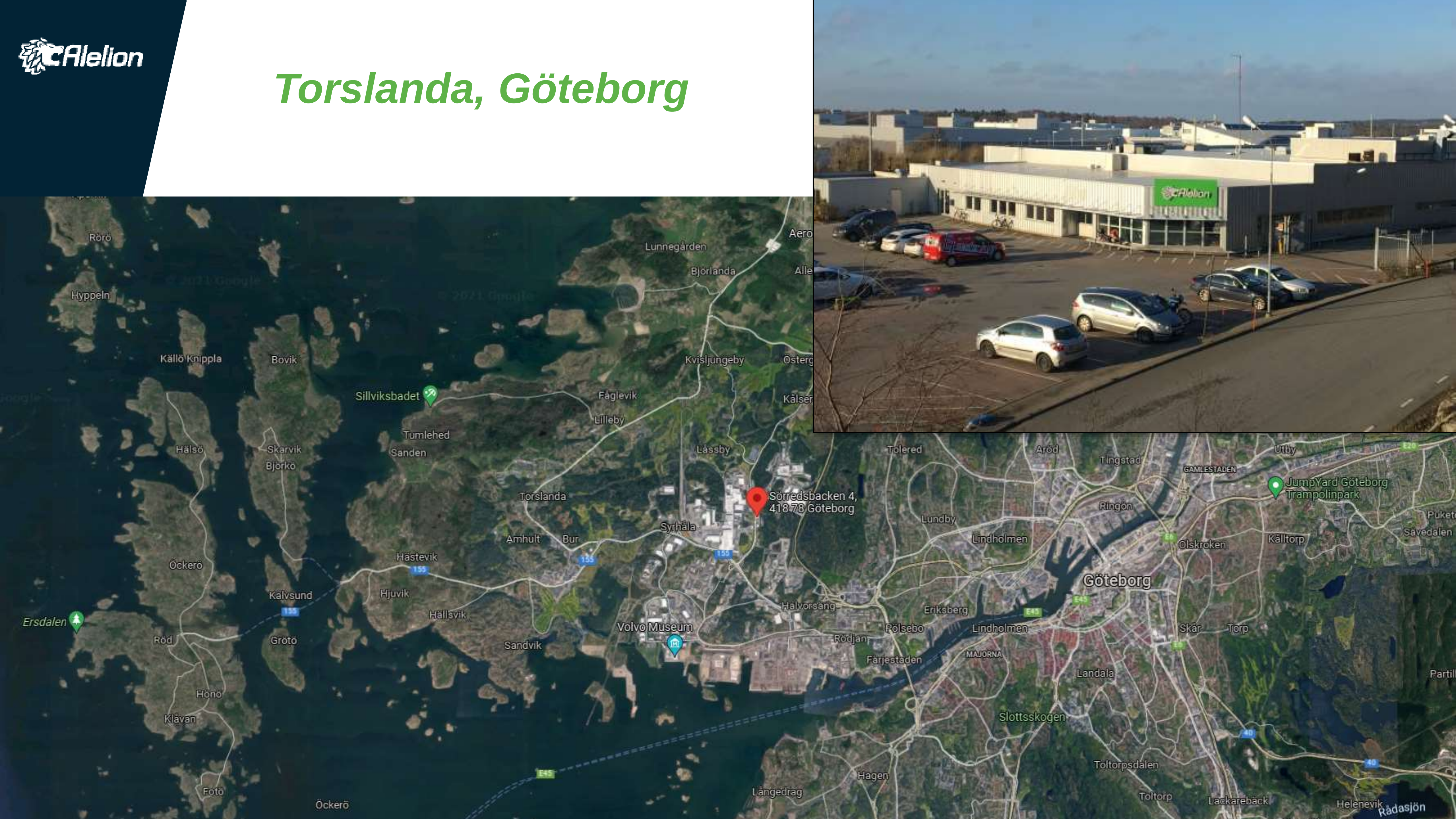
Alelion

Power to change

What does Alelion Energy System?

Peter Tammpere, Senior System Engineer

Torslanda, Göteborg



Alelion Powerhouse

- The first Lithium-Ion factory in Sweden
- Highly automated module production
- 500 MWh annual capacity
  (corresponding to 10 000 Tesla cars)

We know Lithium-Ion

- Founded 2006, Tudor Nol (Ale)
- Long experience in electrical vehicles

Alelion

Fiat 500

Teknikens Värld NYHETER + VÄLJ BIL TEST & PROVKÖRNINGAR + BILHJÄLP + PREMIUM PRENUMERERA

Landshövdingen av Västra Götalands län fick äran att ta hand om premiärturen...

Fiat 500 som elbil med svensk teknik

PUBLICERAD: 15 APR 2009, KL 14:08

2009

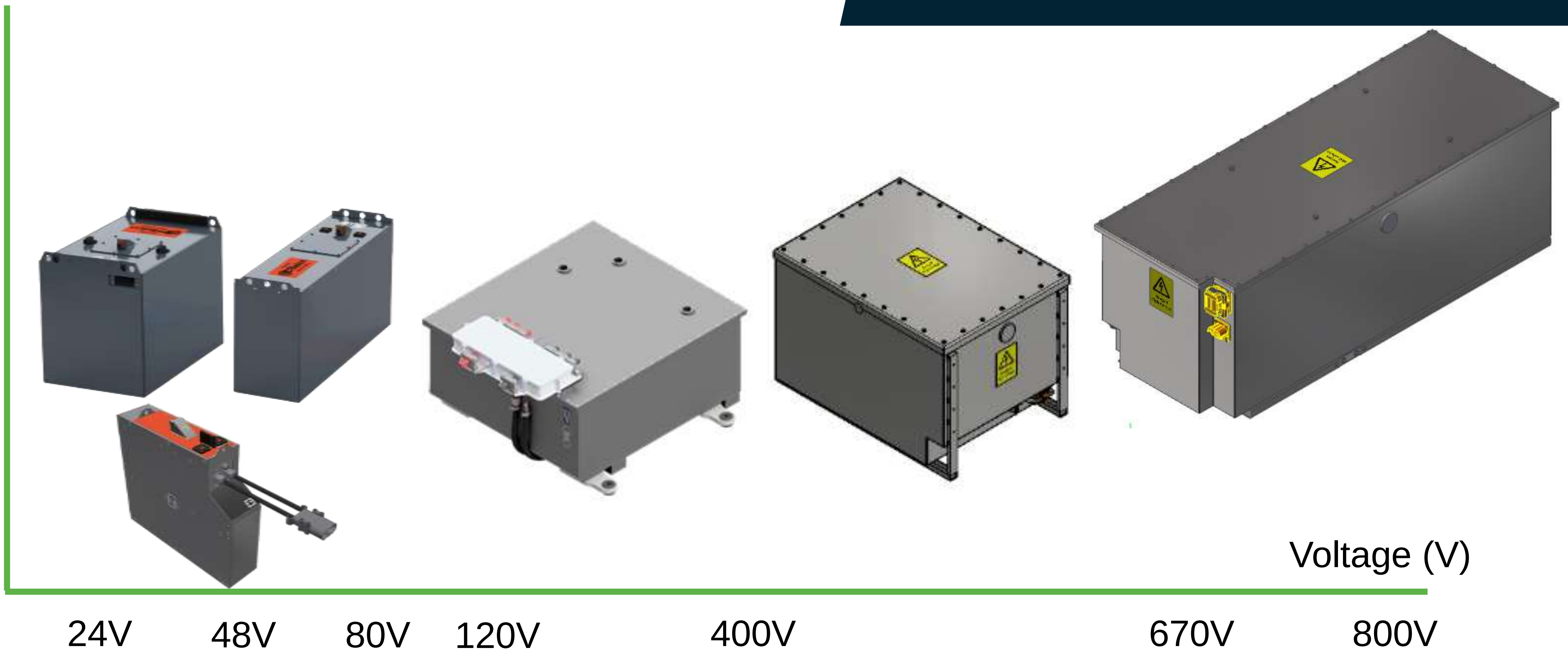
We know Lithium-Ion

- Founded 2006, Tudor Nol (Ale)
- Long experience in electrical vehicles

We are today a total provider:

- Development
- Manufacturing
- Test
- Purchasing
- Sales
- Service
- Training

Wide product range



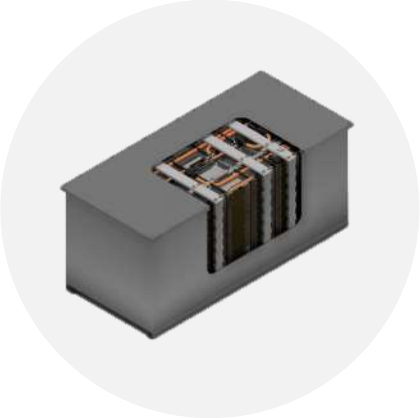
Alelion advantages

- System integration: Software and safety
- Thermal management
- Standards and certifications
- Training offer - Expertise

Value chain from cell manufacturing to customer solutions

Cell manufacturing

Cell suppliers



Battery production

Alelion
- Cell independant
- Modules
- Inhouse design

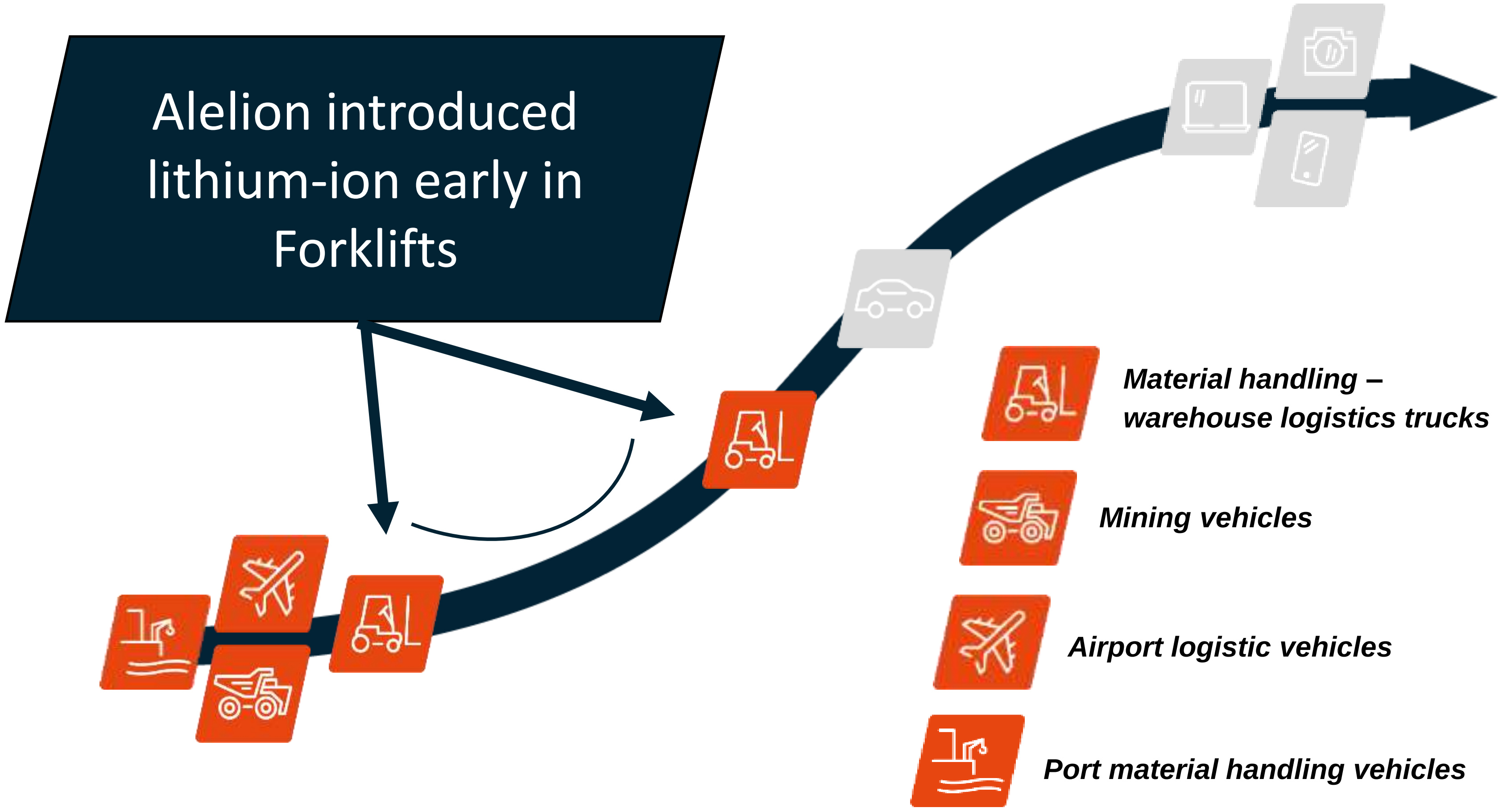
Battery system

Alelion
- Own BMS (Battery Management System)
- Extended features
- Safety
- Standards & Certifications

Application integration

Alelion & Customer
- Optimization
- Vehicle Integration
- Service & Education

Alelion segments for electrification & introduction of lithium-ion technology



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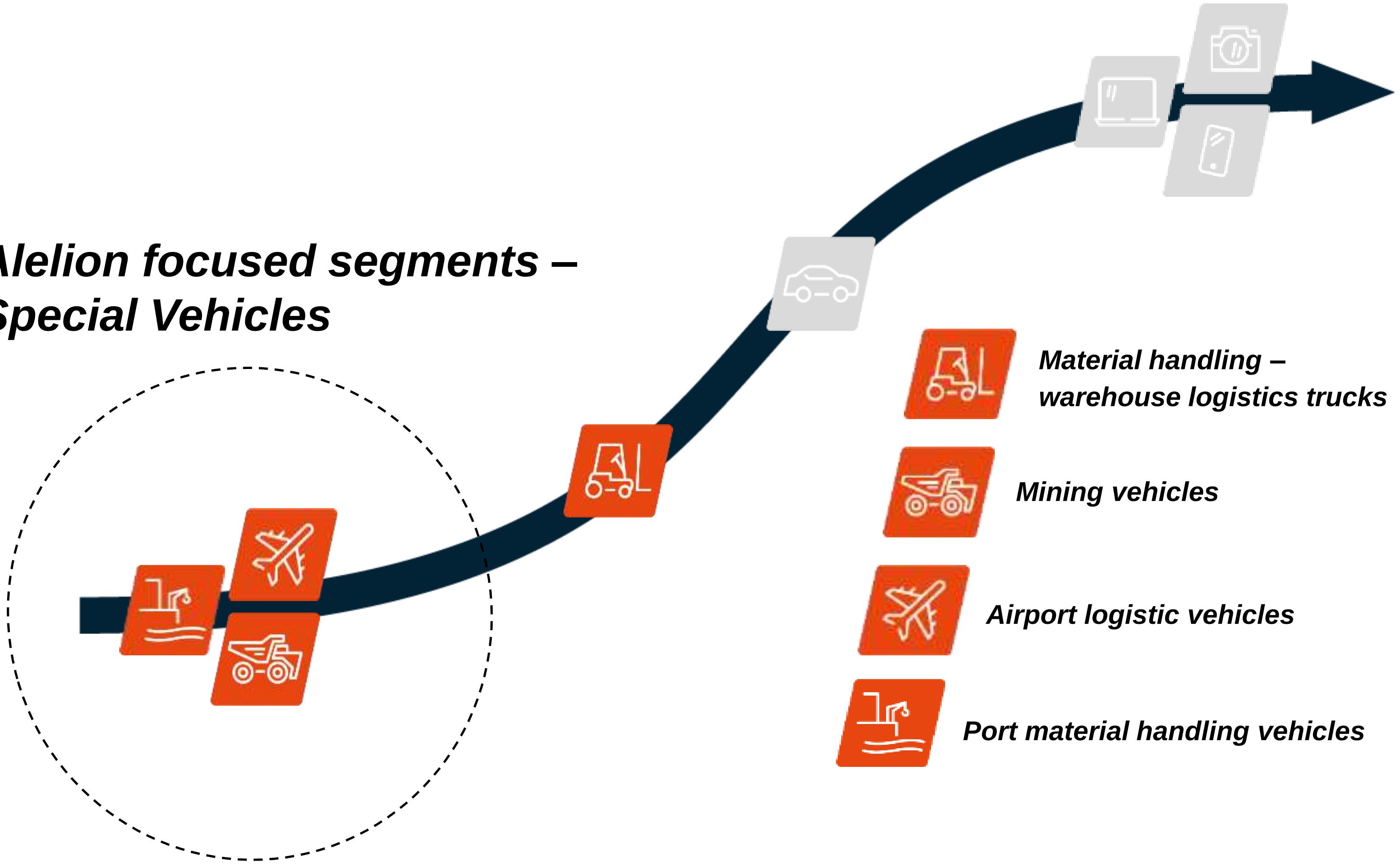
Alelion segments for electrification & introduction of lithium-ion technology

CARGOTEC
KALMAR
HIAB
HUDDIG
KAMAG
TERBERG SPECIAL VEHICLES

Alelion focused segments – Special Vehicles



Special Vehicles

LOGISTIK

Flygplats, Hamnar, Distribution tätort, Lagerhantering

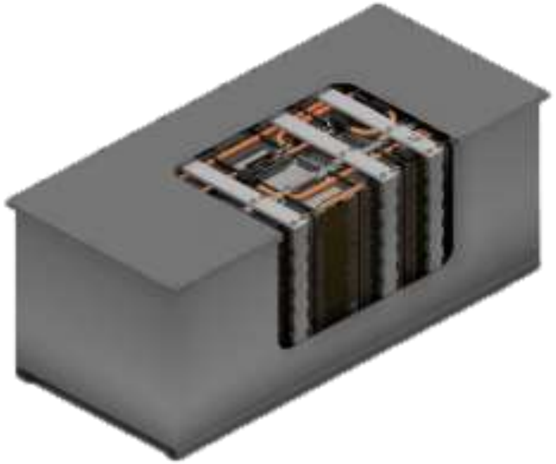
ARBETSFORDON

Gruvor, Anläggning, Kranar

Alelion guides and helps clients to succeed with their electrification of industrial vehicles.

By:

- Challenging today’s technical solutions, and
- Providing new power solutions (lithium-ion battery systems.)



Example Applications

KAMAG

Kamag
E-Catering Wiesel (ECW)

1..4 batteries

40 km/h

4500 kg load

6m elevation

45 kWh, 400 V

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TERBERG SPECIAL VEHICLES

PORT TERMINAL TRACTORS

PORT RORO TRACTORS

DISTRIBUTION TRACTORS

INDUSTRY YARD TRACTORS

Terberg YT203-EV

74 kWh, 670 V

Liquid cooling/heating

1..3 batteries per vehicle

Helsingborgs hamn

HUDDIG

Hudiksvall, Sweden

Tigon = Tiger + Lion

Backhoe loaders

PHEV

Forrest

Railroads

- Hudiksvall, Sweden
- Cranes for lorries
- ePTO is a concept in the business
- On-board 230 V AC charger
- Charge and discharge simultaneously

ePTO

Arbeta i tystnad, helt utan utsläpp

ePTO står för Electric Power Take Off, en elhydraulisk kraftkälla för kranar. Den är monterad parallellt med det traditionella motordrivna systemet, vilket gör att operatören kan arbeta med lastbilsmotorn avstängd och ändå utföra samma jobb som vanligt. ePTO innebär flera fördelar, både miljömässigt och ekonomiskt. Till exempel 60–70 % lägre energiförbrukning, 70 % lägre driftskostnader och 30 % lägre ljudnivå.

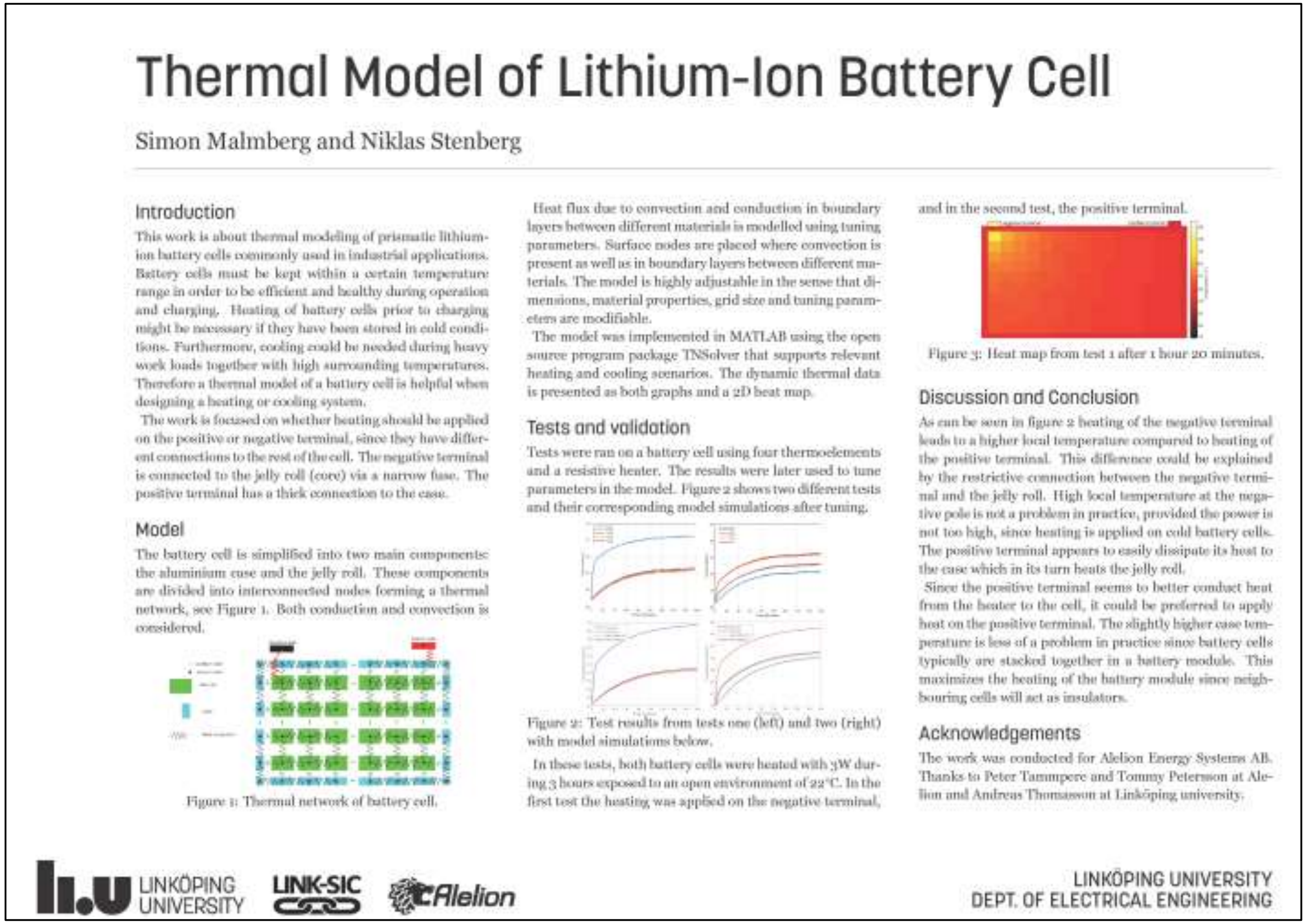
LINK-SIC Activities

Student projects

2018:	Student Summer project	- Thermal Modelling of a battery cell
2019:	Master Thesis	- Applied SOH estimation methods
2019:	Student Summer Project	- Battery Data Parser and Report Generator
2020:	Student Summer Project	- Remote logging
2021:	(No activity.)	

2018 – Thermal Modelling of a battery cell

- Better understanding of thermal properties of the cell.
- Help for some decisions on thermal design.



Thermal Model of Lithium-Ion Battery Cell

Simon Malmberg and Niklas Stenberg

Introduction

This work is about thermal modeling of prismatic lithium-ion battery cells commonly used in industrial applications. Battery cells must be kept within a certain temperature range in order to be efficient and healthy during operation and charging. Heating of battery cells prior to charging might be necessary if they have been stored in cold conditions. Furthermore, cooling could be needed during heavy work loads together with high surrounding temperatures. Therefore a thermal model of a battery cell is helpful when designing a heating or cooling system.

The work is focused on whether heating should be applied on the positive or negative terminal, since they have different connections to the rest of the cell. The negative terminal is connected to the jelly roll (core) via a narrow fuse. The positive terminal has a thick connection to the case.

Model

The battery cell is simplified into two main components: the aluminium case and the jelly roll. These components are divided into interconnected nodes forming a thermal network, see Figure 1. Both conduction and convection is considered.

Figure 1: Thermal network of battery cell.

Heat flux due to convection and conduction in boundary layers between different materials is modelled using tuning parameters. Surface nodes are placed where convection is present as well as in boundary layers between different materials. The model is highly adjustable in the sense that dimensions, material properties, grid size and tuning parameters are modifiable.

The model was implemented in MATLAB using the open source program package TNSolver that supports relevant heating and cooling scenarios. The dynamic thermal data is presented as both graphs and a 2D heat map.

Tests and validation

Tests were ran on a battery cell using four thermoelements and a resistive heater. The results were later used to tune parameters in the model. Figure 2 shows two different tests and their corresponding model simulations after tuning.

Figure 2: Test results from tests one (left) and two (right) with model simulations below.

In these tests, both battery cells were heated with 3W during 3 hours exposed to an open environment of 22°C. In the first test the heating was applied on the negative terminal, and in the second test, the positive terminal.

Figure 3: Heat map from test 1 after 1 hour 20 minutes.

Discussion and Conclusion

As can be seen in figure 2 heating of the negative terminal leads to a higher local temperature compared to heating of the positive terminal. This difference could be explained by the restrictive connection between the negative terminal and the jelly roll. High local temperature at the negative pole is not a problem in practice, provided the power is not too high, since heating is applied on cold battery cells. The positive terminal appears to easily dissipate its heat to the case which in its turn heats the jelly roll.

Since the positive terminal seems to better conduct heat from the heater to the cell, it could be preferred to apply heat on the positive terminal. The slightly higher case temperature is less of a problem in practice since battery cells typically are stacked together in a battery module. This maximizes the heating of the battery module since neighbouring cells will act as insulators.

Acknowledgements

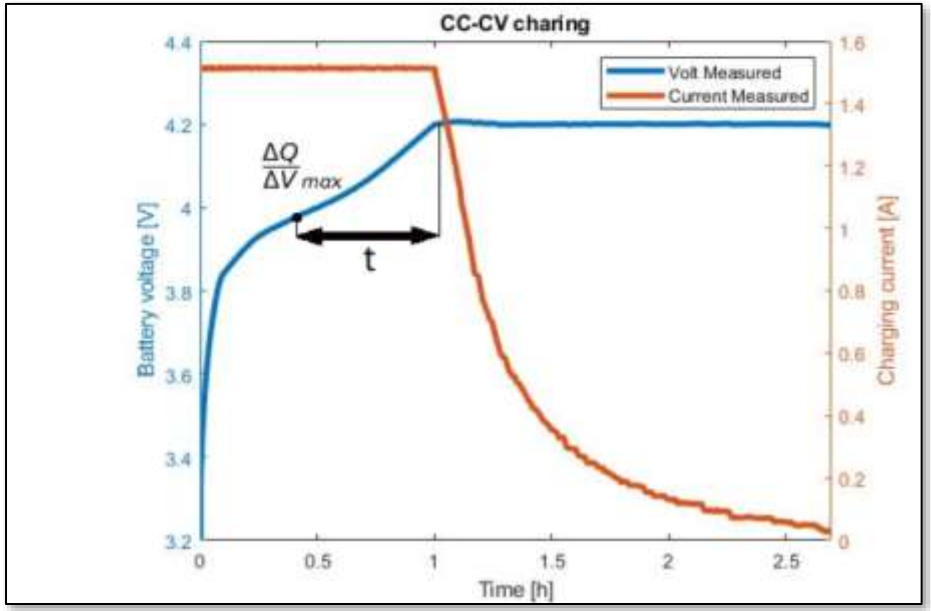
The work was conducted for Alelion Energy Systems AB. Thanks to Peter Tammpere and Tommy Petersson at Alelion and Andreas Thomasson at Linköping university.

LINKÖPING UNIVERSITY LINK-SIC Alelion

LINKÖPING UNIVERSITY
DEPT. OF ELECTRICAL ENGINEERING

2019 – Applied SOH estimation methods

- Novel idea with high potential
- Patent application



Master of Science Thesis in Electrical Engineering
Department of Electrical Engineering, Linköping University, 2019

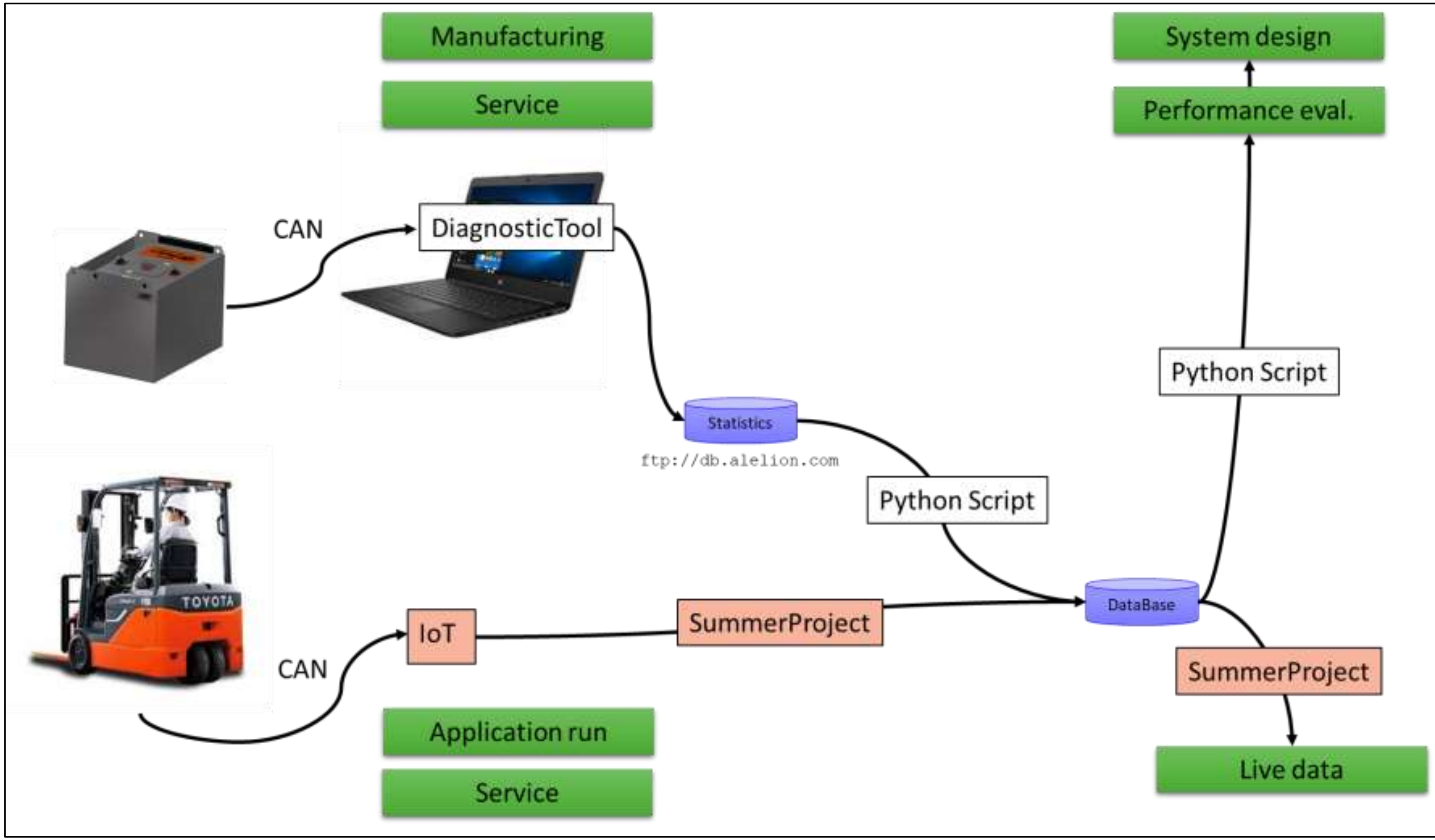
Applied State of Health Estimation Methods for Lithium-ion Batteries

Simon Malmberg

LINKÖPING UNIVERSITY

2019, 2020 – Experiments with IoT and data processing

- Learning



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Challenges

- Mastering data collection and analysis
- Battery cell electrical characterisation
  - Fast (in production line)
  - Slow (in field)
- Thermal management

Alelion is a power solution provider that helps you succeed with your electrification.

We have and give the power to change.