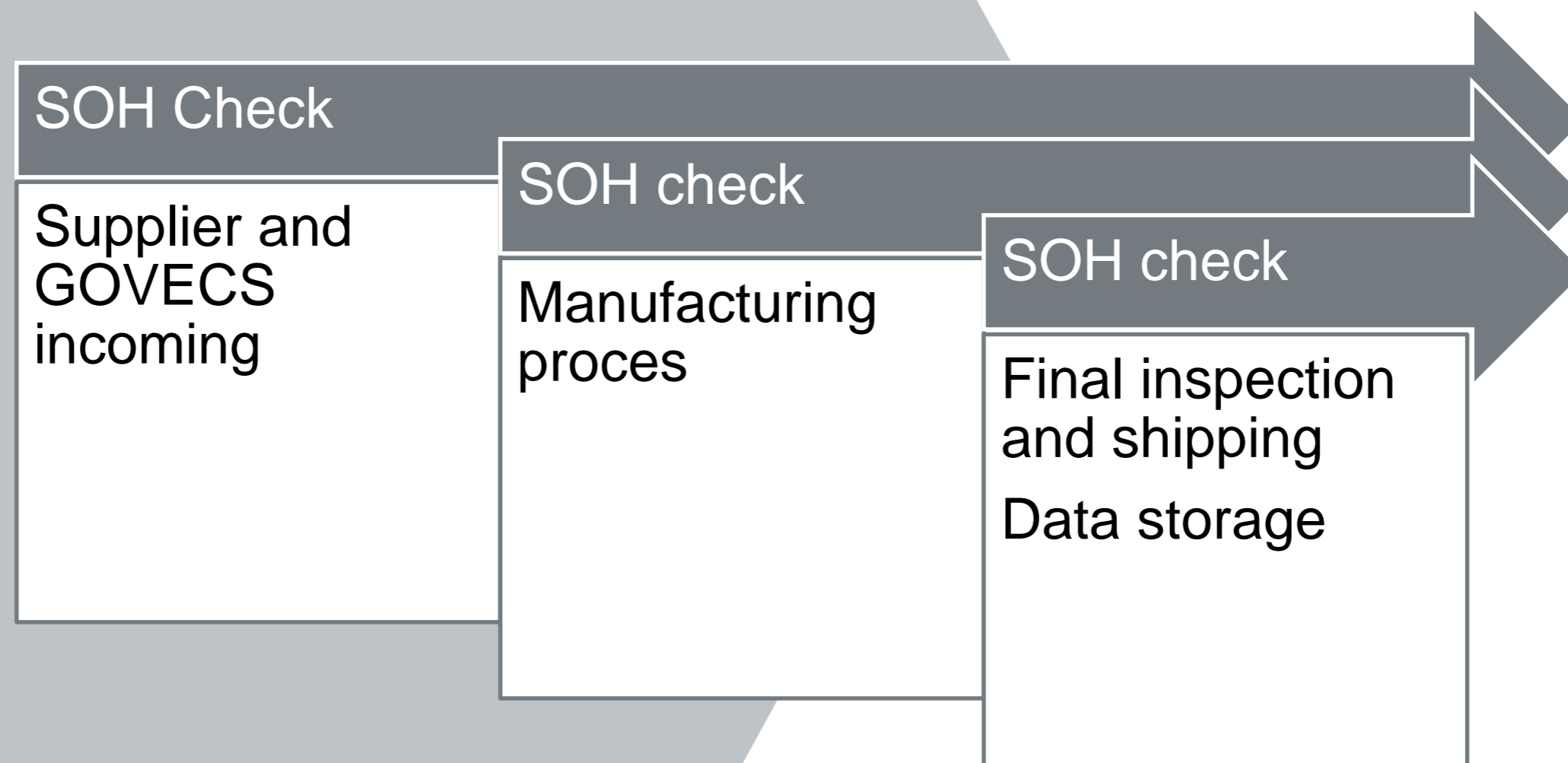
- **After battery delivery to GOVECS there is supplier's initial battery SOH notification compared to GOVECS incoming warehouse check. All potential discrepencies are notified**



# Supporting role of IT for Lithium Ion batteries transportation. ERP and cloud base system

How do we utilise ERP and cloud for battery safety monitoring?

- During entire production system battery SOH is monitored in a different stage of vehicle assembly

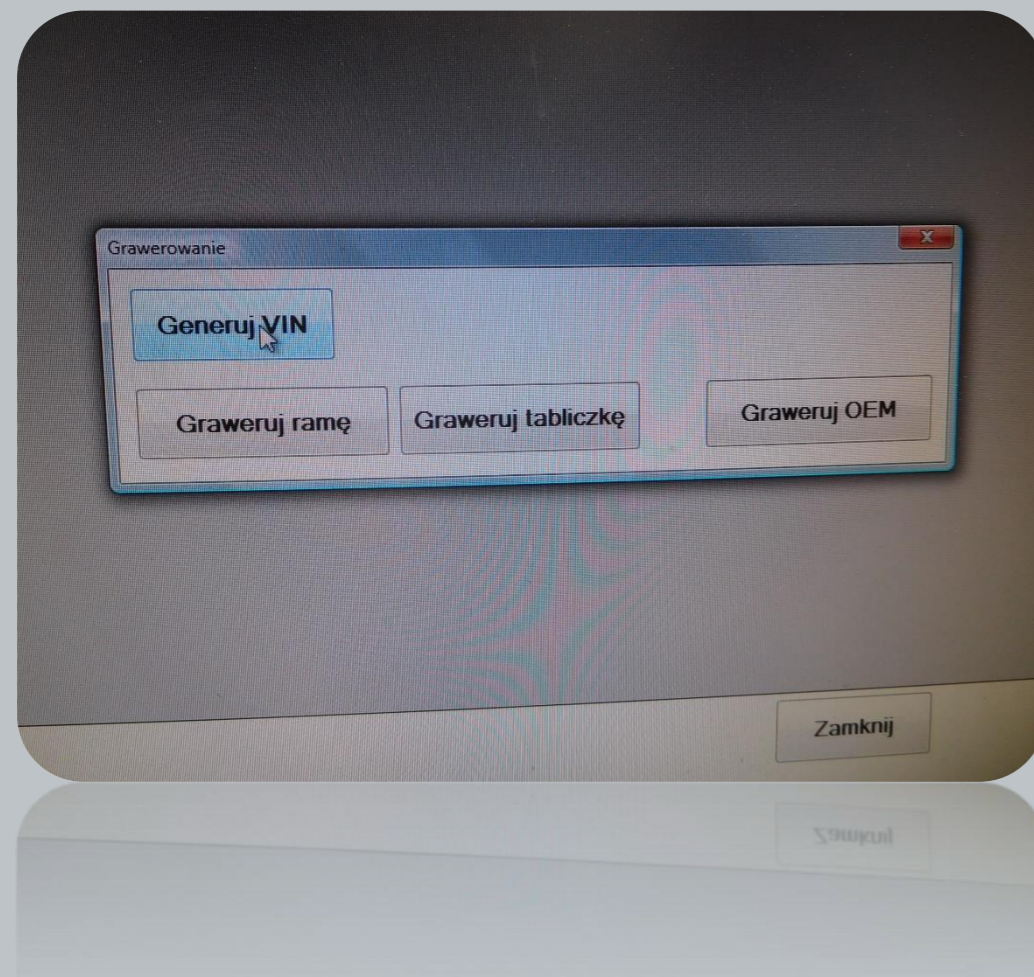




# Supporting role of IT for Lithium Ion batteries transportation. ERP and cloud base system

How do we utilise ERP and cloud for battery safety monitoring?

- During entire production system battery SOH is monitored in a different stage of vehicle assembly, battery delta is stored in the ERP system
- VIN – as a scooter reference number



# Supporting role of IT for Lithium Ion batteries transportation. ERP and cloud base system

How do we utilise ERP and cloud for battery safety monitoring?

- Next step in a battery health monitoring is to merge battery serial number and its SOH with Scooter VIN number
- Battery is treated like critical components in the scooter





# Supporting role of IT for Lithium Ion batteries transportation. ERP and cloud base system

How do we utilise ERP and cloud for battery safety monitoring?

- Battery serial number and SOH merged with a VIN



Edycja Surowca (2438; Li\_On\_Battery\_72V\_53Ah)

Ogólne Rezerwacje Koszty Związane Atrybuty

Kod: 2438 Magazyn: PROD

Nazwa: Li\_On\_Battery\_72V\_53Ah

Typ materiału:  
 Produkt  Surowiec  Materiał pomocniczy  Produkt uboczny

Towar: 2438

Nr seryjny: 2216330134

Pozycja kooperacji:

Ilość:  
Ilość: 1.0000 pcs  
Pomocnicza: 0.0000

Koszt:  
 Koszt ustalono  
Koszt: 7,495.0500  
Koszt surowca: 7,495.0500

Numer seryjny:

Rodzaj kosztu: Rzeczywisty

Waga:  
Waga kosztu: 0.00 Waga wg ilości:

Produkt uboczny:  
Rodzaj:

Kod niezgodności:

Opis:

# Supporting role of IT for Lithium Ion batteries transportation. ERP and cloud base system

How do we utilise ERP and cloud for battery safety monitoring?

- All informations about batteries ,stored in the system, are analysed before Scooters shippment



| VIN#              | Battery Serial | SOH  | Status |
|-------------------|----------------|------|--------|
| SVE2E736XHW006458 | SX13240        | 9mV  | OK     |
| SVE2E736XHW006459 | SX13247        | 20mV | OK     |
| SVE2E736XHW006460 | SX13243        | 15mV | OK     |
| SVE2E736XHW006461 | SX13245        | 60mV | NOK    |
| SVE2E736XHW006462 | SX13242        | 10mV | NOK    |



# **Supporting role of IT for Lithium Ion batteries transportation. ERP and cloud base system**

**How do we utilise ERP and cloud for battery safety monitoring?**

**Scooters are shipped and what is next?**

# Supporting role of IT for Lithium Ion batteries transportation. ERP and cloud base system

## Live market scooters's battery SOH monitoring

- **Connectivity**

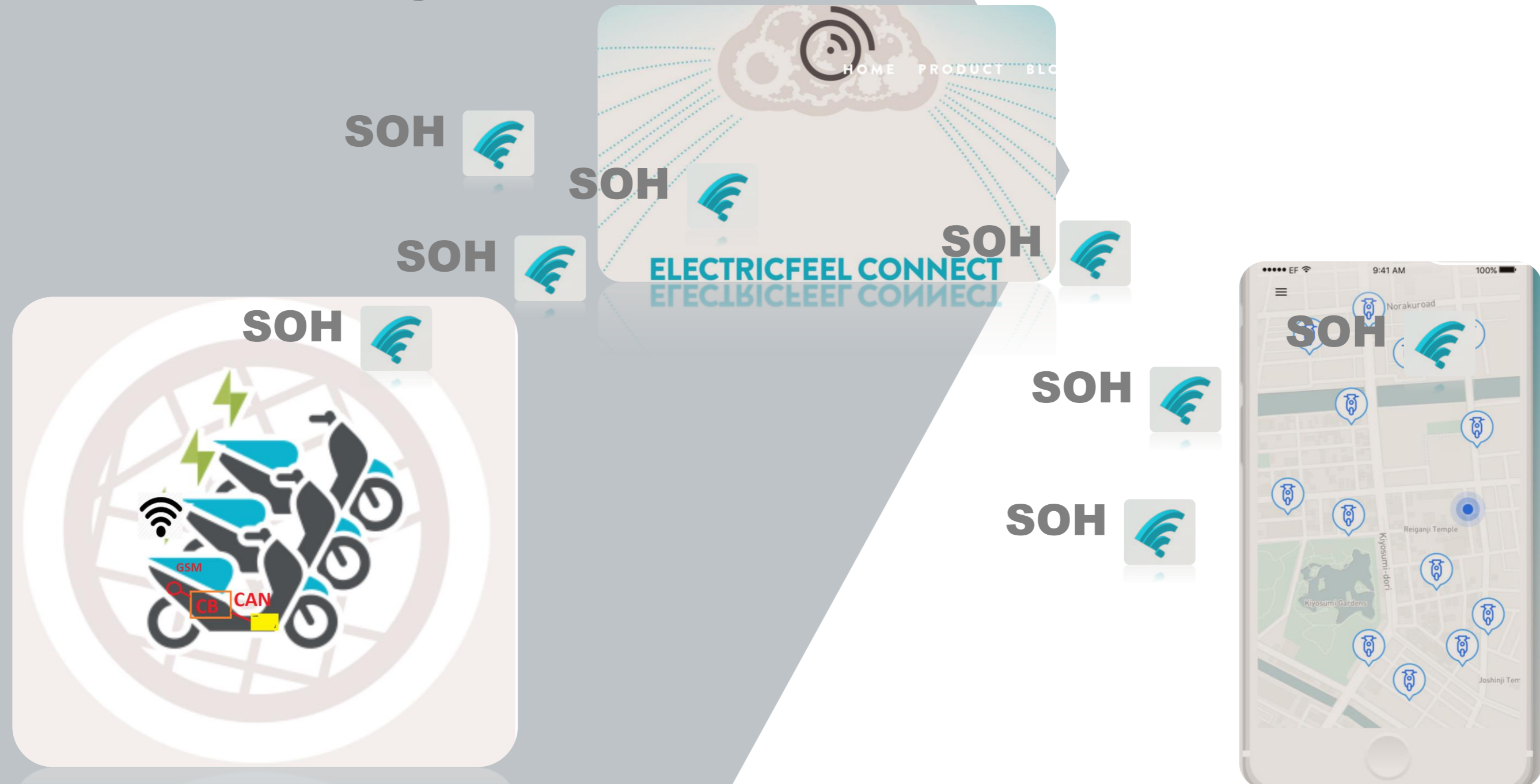




# Supporting role of IT for Lithium Ion batteries transportation. ERP and cloud base system

## Live market scooters's battery SOH monitoring

- **SOH Monitoring trough battry CAN communication with connectivity BOX**



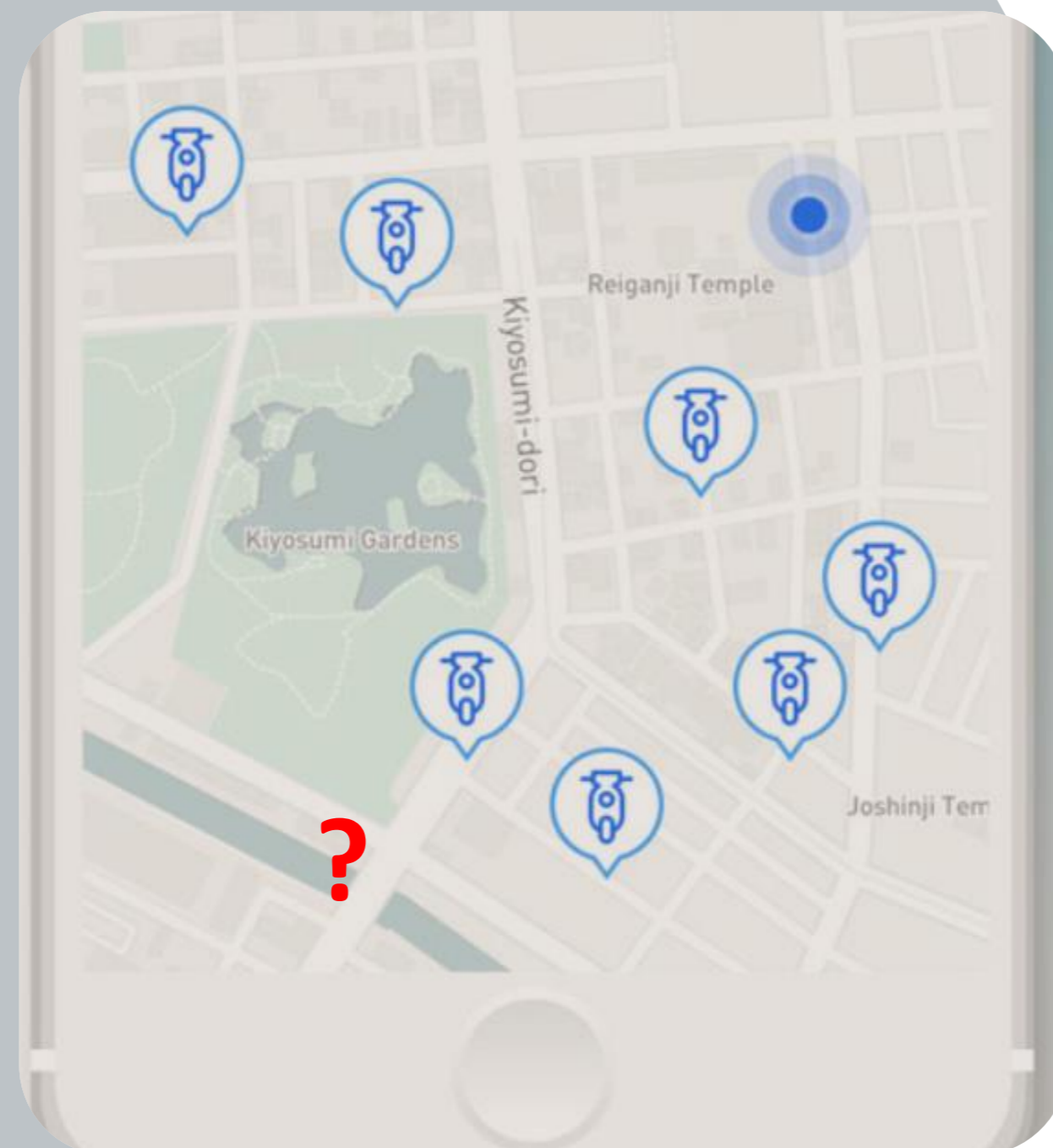




# Supporting role of IT for Lithium Ion batteries transportation. ERP and cloud base system

## Live market scooters's battery SOH monitoring

- **Data analysis**
- **With a continuous information flow we are able to monitor battery SOH in every scooter which is on the market and take preventive action**





# GOVECS GROUP

DESIGNING MOBILITY

An aerial photograph of a city, likely Wrocław, Poland, showing a dense urban landscape with many buildings and a prominent tower in the distance. The text 'THANK YOU' is overlaid in the center of the image.

# THANK YOU

## CONTACT:

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