THURGAUER
TECHNOLOGIE
FORUM

Innovationsimpuls

Energiespeicher-Technologien & ihre Anwendungsmöglichkeiten

Amriswil, 20.03.2025

Träger

IHK Industrie- und Handelskammer Thurgau

GEWERBE THURGAU

Thurgau

Hauptsponsor

Thurgauer Kantonalbank

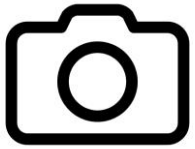
PROGRAMM

THURGAUER TECHNOLOGIE FORUM

▪ Einführung:	Andreas Kaiser / Thurgauer Technologieforum
▪ Grundlagenreferat:	Martin Stöck / FH OST
▪ Praxisbeispiel:	Adrian Kummer / Wunderli Electronics
▪ Praxisbeispiel:	Lukas Krüsi / Styromat AG
▪ Diskussion mit Q&A	
▪ Apéro & Networking	

HINWEIS

THURGAUER TECHNOLOGIE FORUM

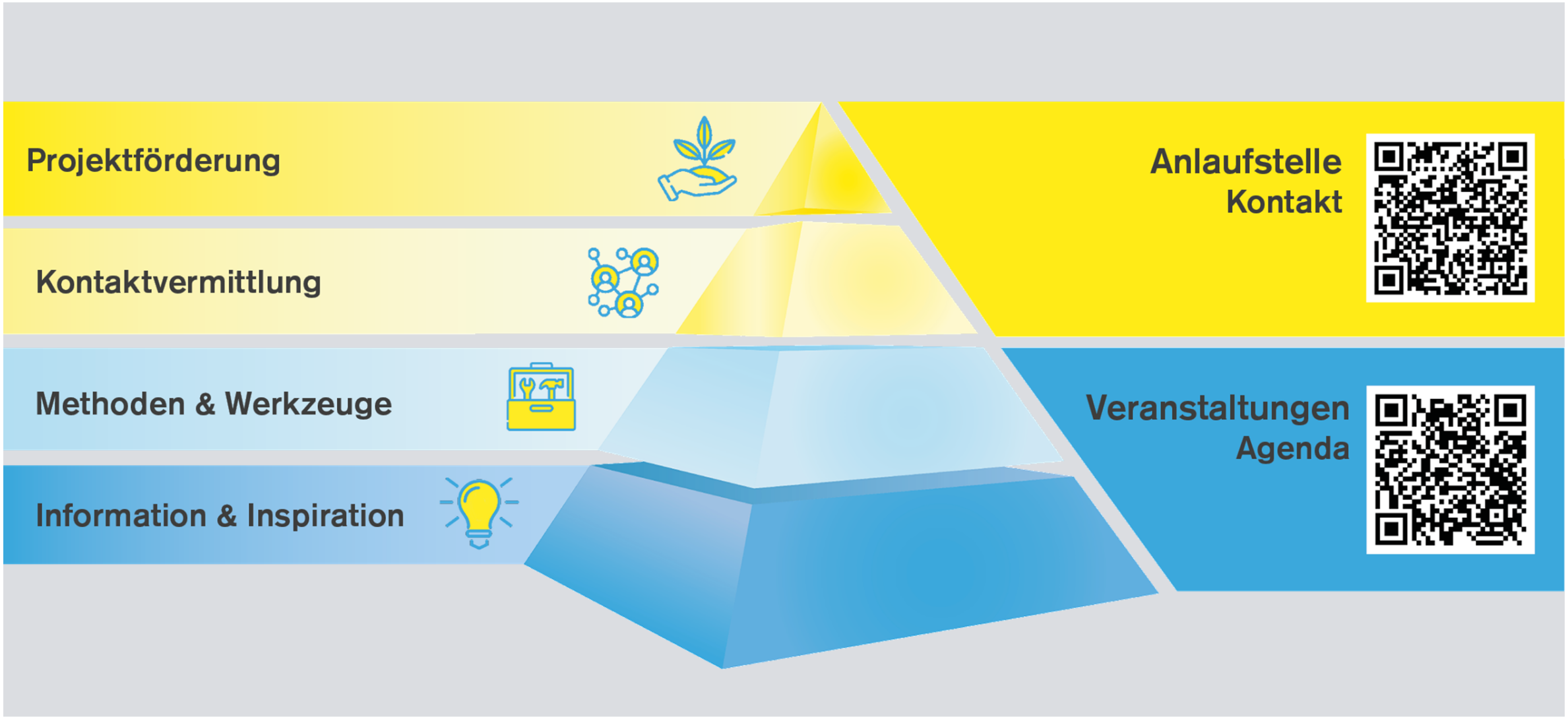


Wir machen einige Fotos für unsere Kommunikation.

Präsentation wird auf der Website aufgeschaltet.
(www.technologieforum.ch)

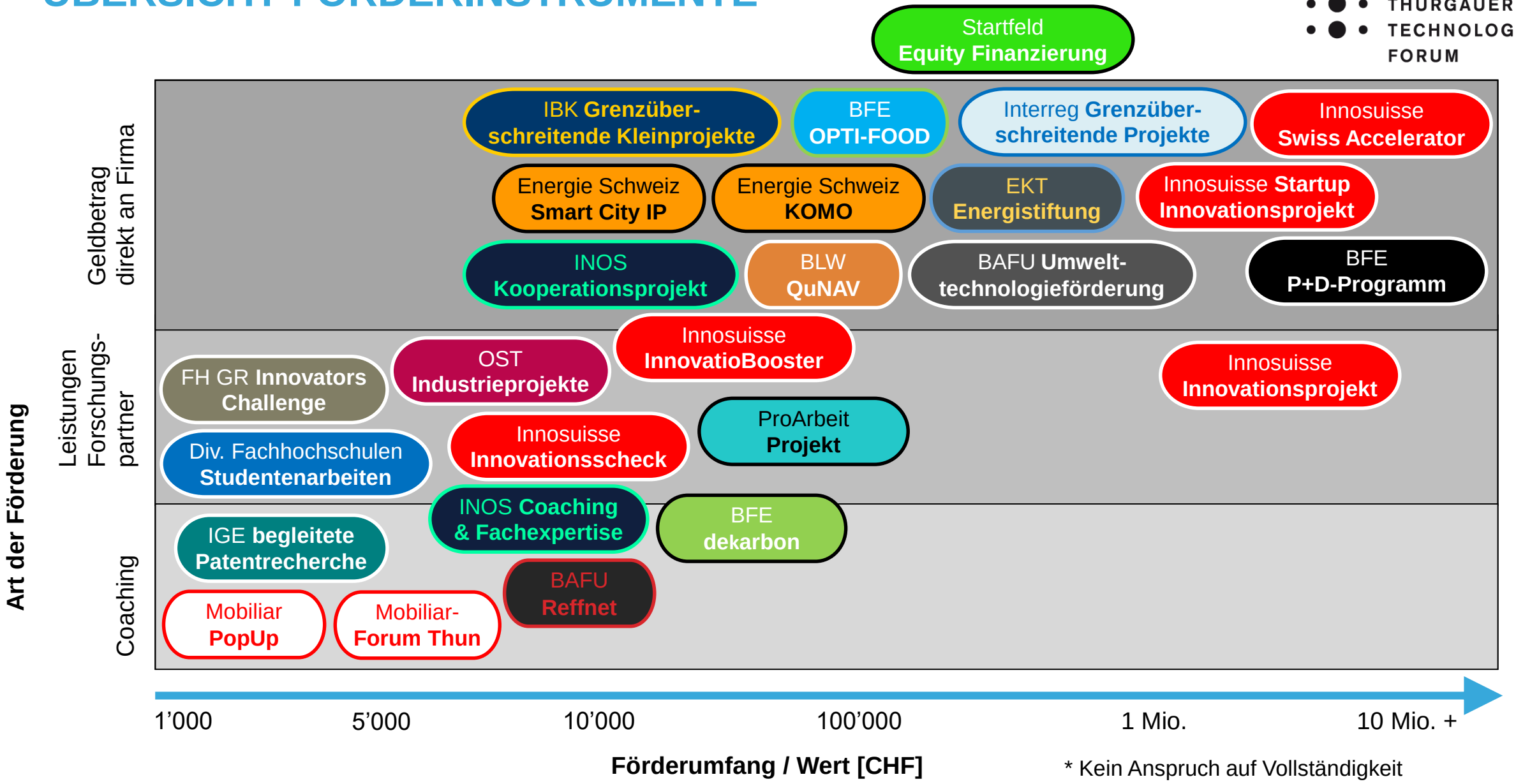
BEDÜRFNISORIENTIERTES ANGEBOT IN VIER STUFEN

THURGAUER TECHNOLOGIE FORUM



ÜBERSICHT FÖRDERINSTRUMENTE*

THURGAUER TECHNOLOGIE FORUM



* Kein Anspruch auf Vollständigkeit

IHRE ANSPRECHPARTNER

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Battery as Innovation enabler

Martin Stöck

26. März 2025

OST / EMS / Battery-Lab

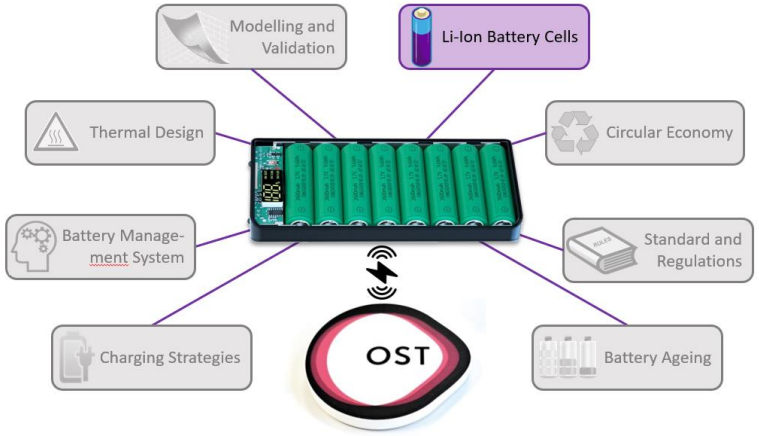
OST
Ostschweizer
Fachhochschule

WO WISSEN WIRKT.

Agenda: Batteries enabling Innovations

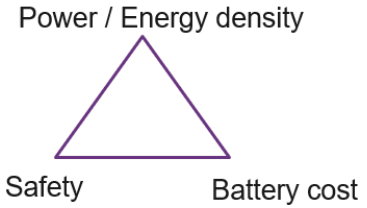
- Intro

- Batteries as enabler of Innovations - History

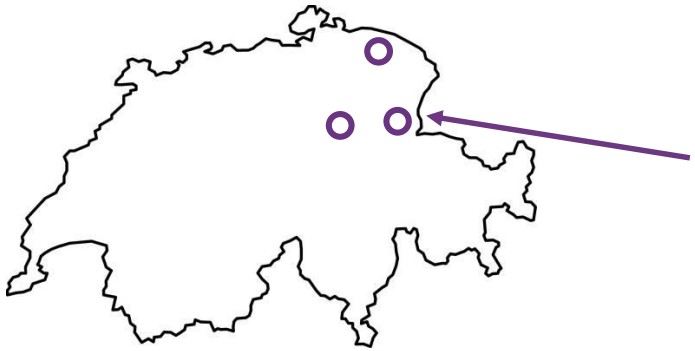


- How to design a Battery-Pack – the most important Steps:

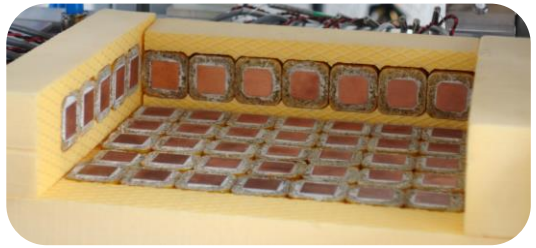
- Future Trends in Batterie Technology



OST & EMS



- **Institut EMS – Entwicklung Mechatronischer Systeme**
  - Batterie
  - Robotik



Head of Battery Research Group OST

- Martin Stöck
- Apprentiship - Physic Laboratory Assistent
- Bachelor & Master in Microtechnic EPFL
- PHD at ETH
- Head of BU – Powertrain at BRUSA
- Vice CTO & Teamleader Motor development at ThyssenKruppPresta AG
- Professor at OST (Team of 5 people)

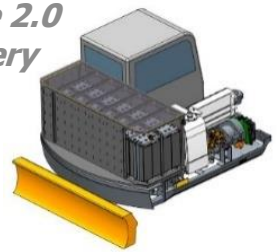
History: EV & Battery of EMS

Batteries

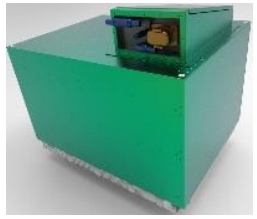
Air-Water cooled

Water cooled, 16 kWh, flat

Bagger-Batterie 2.0
200 kWh Battery



Inductive Charging 22 kW

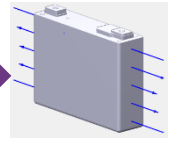


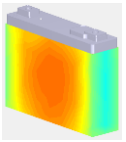
E-Dumper Batt.

133 kWh
LKW Battery

Water cooled

sccer mobility





SCCER Cell-Test-Rig

2007 2010 2014 2015 2017 2019 2020 2022

New Prof. Martin Stöck since 2.2022

Applications

Brusa Spider

SUNCAR

ETH Zürich

Skoda Octavia

Solar-preis 2015

16t Solar
8h autonomous

E-Dumper

Range-Extender

Lotus Evora

BMW SUV
with Steer-by-Wire

E-Traktor

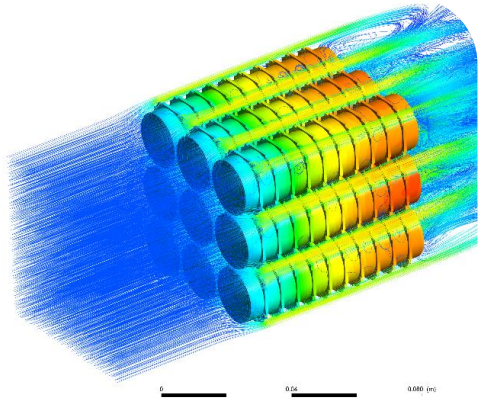
E-Motorrad

OST

Skills

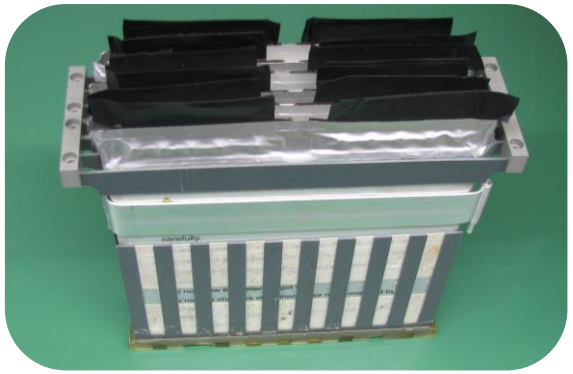
Thermal Simulation FEM

- Thermal CFD Simulation
- Thermal FEM Simulation



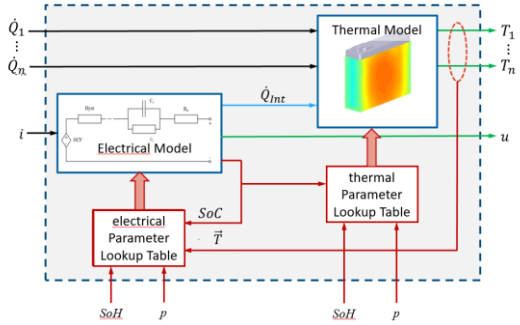
Battery Prototyping

- Prototyping capability of battery backs
- BMS
- Safety features for battery



Digital Twin of Battery

- Thermal electrical digital twin of battery cell
- Digital Twin in Simulink

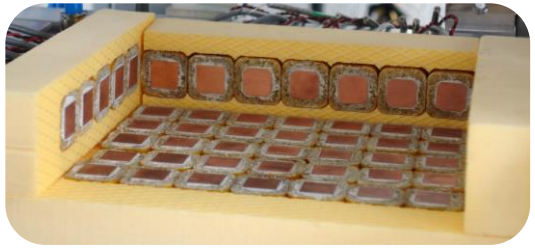


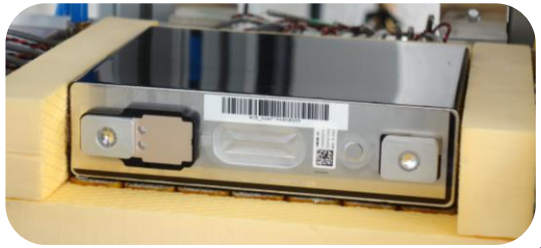
Measurement Equipment

- Large amount of measurement equipment
- Acquisition systems
- A lot of Sensors

Equipment for battery tests / prototyps

CTR 2: Thermal & Electrical Characterisation of pouch cell



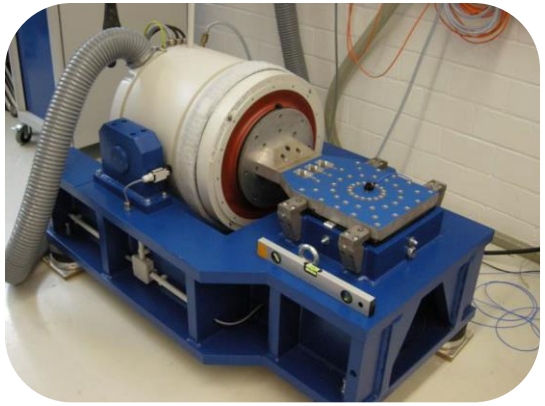


Climatic chambers

- Climatic chambers with special safety equipment for battery tests
- Up to 1800A

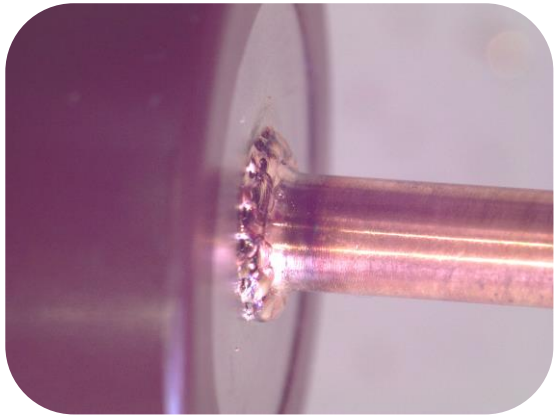
Mechanical testing

- Shaker for mechanical cell aging tests
- Shaker for batter pack validation



Welding

- Development of welding process with "no" heat impact into cell
- Fully automised for quality assurance
- For research purpose



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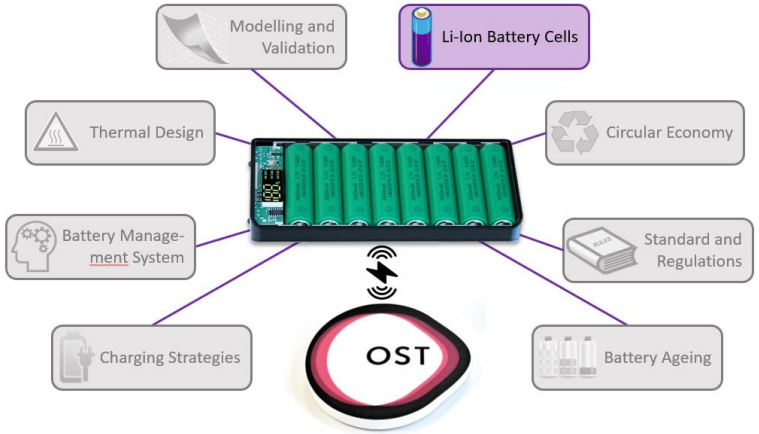
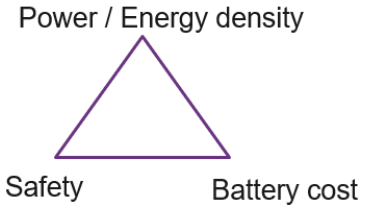
- Batteries as enabler of Innovations - History
- How to design a Battery-Pack – the most important Steps:

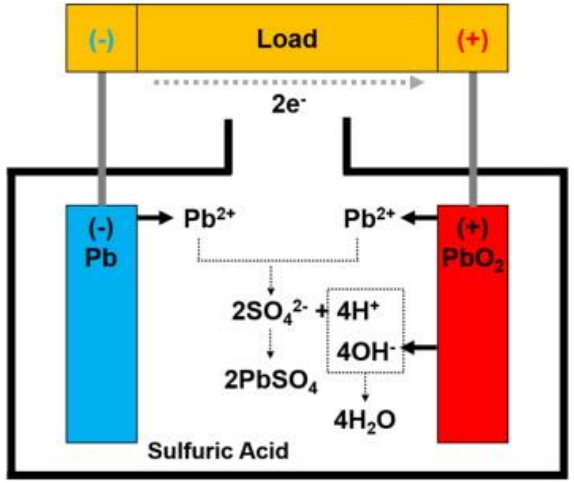


- Future Trends in Batterie Technology



Source: https://www.youtube.com/watch?v=3CCG7__rQqU
https://doi.org/10.1016/j.pecs.2015.01.002

1859 First recharable battery – lead acid battery 60Wh/l



Negative electrode:

$Pb \rightleftharpoons Pb^{2+} + 2e^-$

$Pb^{2+} + SO_4^{2-} \rightleftharpoons PbSO_4$

Positive electrode:

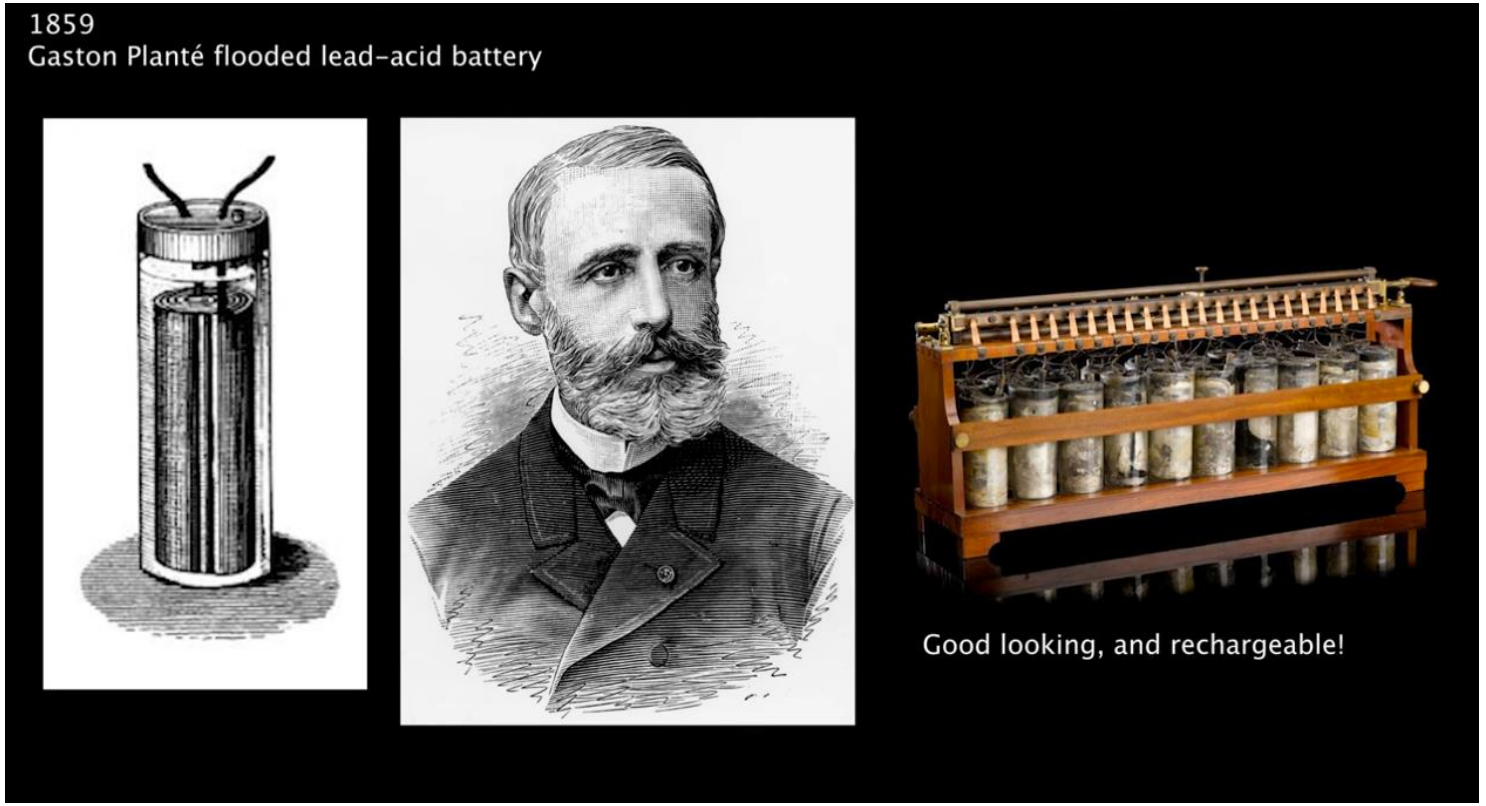
$PbO_2 + 4H^+ + 2e^- \rightleftharpoons Pb^{2+} + 2H_2O$

$Pb^{2+} + SO_4^{2-} \rightleftharpoons PbSO_4$

Overall reaction:

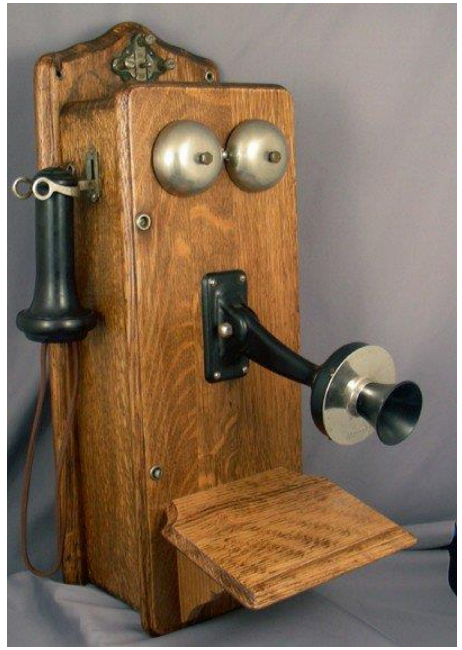
$Pb + PbO_2 + 2H_2SO_4 \rightleftharpoons 2PbSO_4 + 2H_2O$

Oxyd.	Red.	E^0(V)
PbO_2	Pb^{2+}	1,46



Lead Acid battery as enabler for telegraph & telephones

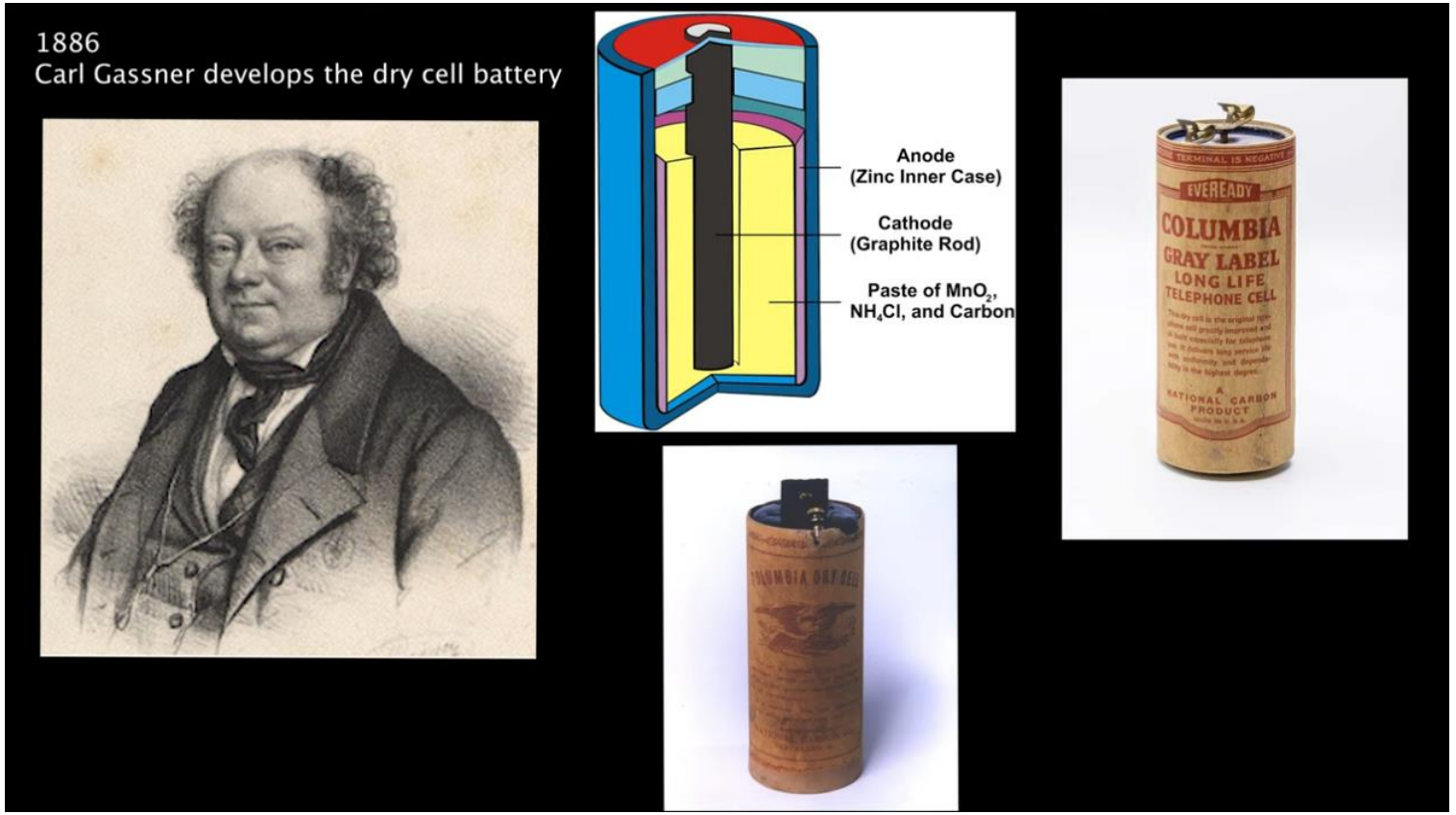
- Electric generators as we know them today were not yet developed, telegraph systems primarily relied on batteries for power
- No Grid developed yet or unstable



Source: https://www.youtube.com/watch?v=3CCG7__rQqU

1886 Zn-Graphite Battery (100Wh/l)

- First battery without fluid, could be used in any position.
- No maintenance
- Smaller sizes than Lead-acid



Source: https://www.youtube.com/watch?v=3CCG7__rQqU

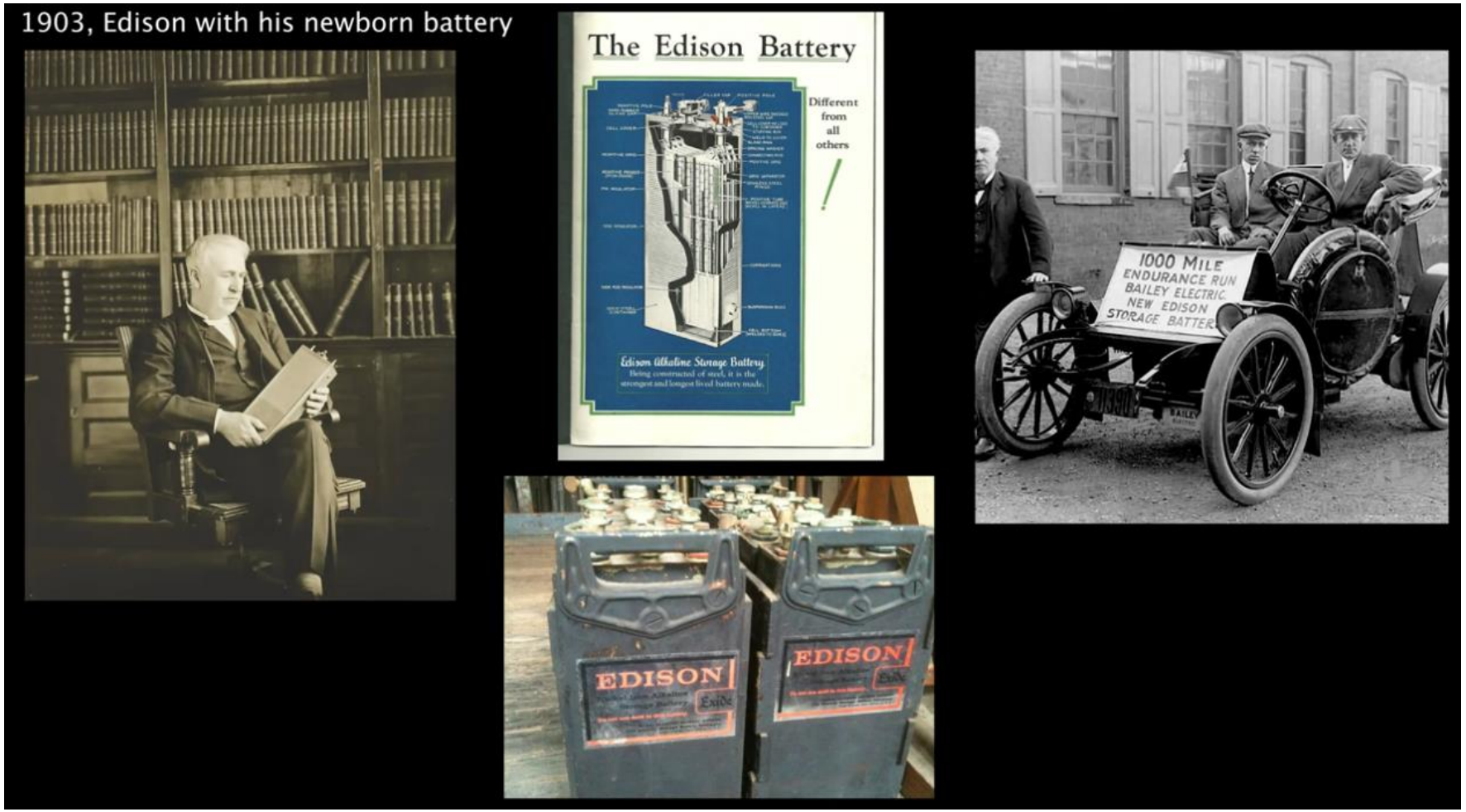
1899 The dry cell enabled the flash light

- 1899: First Flashlight

Source: https://www.youtube.com/watch?v=3CCG7__rQqU

1903: Nickel-Iron Battery (80Wh/l)

- NiFe batteries are known for their robustness
- Reliable
- High durability and lifespan
- Generally high safety



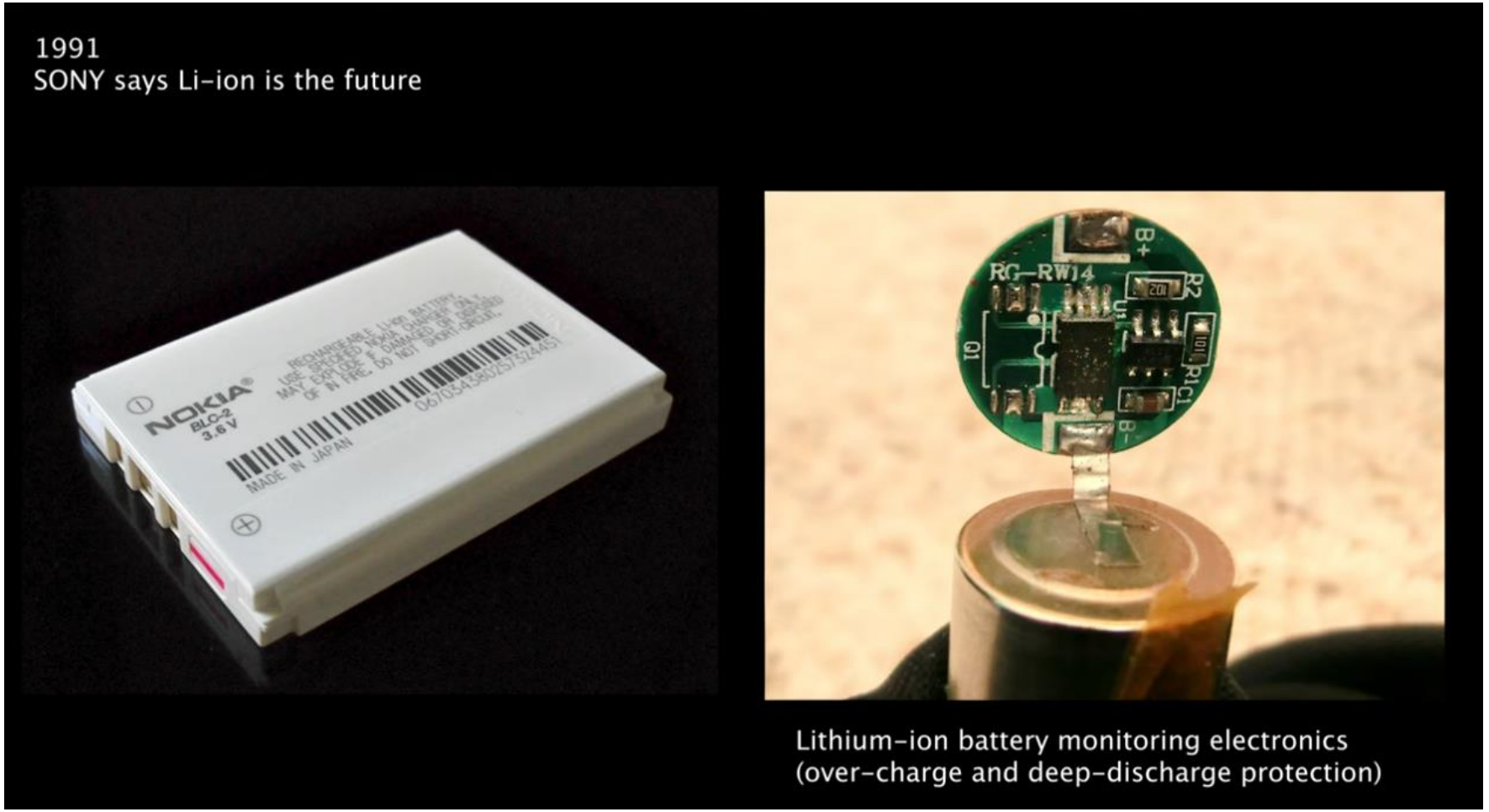
Nickel-Iron Battery Applications

- Railroad Signalling and Communications
- Emergency Lighting and Power Systems
- Mining and Heavy Industry
- Stationary Power Storage

Source: https://www.youtube.com/watch?v=3CCG7__rQqU

1991: Li-Ion (250 to 680Wh/l)

- High Energy - or Power - Density



https://physicsworld.com/a/lithium-i
batteries-break-energy-density-reco

Energy density vs time

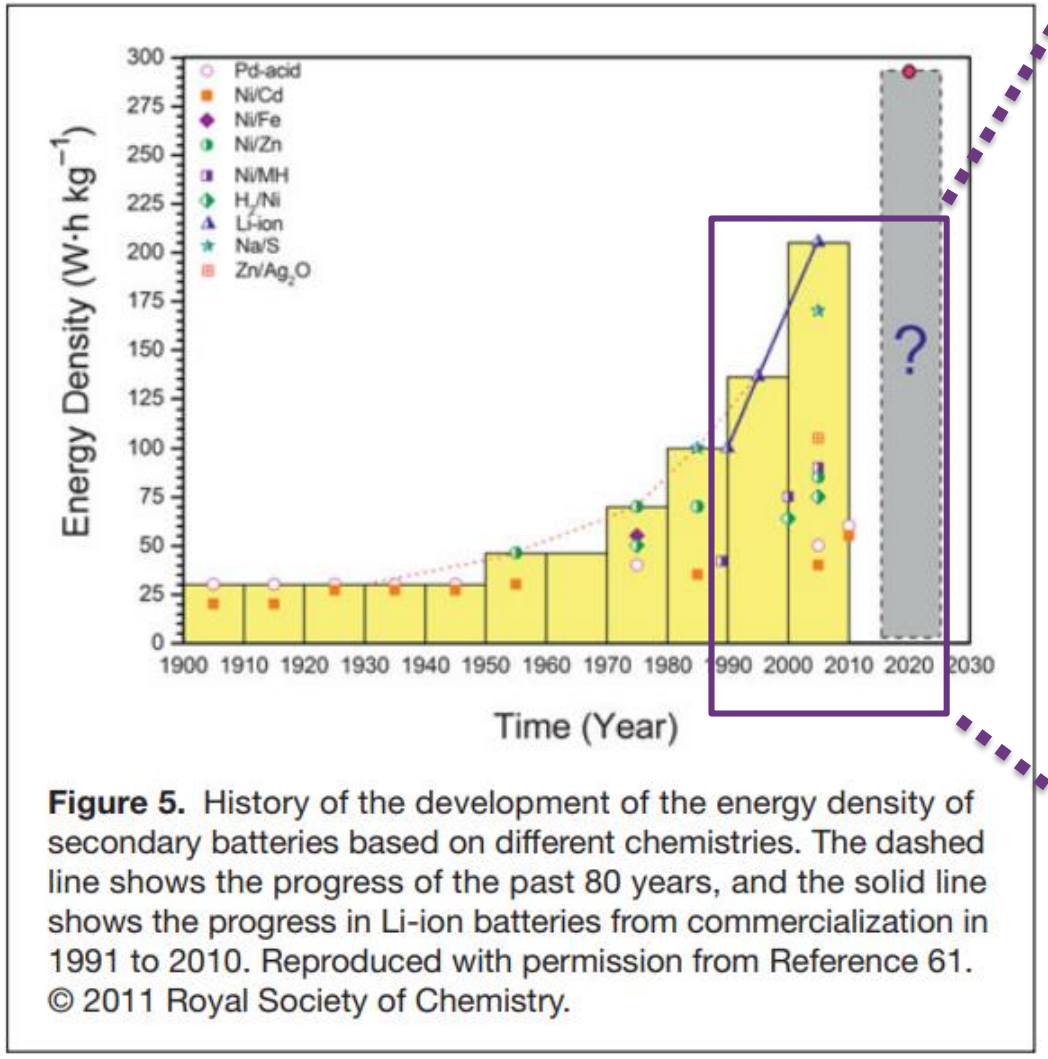
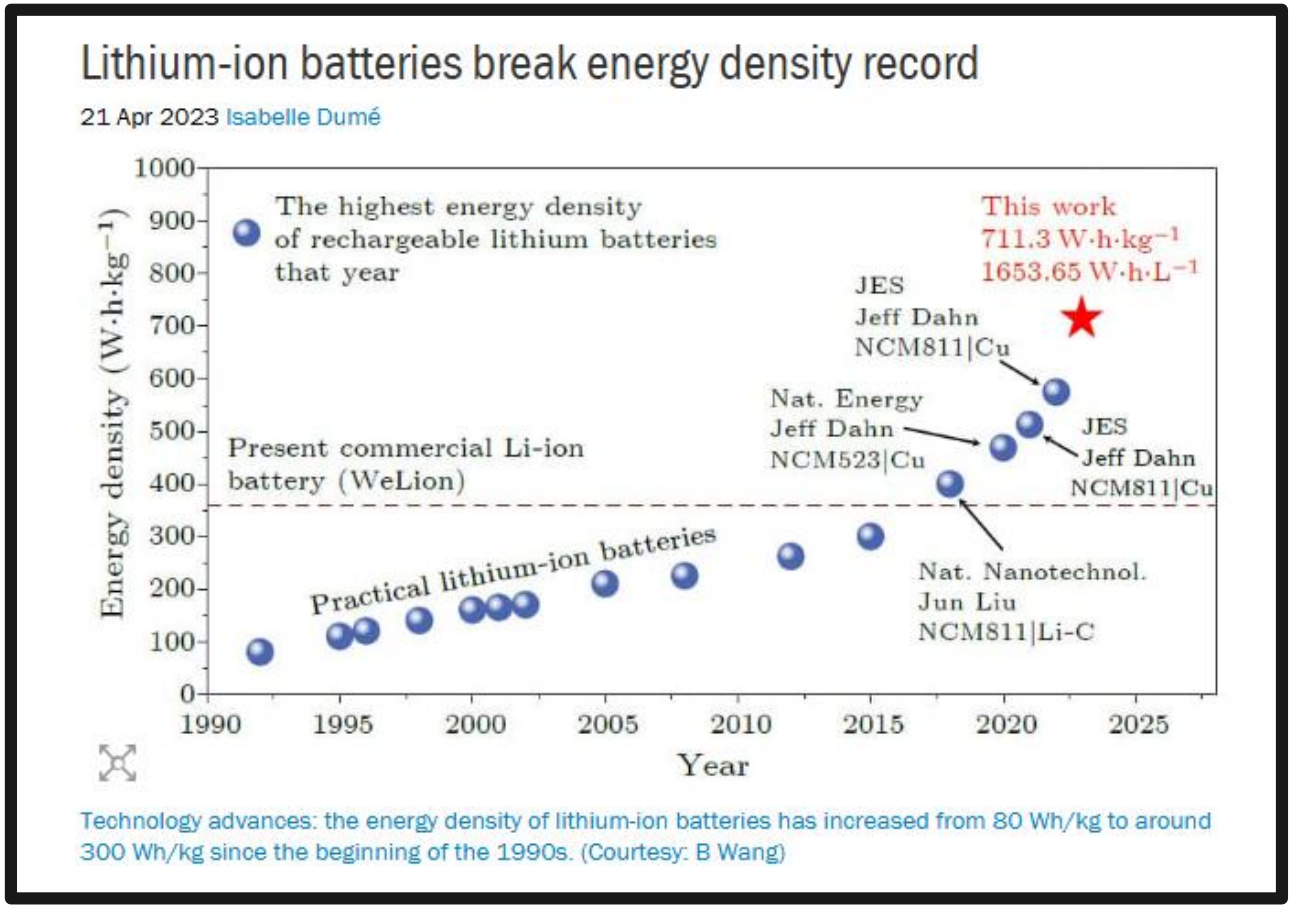


Figure 5. History of the development of the energy density of secondary batteries based on different chemistries. The dashed line shows the progress of the past 80 years, and the solid line shows the progress in Li-ion batteries from commercialization in 1991 to 2010. Reproduced with permission from Reference 61. © 2011 Royal Society of Chemistry.



https://brassicgamer.blogspot.com/2018/11/toshiba-t1000-part-one-profile-history.html
https://www.cultofmac.com/apple-history/first-generation-ipad-unveiled

Li-Ion Applications

- 1985 - Nickel-cadmium

- Toshiba-t1000

- 1991 - Li-Ion

- Apple PowerBook 100

- 2010 - Li-Ion

Patent 2004

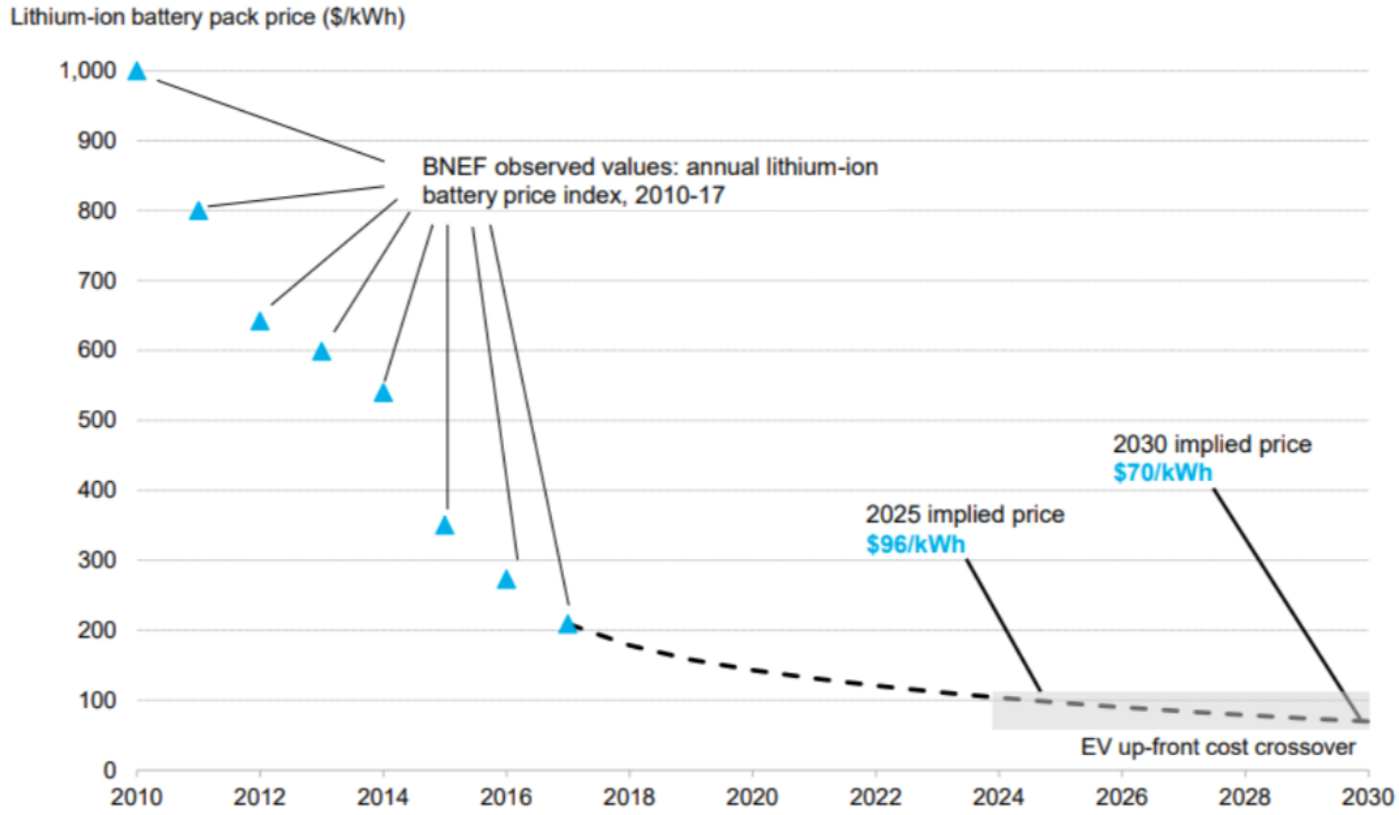
- First I Pad

https://www.researchgate.net/publication/350690343_Carbon_Purchase_Agreements_Dactories_and_Supply-Chain_Innovation_What_Will_It_Take_to_Scale-Up_Modular_Direct_Air_Capture_Technology_to_a_Gigatonne_Scale

Li-Ion mass production – enabler for EV

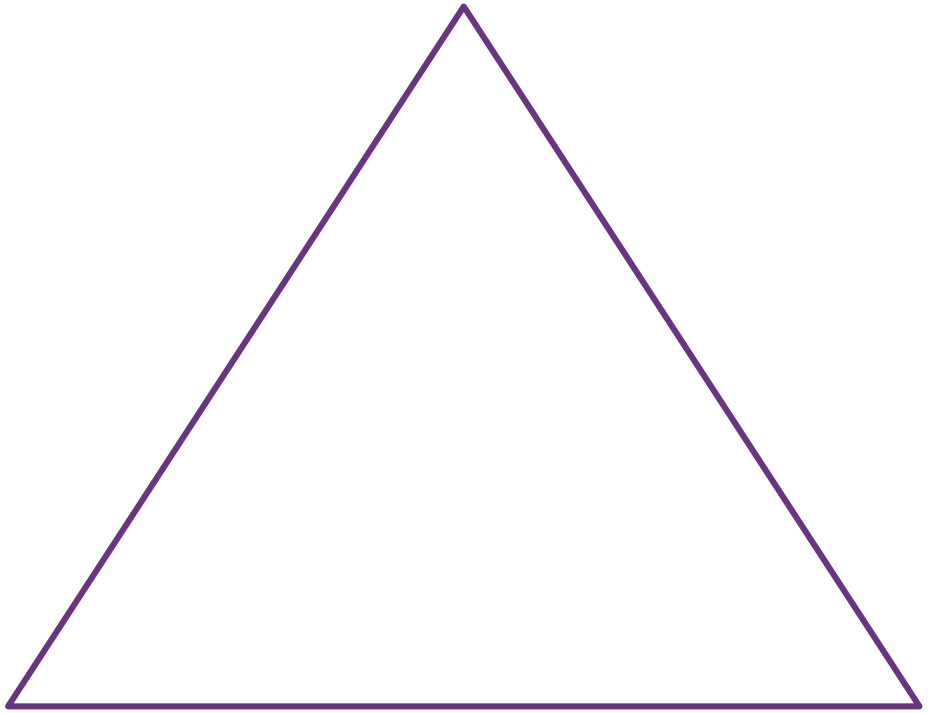
- Every Week a Giga-Factory opens in China!
- Giga = 10^9 Wh => 100 Mio. 18605 Zellen => 3 per second!

10Wh



Source: Bloomberg New Energy Finance

Summary



Innovation potential in your company?

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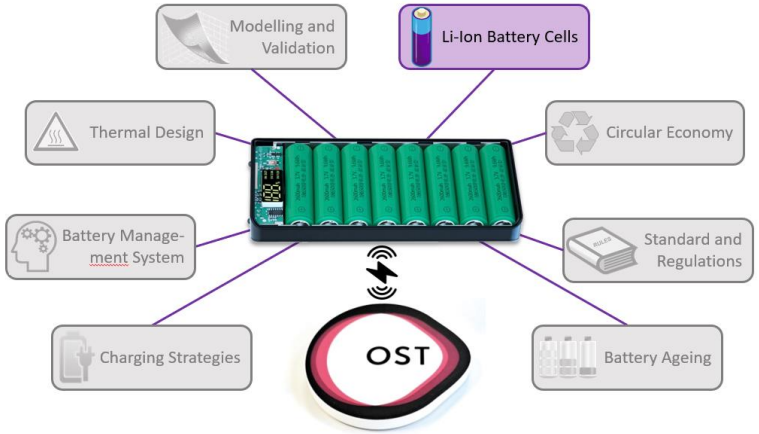
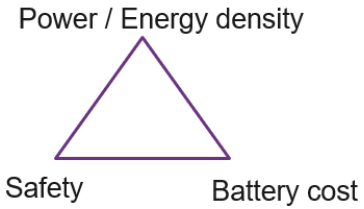
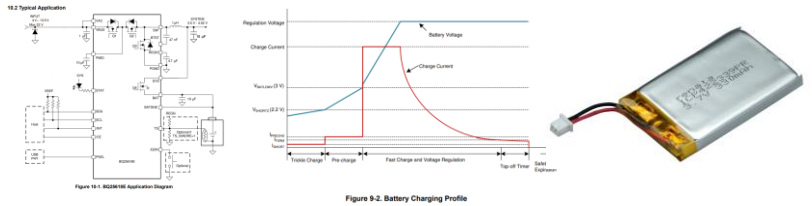
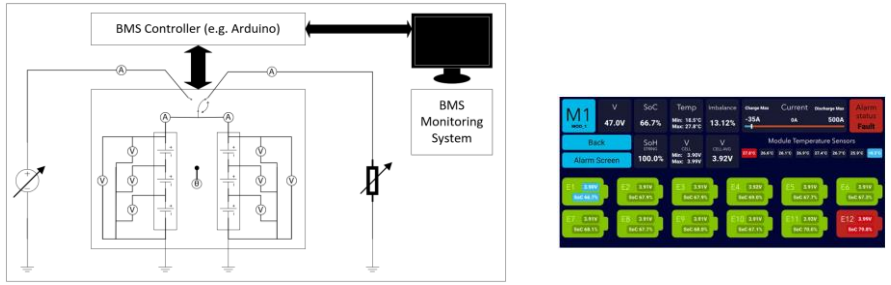
- How to design a Battery-Pack – the most important Steps:



- Future Trends in Batterie Technology

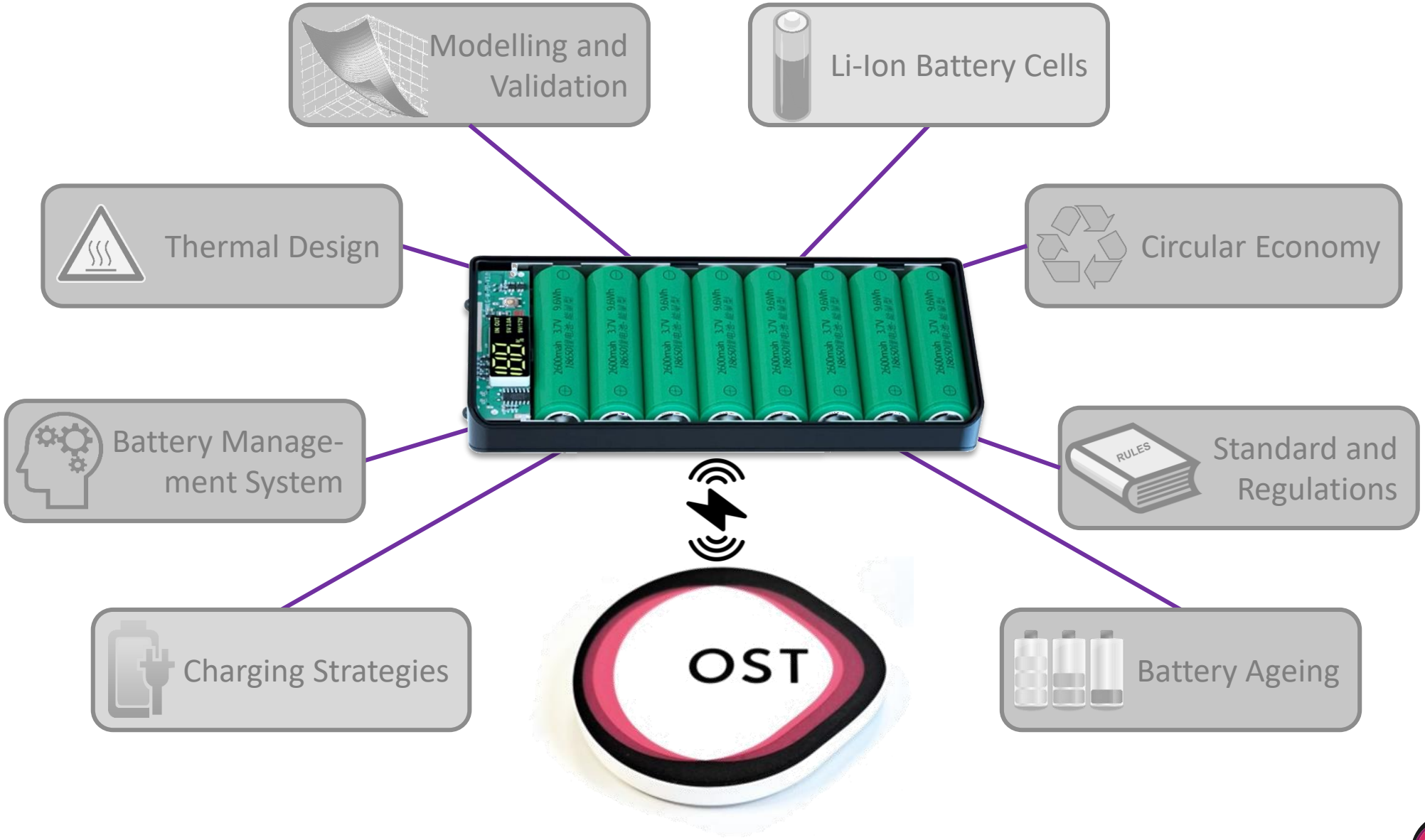


Wir bieten einen Batterie Kurs & Praktikum an

Woche	Kurs (2CP)	Praktika
1	Battery Course 01 - Li-Ion Battery Cells (Part 1)	Mobile Spannungsversorgung für USB-Applikationen 
2	Battery Course 01 - Li-Ion Battery Cells (Part 2)	
3	Battery Course 02 - Modelling of Li-Ion Batteries (Part 1)	
4	Battery Course 02 - Modelling of Li-Ion Batteries (Part 2)	
5	Battery Course 03 - Model Validation	
6	Battery Course 04 - Thermal Design of Battery Packs (Part 1)	
7	Battery Course 04 - Thermal Design of Battery Packs (Part 2)	Batteriesystem für grössere Applikationen 
8	Battery Course 05 - Battery Management Systems (Part 1)	
9	Battery Course 05 - Battery Management Systems (Part 2)	
10	Battery Course 06 - Charging Strategies for Li-Ion Batteries	
11	Battery Course 07 - Battery Aging (Part 1)	
12	Battery Course 07 - Battery Aging (Part 2)	
13	Battery Course 08 - Standards and Regulation	Repetition
14	Battery Course 09 - Circular Economy and Sustainability	

Li-Ion Battery Course

Metrohm
Metrohm Stiftung



OST

Case study - machine

Task 3: How many cells are required for the battery of an application?

Energy => Roughly estimate how many lithium-ion cells are required for the floor grinding machine battery.

Energy requirement of the application: $E_{ges} = 2200\,W \cdot 4\,h = 8800\,Wh$

Capacity of the single cell: $E_{zelle} = nom.\,cell\ capacity\,[Ah] \cdot nom.\,voltage\,[V]$

$E_{zelle} = 3.3\,Ah \cdot 3.6\,V = 12.06\,Wh$

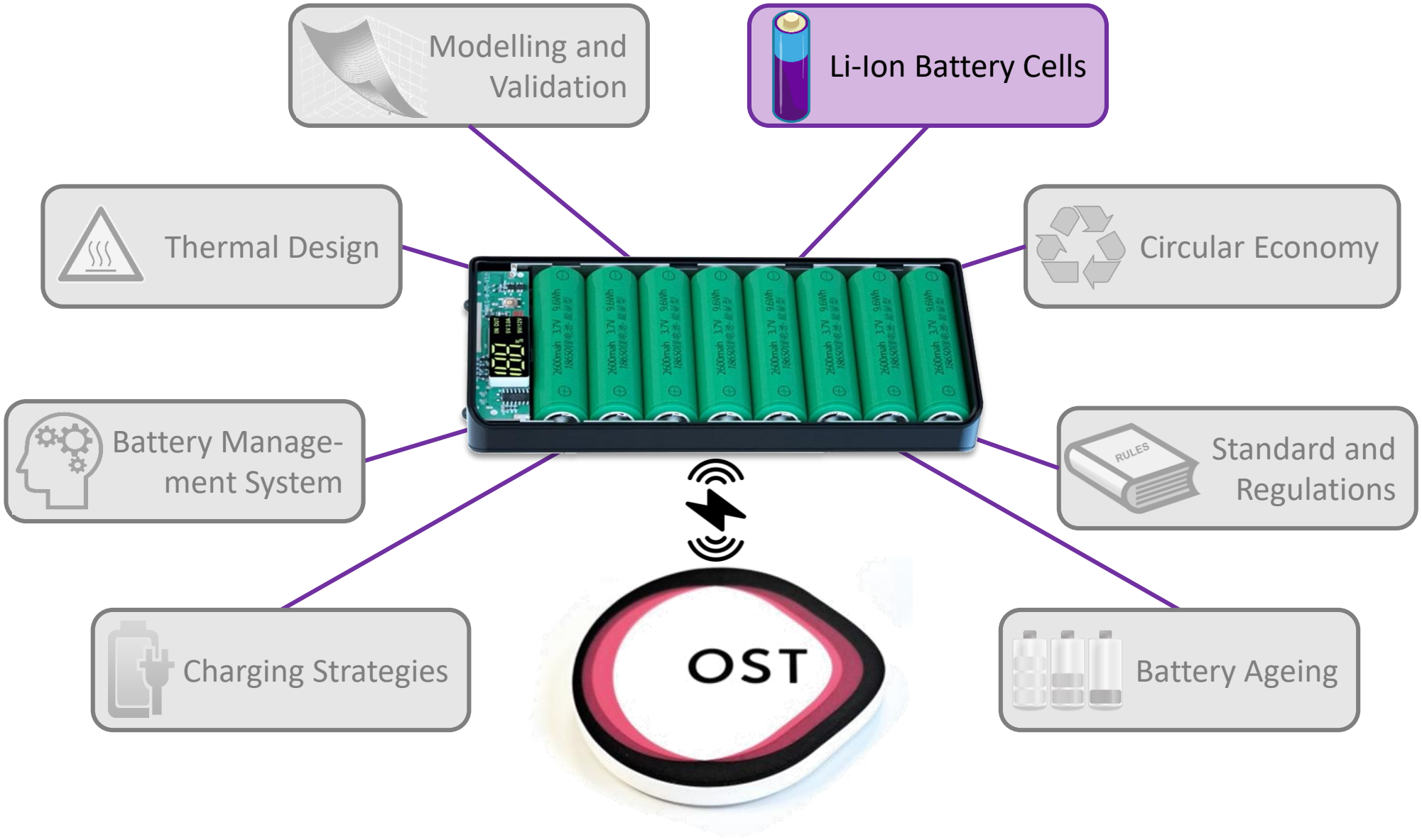
$$\text{number of cells} = \frac{Energy\ requirement}{Capacity\ of\ single\ cell} = \frac{8800\,Wh}{12.06\,Wh} \sim 730\,pcs.$$

Power: How much power can these cells produce?

Power delivered of one Cell at 1C: $P_{cell} = 3.3\,A \cdot 3.6\,V = 12.06\,W$

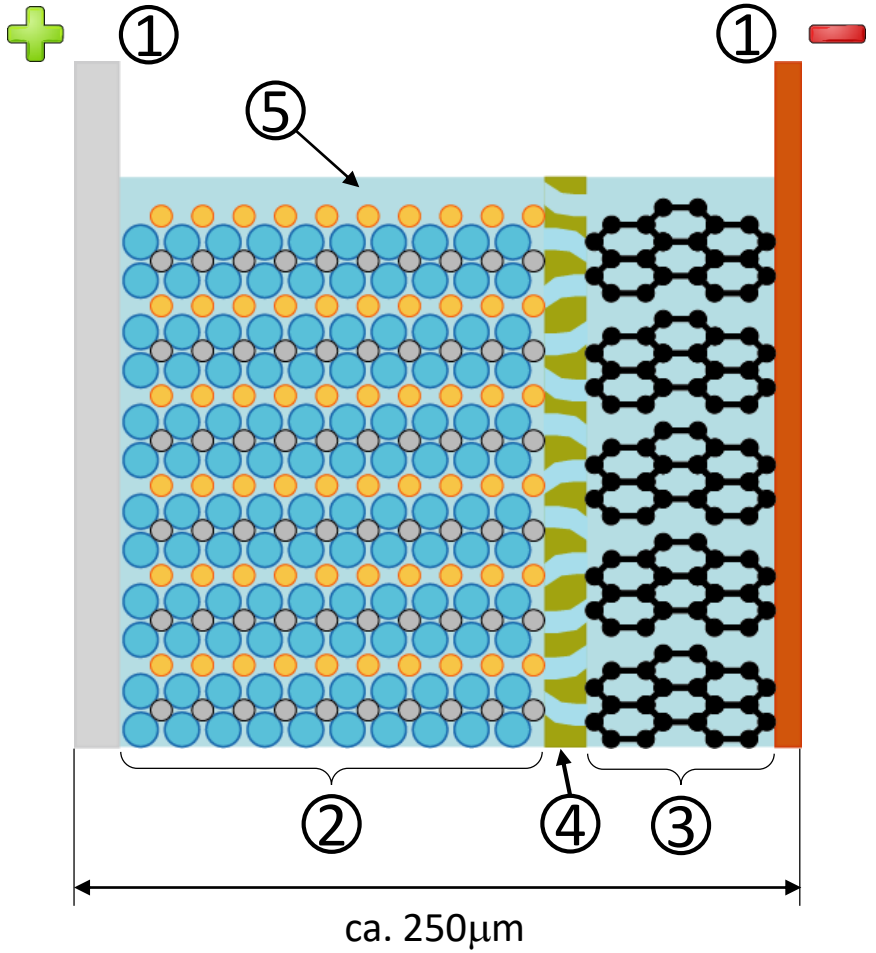
$730\,pcs * 12.06W = 8800\,W$

Li-Ion Battery Course

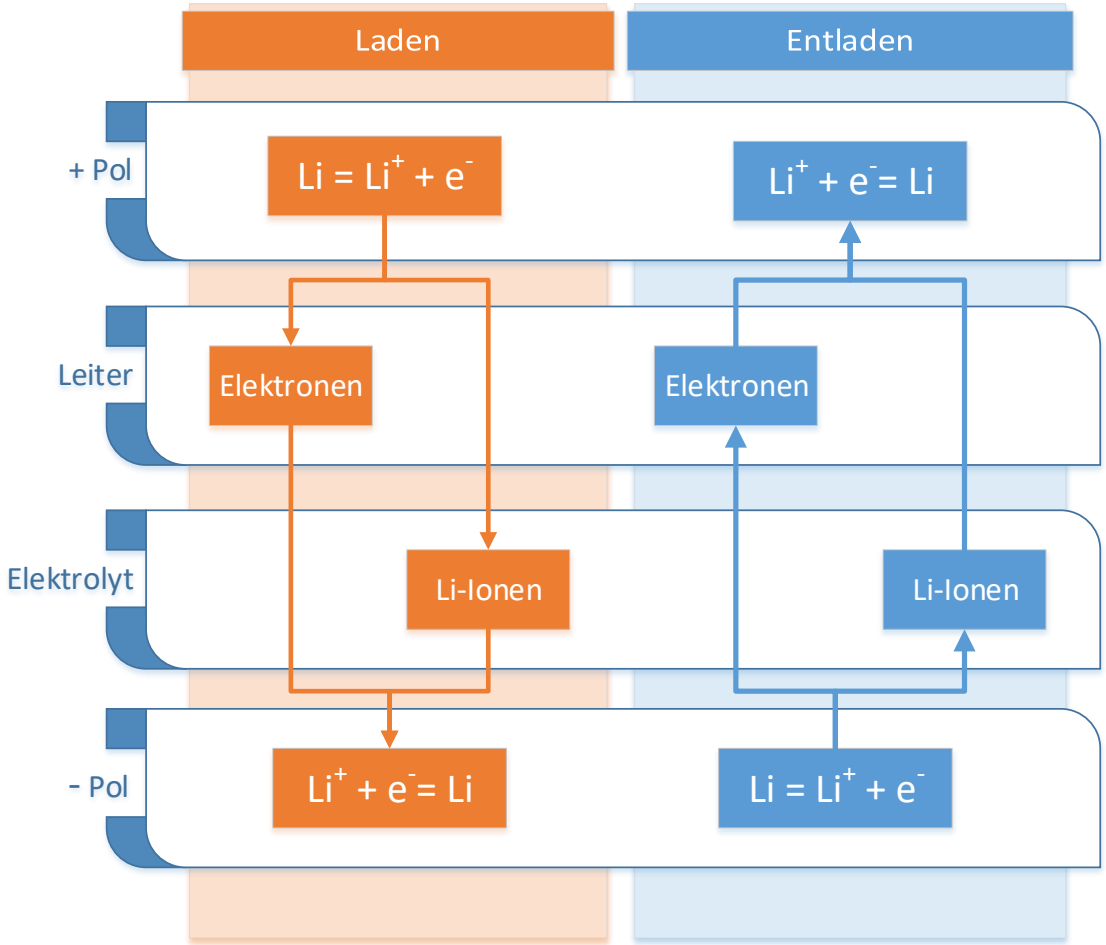


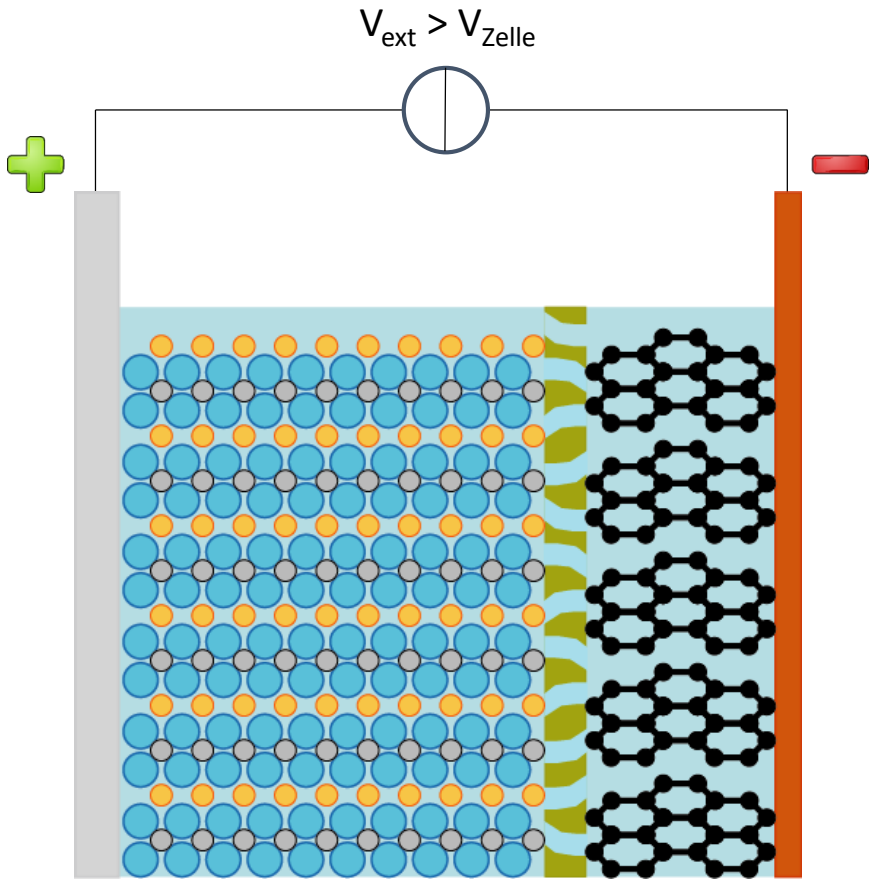
02 – Aufbau einer Li-Ionen-Zelle

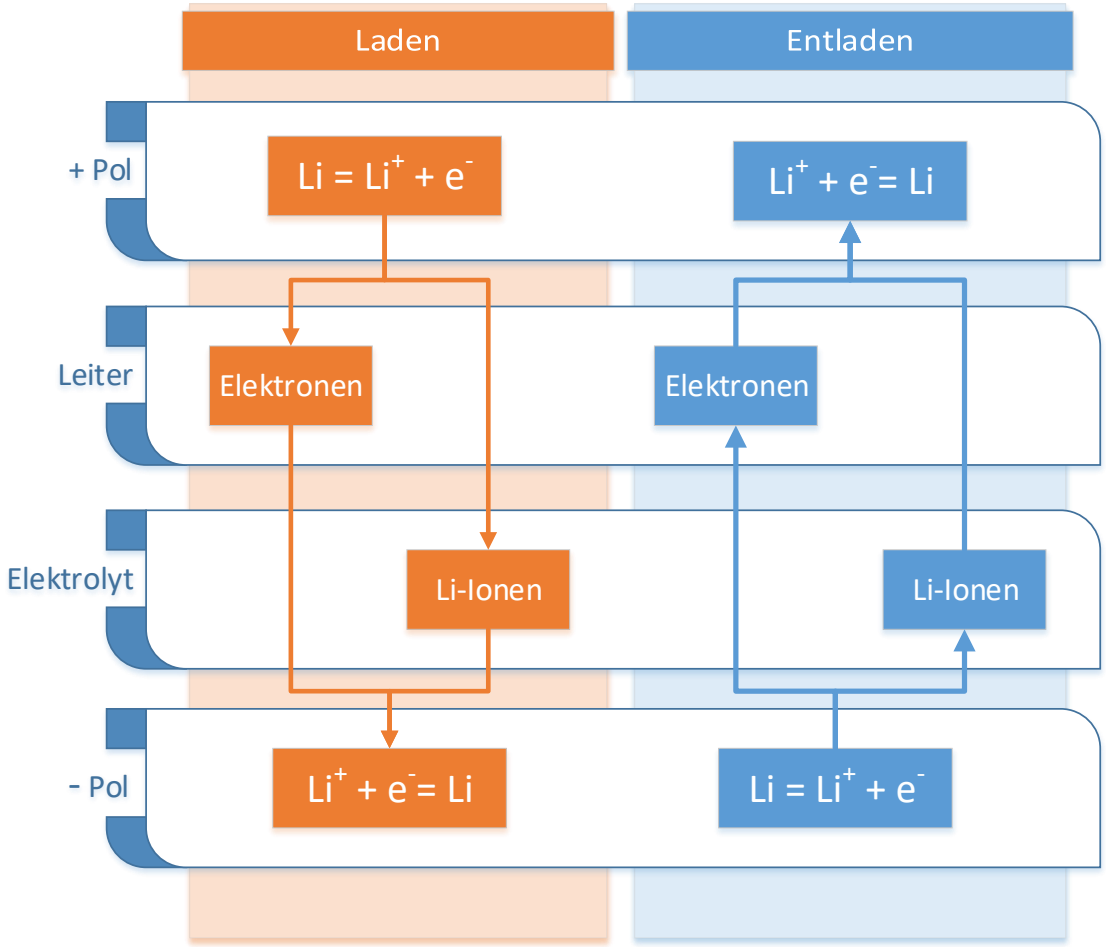
1. **Stromableiter**
   - Aluminium resp. Kupfer
2. **Kathode (pos. Elektrode, z.B. $LiCoO_2$)**
   - Struktur aus Metalloxid mit «variablem» Anteil an Li-Atomen
3. **Anode (neg. Elektrode z.B. C_6)**
   - Geschichte Kohlenstoff Struktur
4. **Separator (PP, PE oder Keramik)**
   - Micro-Poröse Schicht
   - Ionendurchlässig
5. **Elektrolyt (z.B. $LiPF_6$)**
   - Ionenleiter
   - NICHT wässerige Lösung
   - Elektrisch NICHT leitend

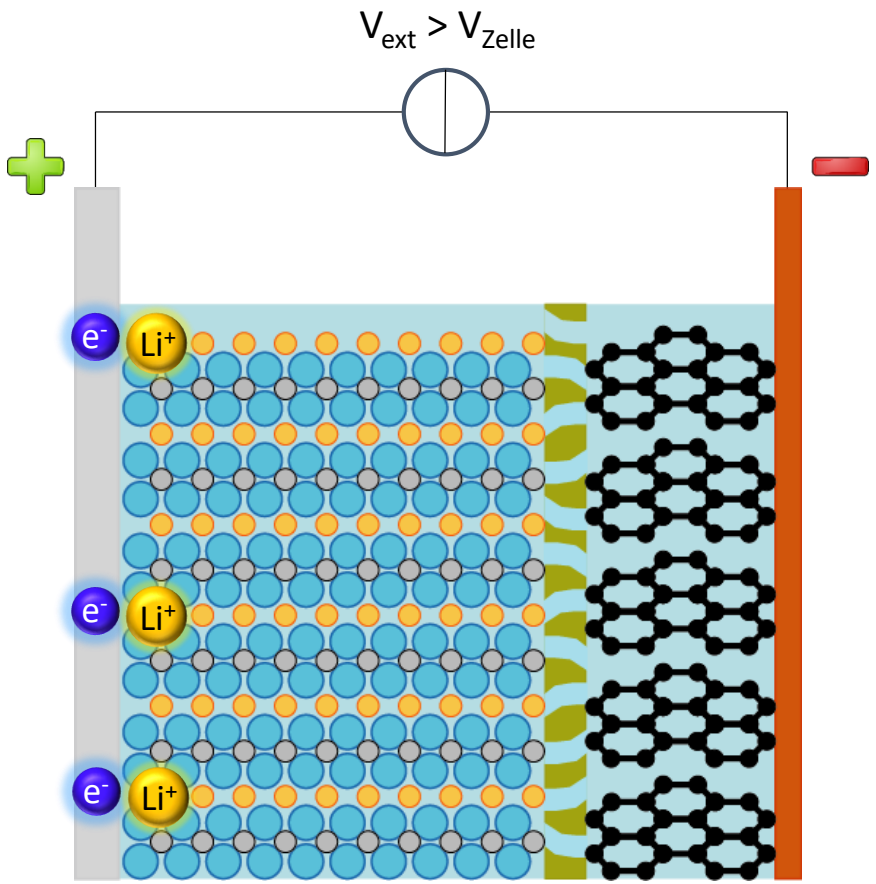


02 – Funktionsweise

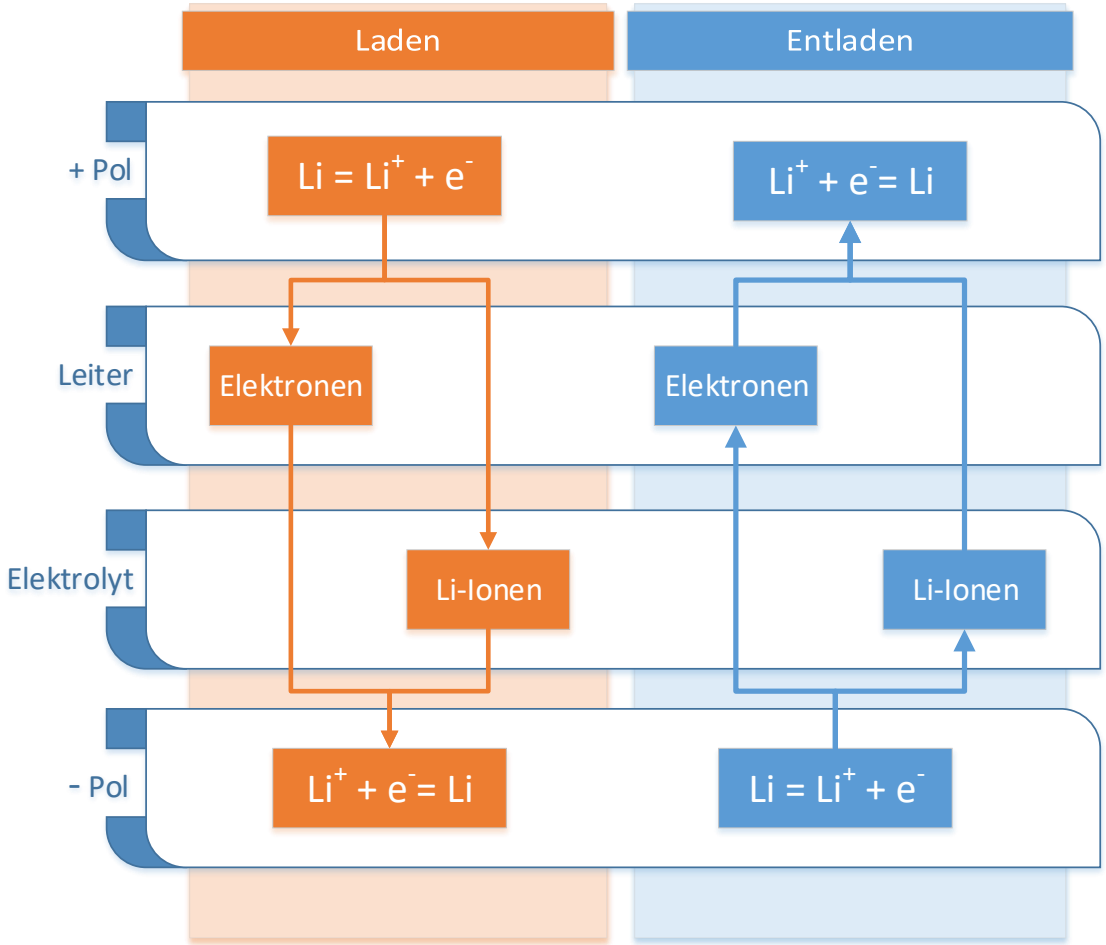


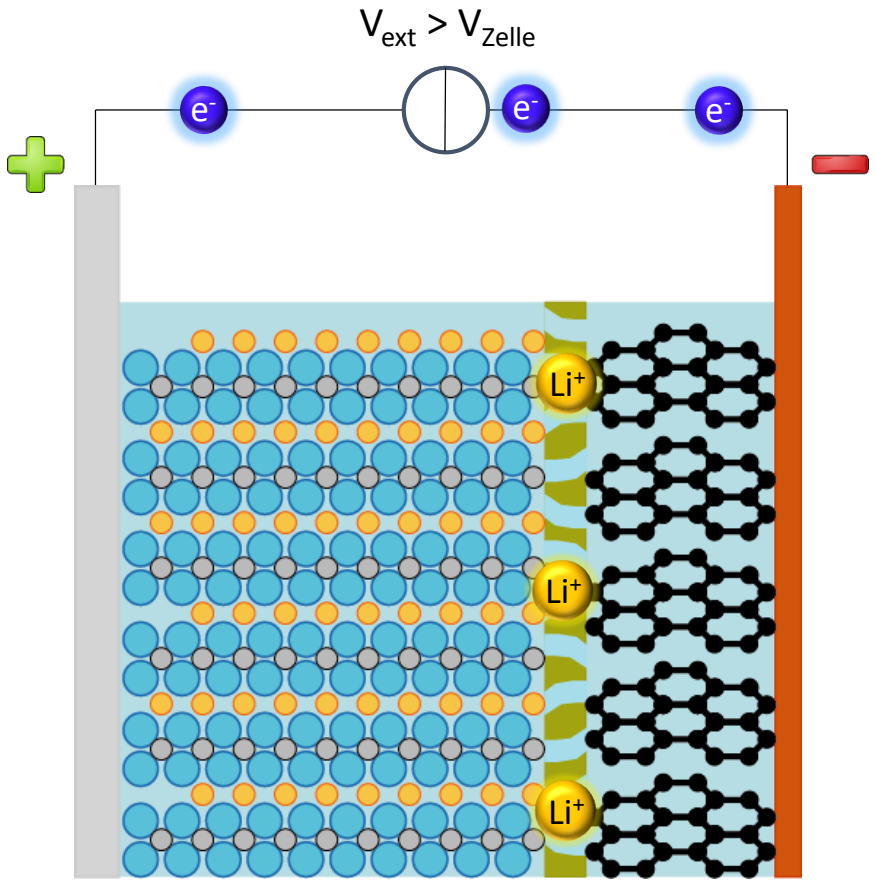



Laden
Entladen
+ Pol
Li = Li+ + e-
Li+ + e- = Li
Leiter
Elektronen
Elektronen
Elektrolyt
Li-Ionen
Li-Ionen
- Pol
Li+ + e- = Li
Li = Li+ + e-

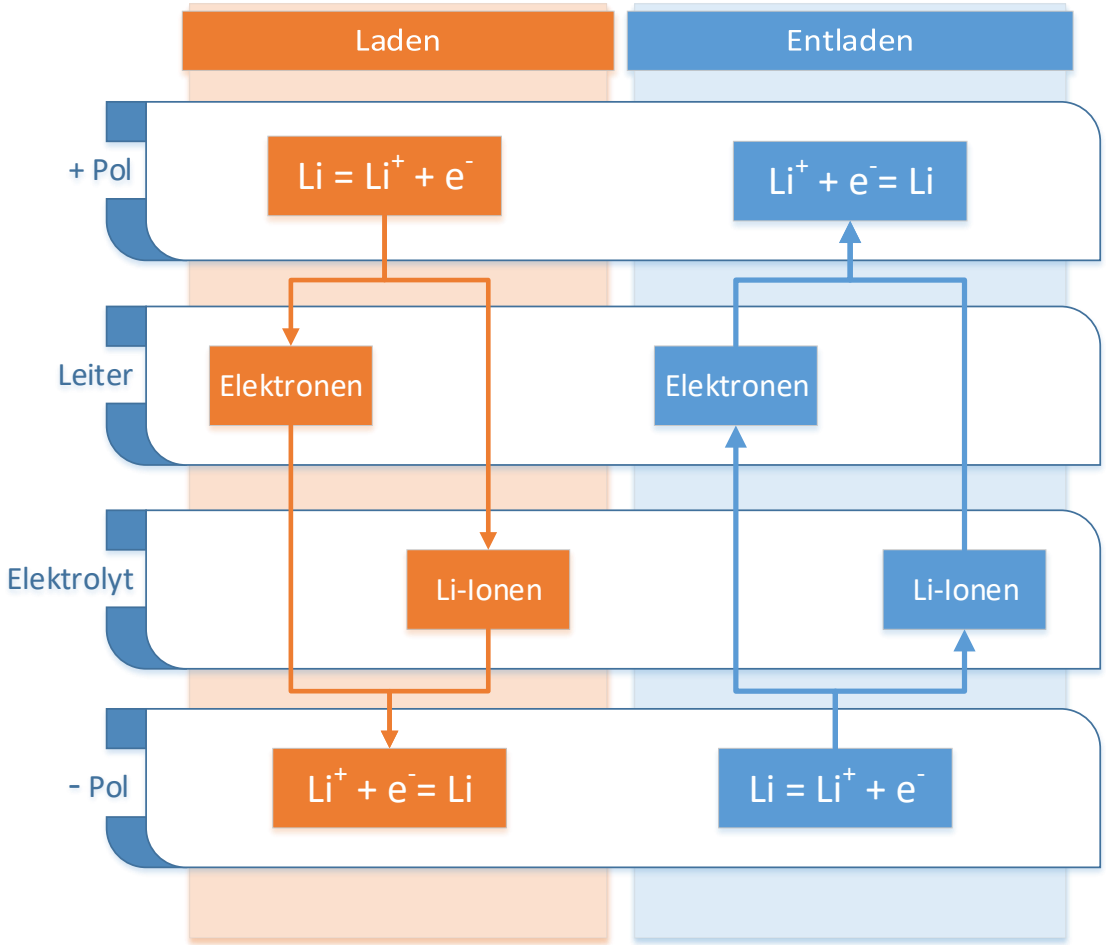

Vext > VZelle
e-
Li+
e-
Li+
e-
Li+

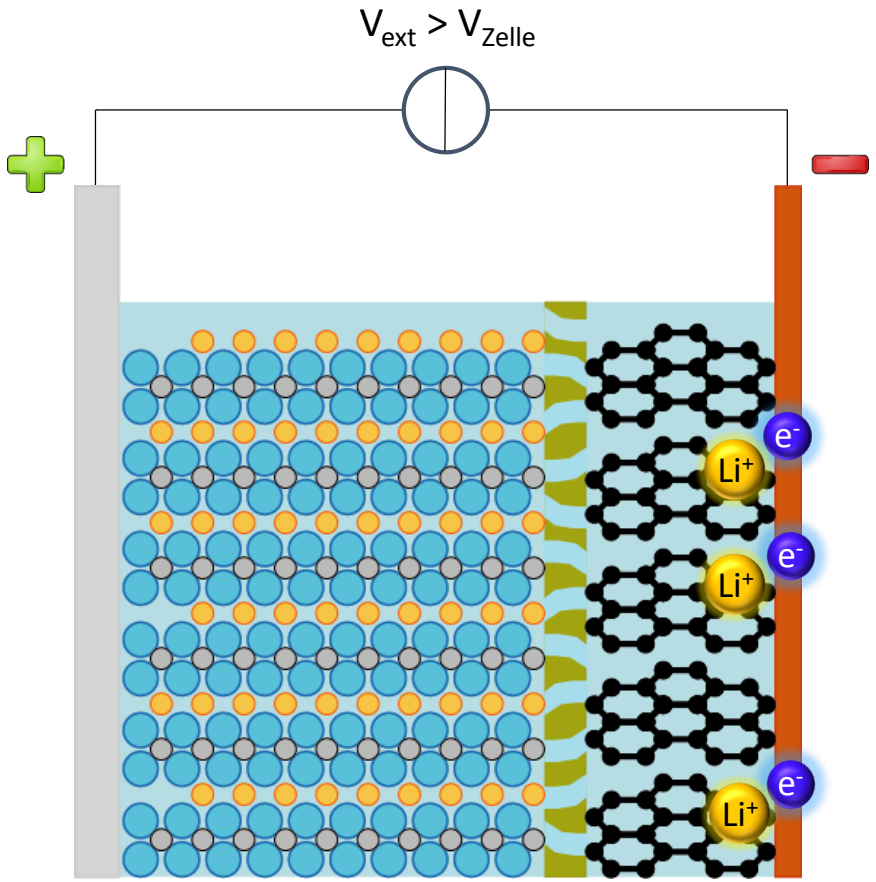
02 – Funktionsweise



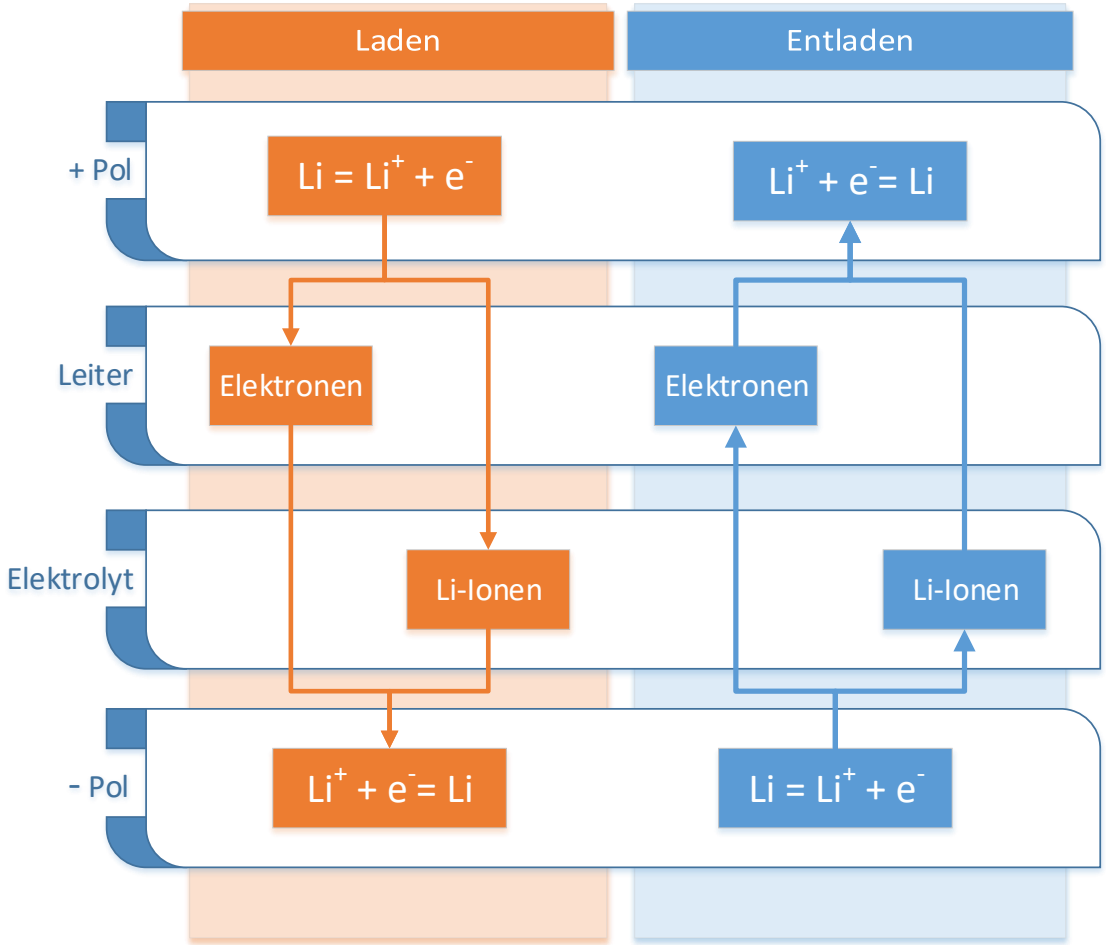


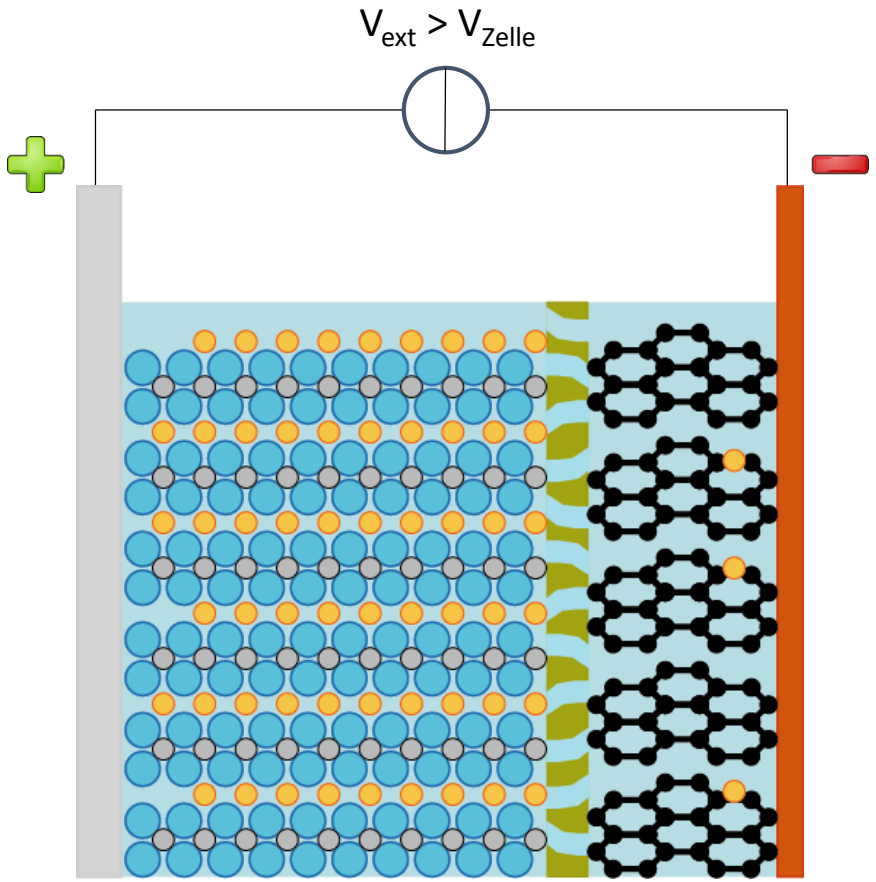
02 – Funktionsweise



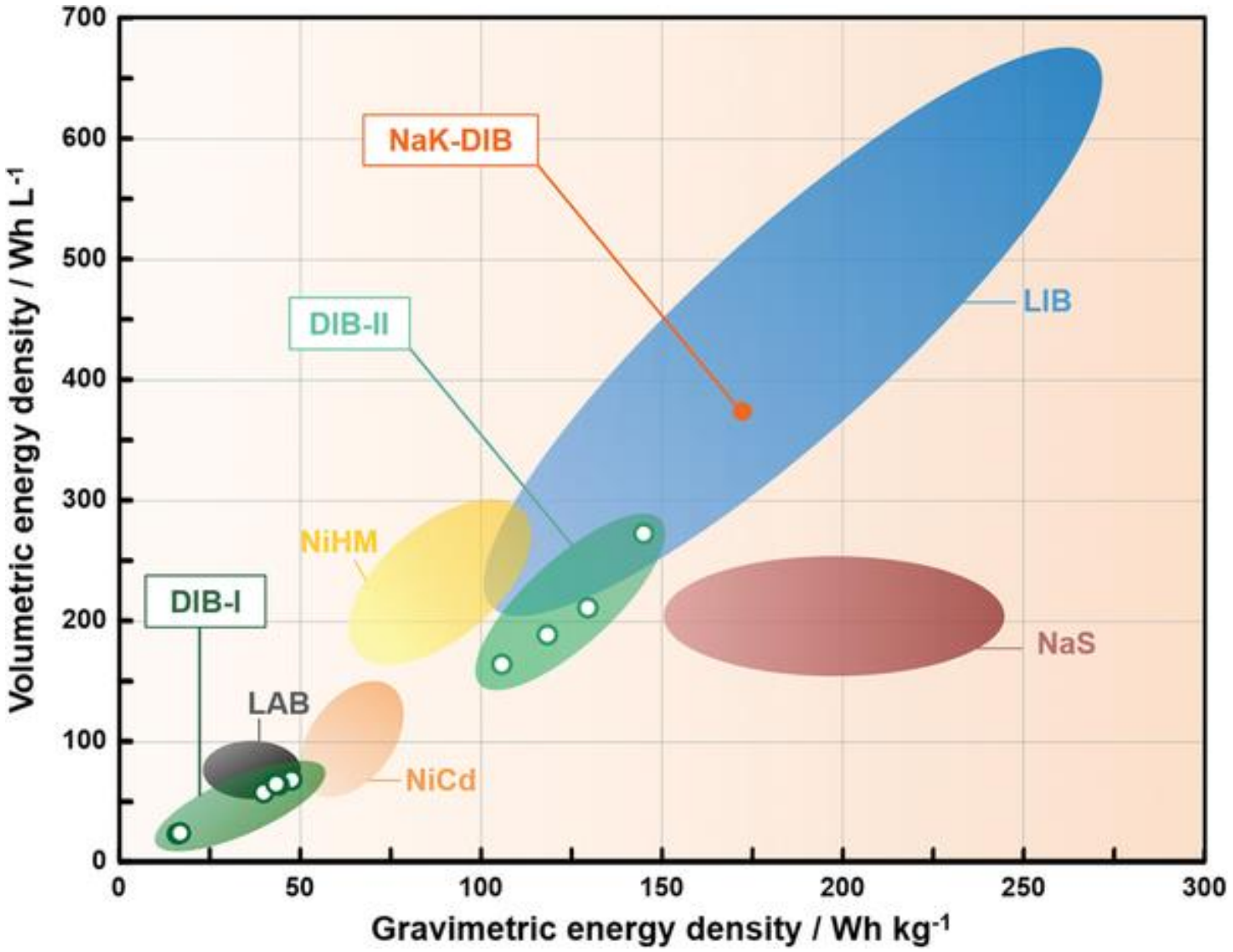


02 – Funktionsweise





- Source: https://www.researchgate.net/figure/Energy-density-comparison-of-different-battery-chemistries-Volumetric-energy-density_fig4_343340778



02 – Vergleich von Kathodenmaterialien

Li-Ionen Zellen

$LiMn_2O_4$ (LMO)

- Tiefer Innenwiderstand
- Billiger als LCO

$LiNiCoAlO_2$ (NCA)

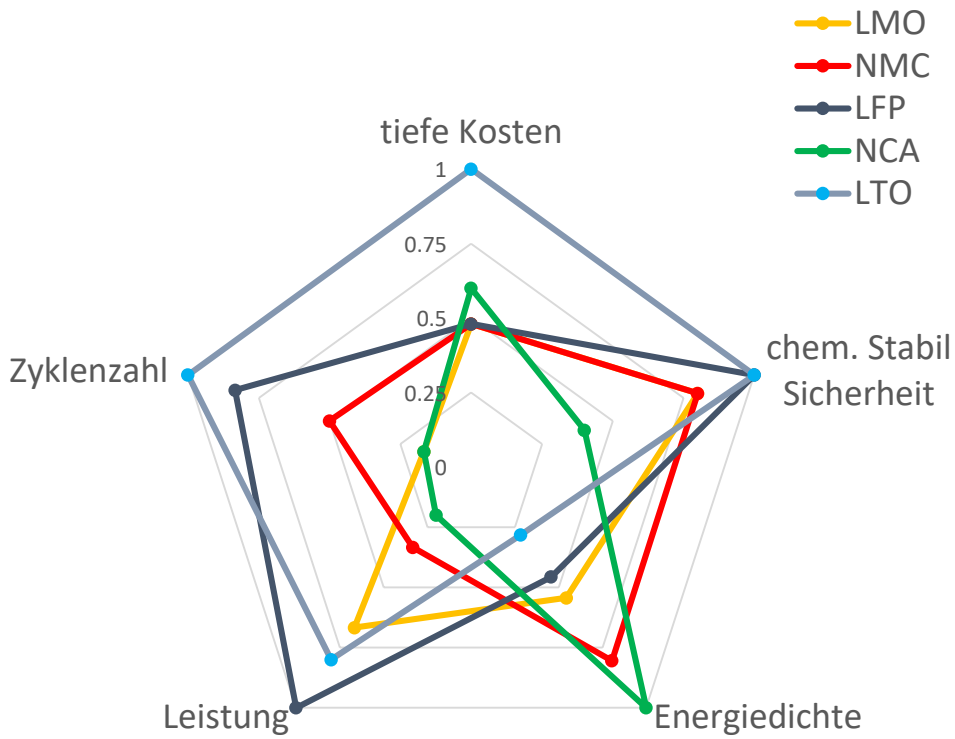
- Hohe spez. Energie
- Geringere Stabilität
  → Sicherheit

$LiNiMnCoO_2$ (NMC)

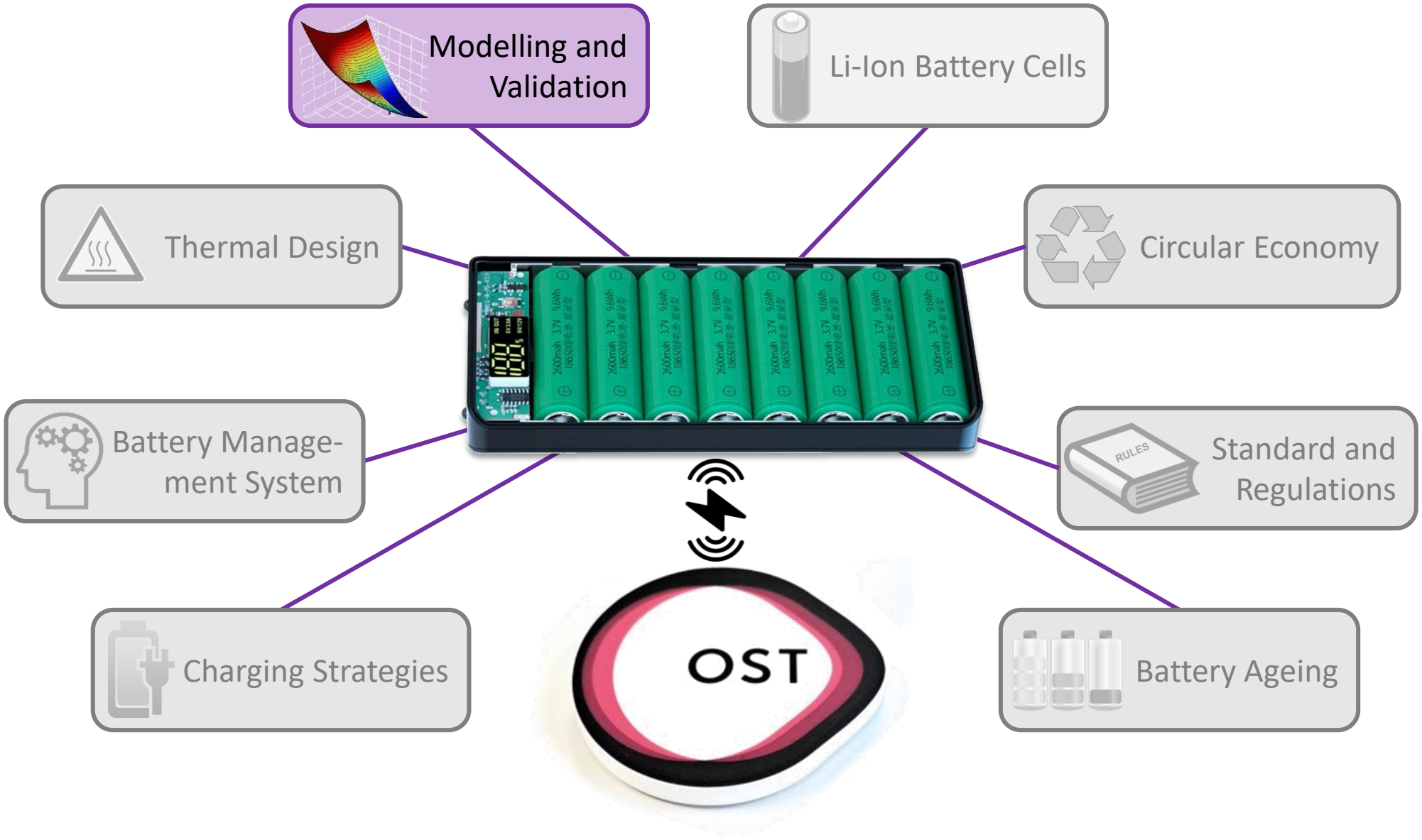
- Power Tools / E-Bikes
- Sicherer als NCA

$LiFePO_4$ (LFP)

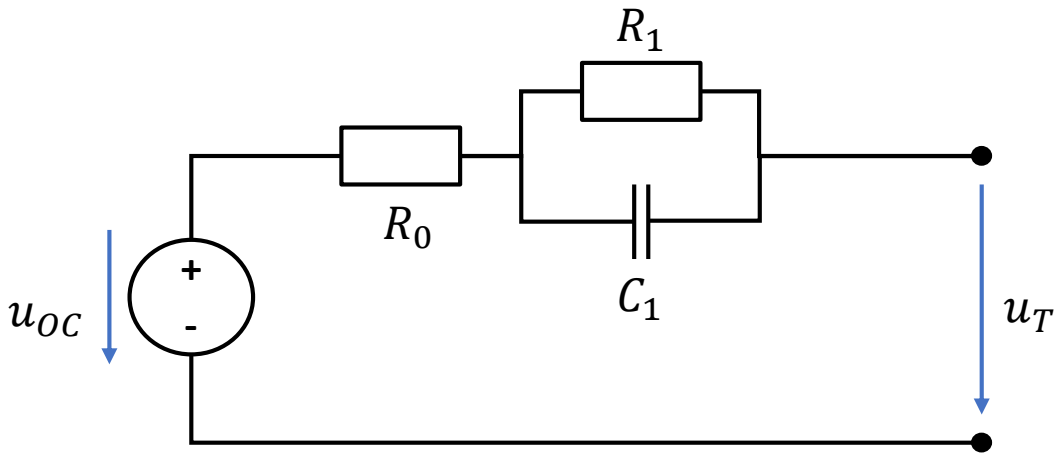
- Stabiles Spannungsprofil
- Tiefere spez. Energie



Li-Ion Battery Course

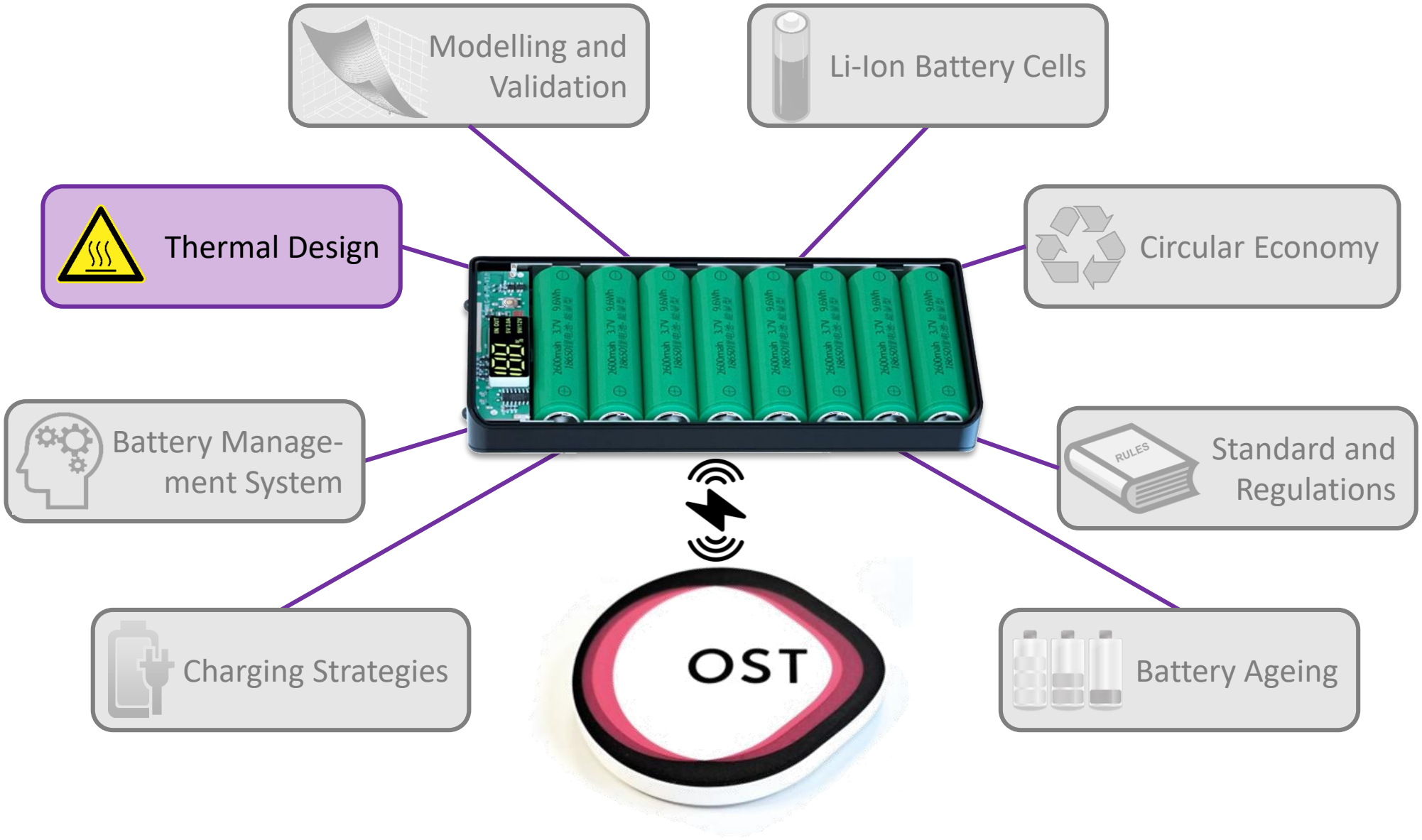


2. Improved internal resistance model



The HPPC reveals transient phenomenon on various time scales, which can be modelled by **one or more RC parallel circuits**.

Li-Ion Battery Course

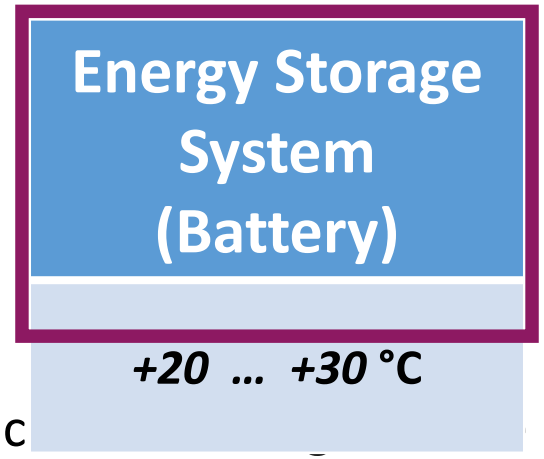


Operating temperature range

Operating temperature range of the energy storage system

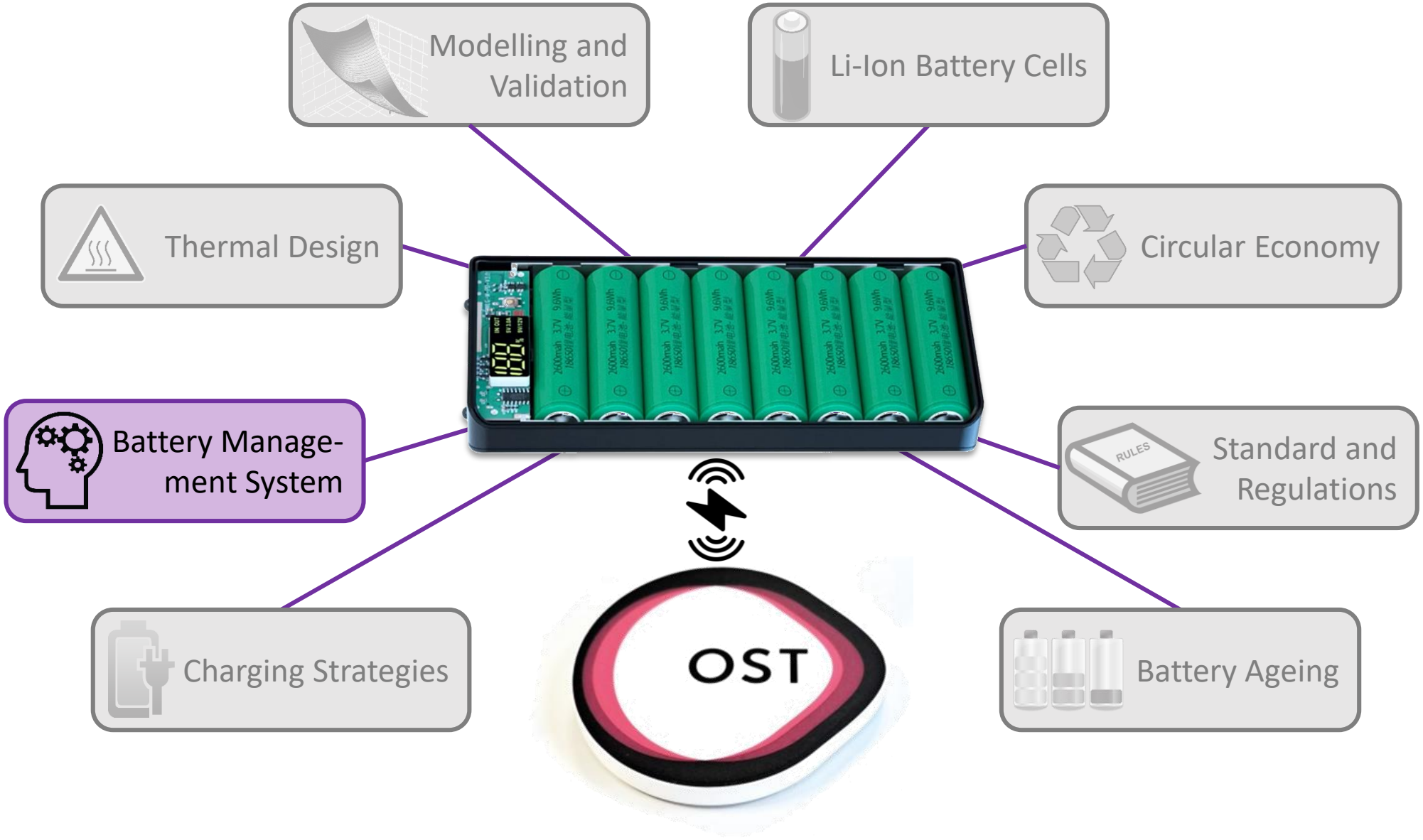
The operating temperature must not be exceeded at any time.

In most cases, this can only be ensured by actively cooling or heating the battery storage system.



If active cooling is not suffic used in some cases to prevent overheating.

Li-Ion Battery Course

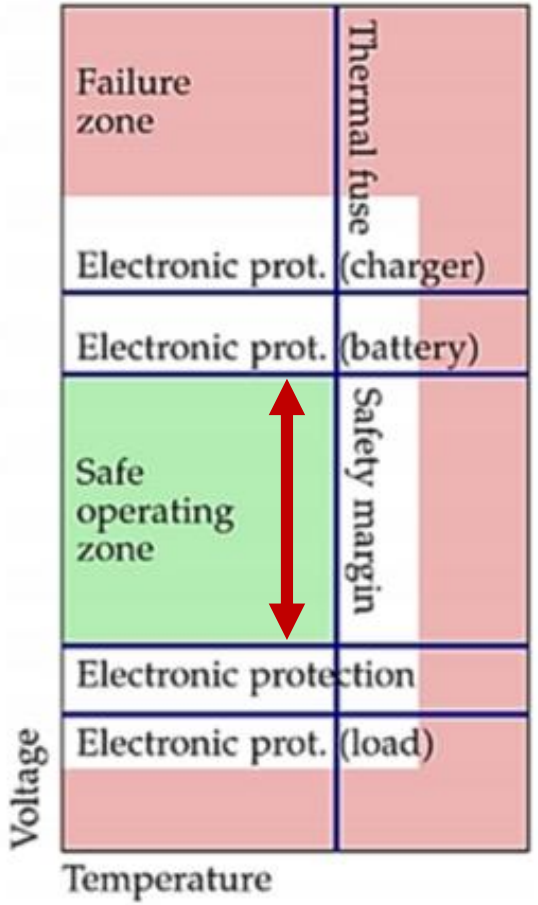


Battery System

Thermal Runaway (I)

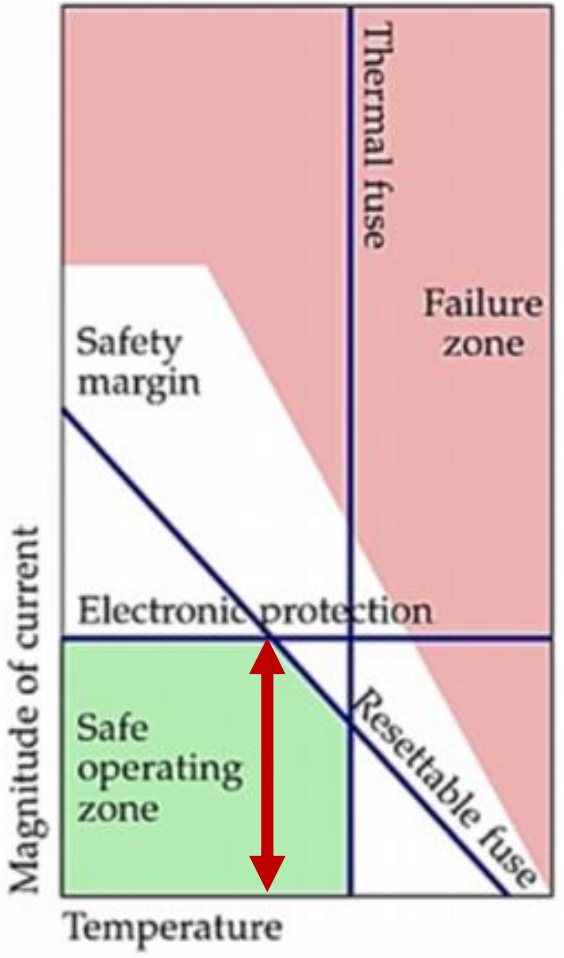
Voltage Monitoring

- Voltage Monitoring is needed to prevent over- and undervoltage. Therefore all cell voltages must be measured
- IC's for measuring multiple cell voltages or analog to digital converters are used
- Required for the derivation of other parameters like SOC, SOH and cell balancing

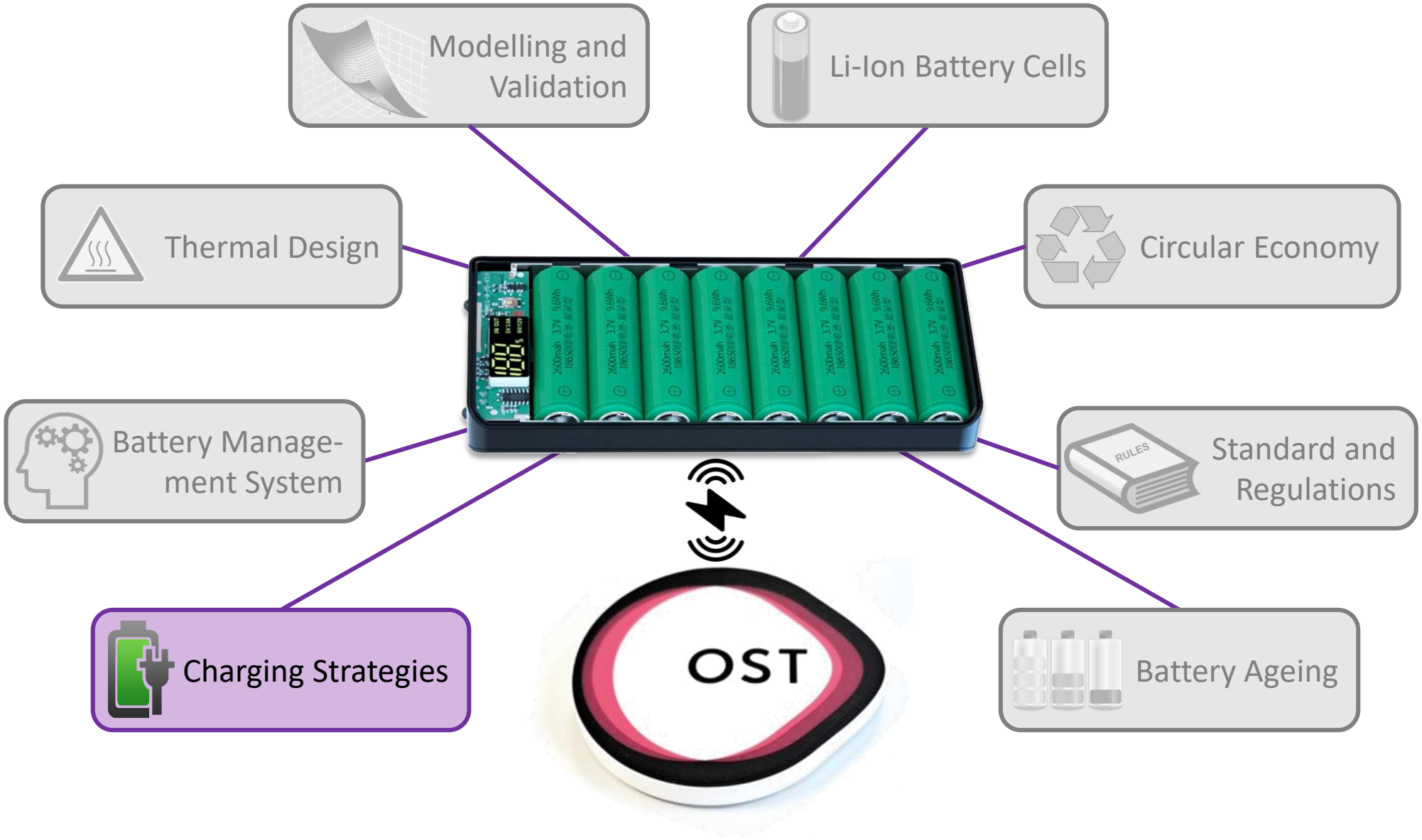


Current Monitoring (I)

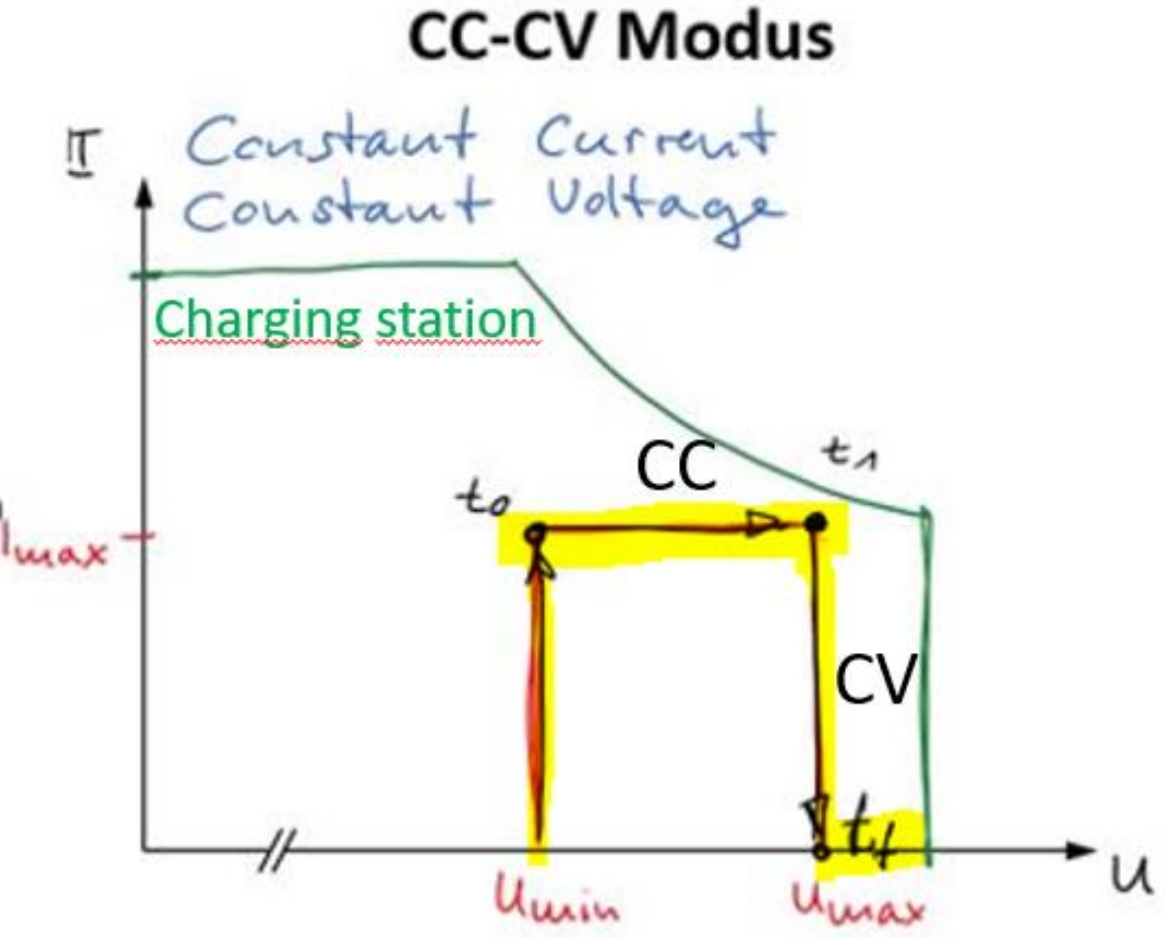
- Is needed to detect overcurrent, or short circuit and correct charge/discharge rates.
- Mainly done over shunt or Hall effect
- Required for the derivation of other parameters like SOC, SOH

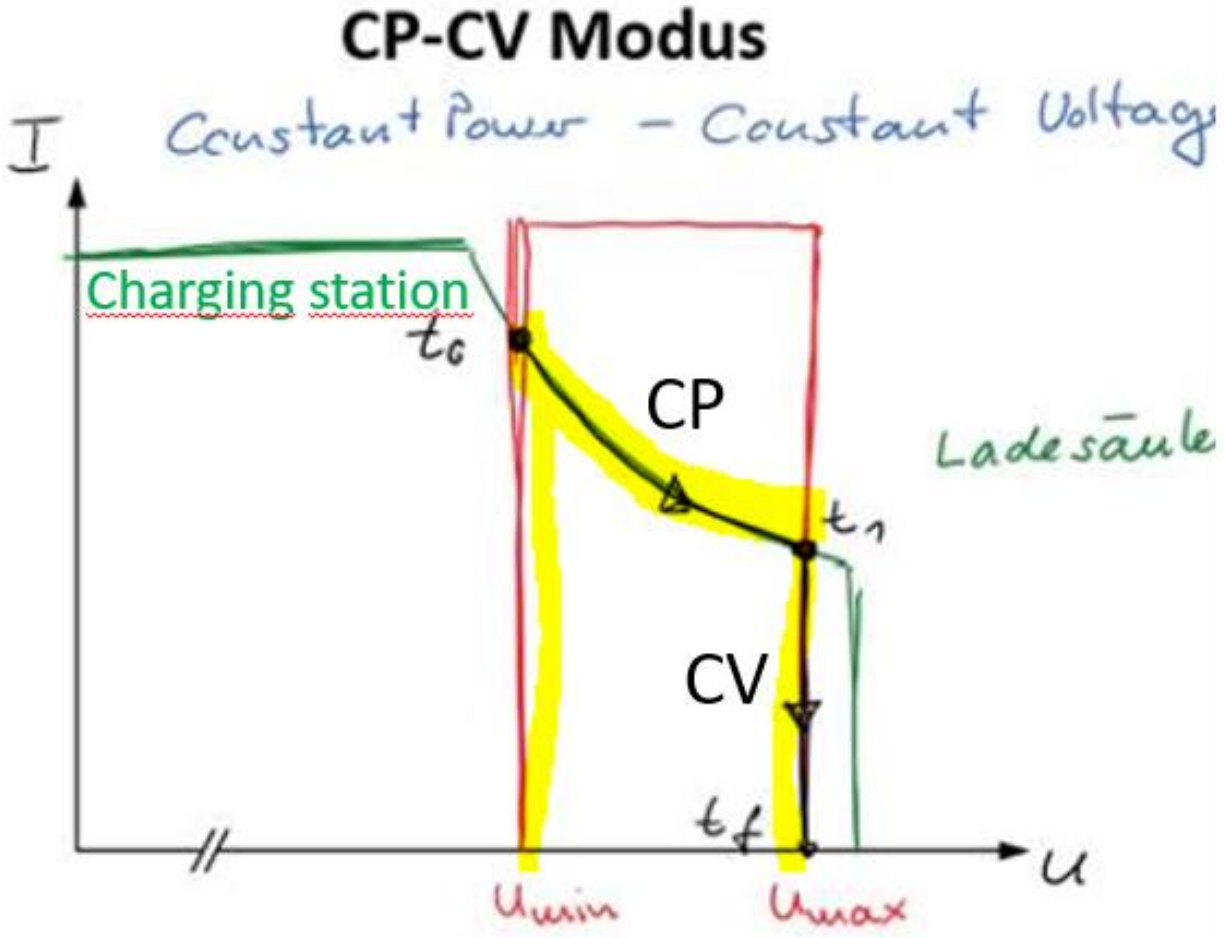


Li-Ion Battery Course

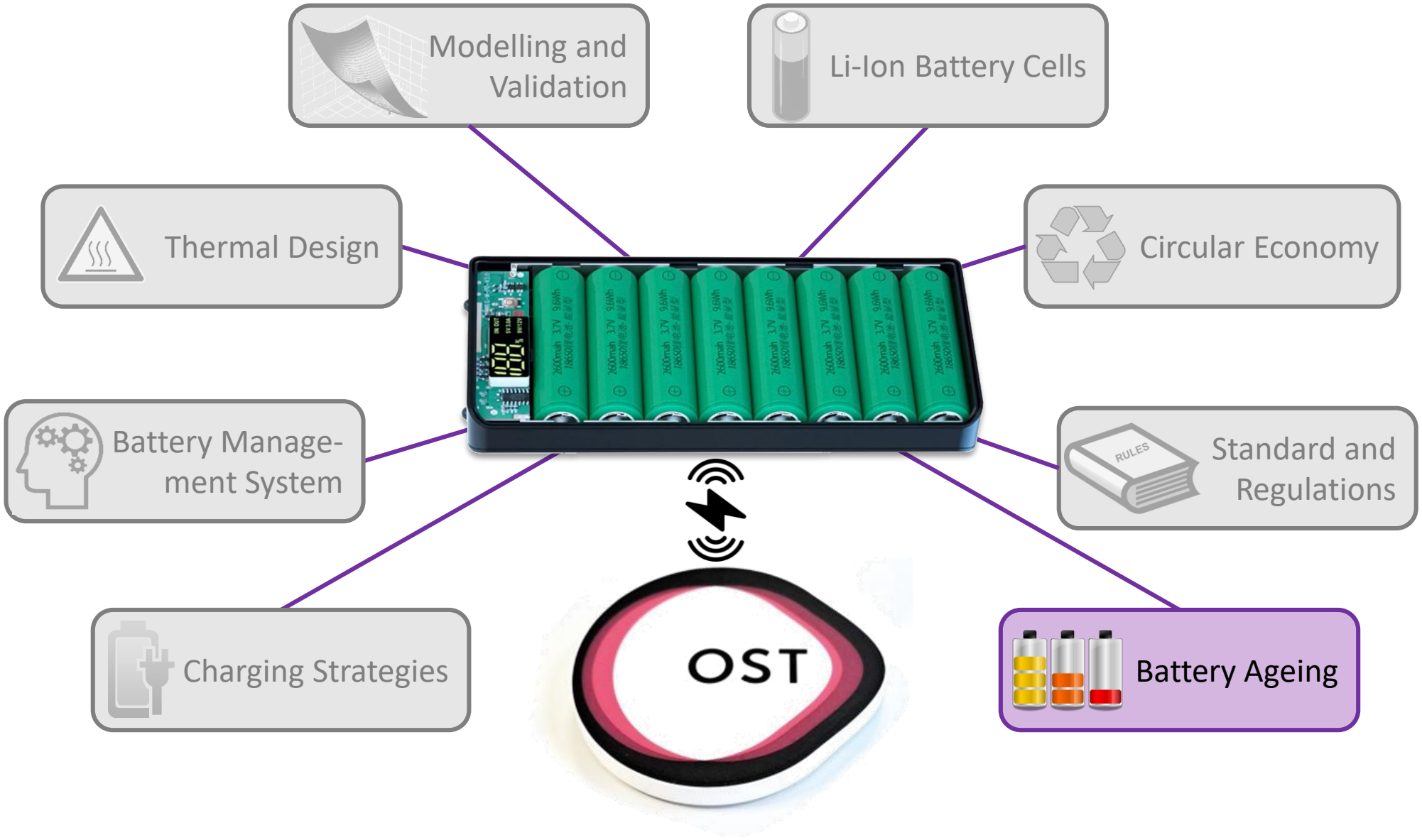


Charging Profiles



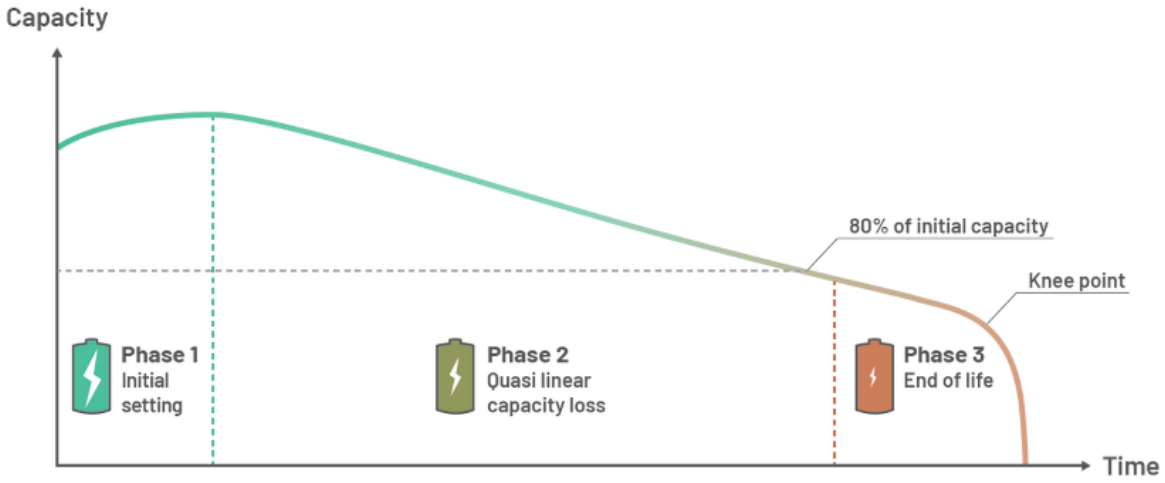


Li-Ion Battery Course



Phenomenological battery ageing

Phases of the consumption curve of the storage capacity Q

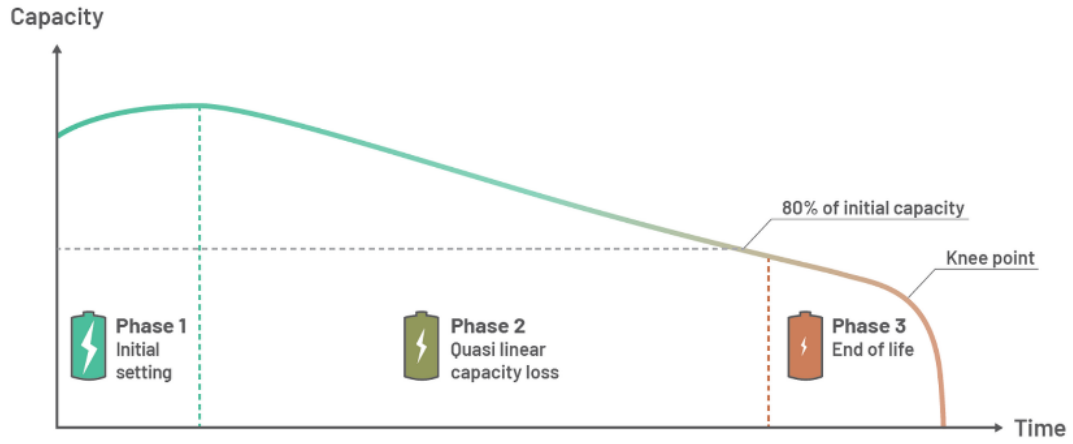


1. *Initial Settling*

At the beginning of a battery's service life, various chem. processes take place. This can temporarily increase the capacity even though the battery is being used. One reason for this increase is the anode overhang effect. Lithium, which is stored in the part of the anode that is slightly wider than the cathode and does not participate directly in the chem. reactions, is relocated and thus increases the number of Li-ions that can be stored.

Phenomenological battery ageing

Phases of the consumption curve of the storage capacity Q

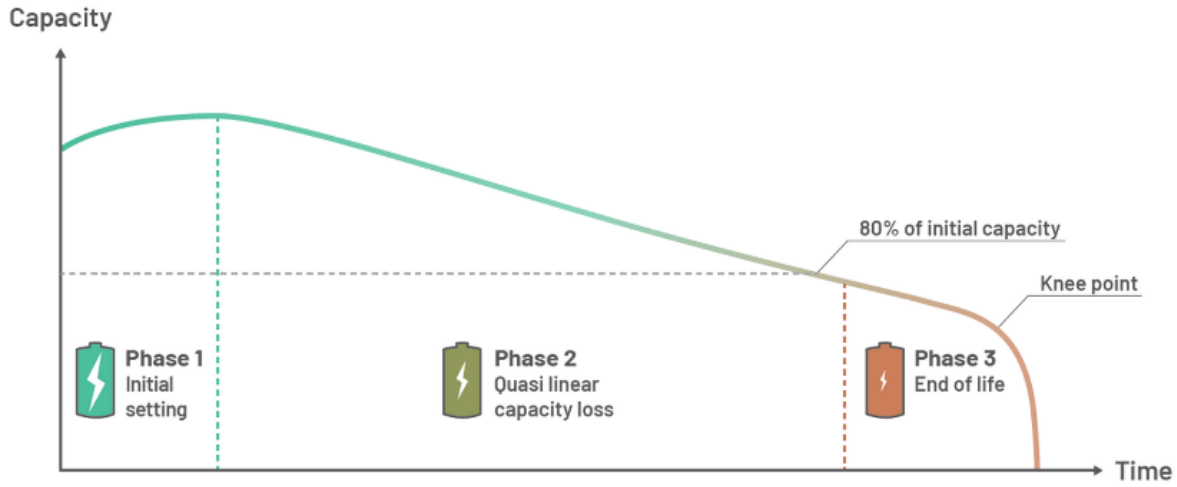


2. Quasi-linear capacity loss

In the second phase, there is a strong correlation between the capacity loss and the use of the battery. As a rule of thumb, the relationship between the two is more or less linear if the battery is used under more or less constant operating conditions.

Phenomenological battery ageing

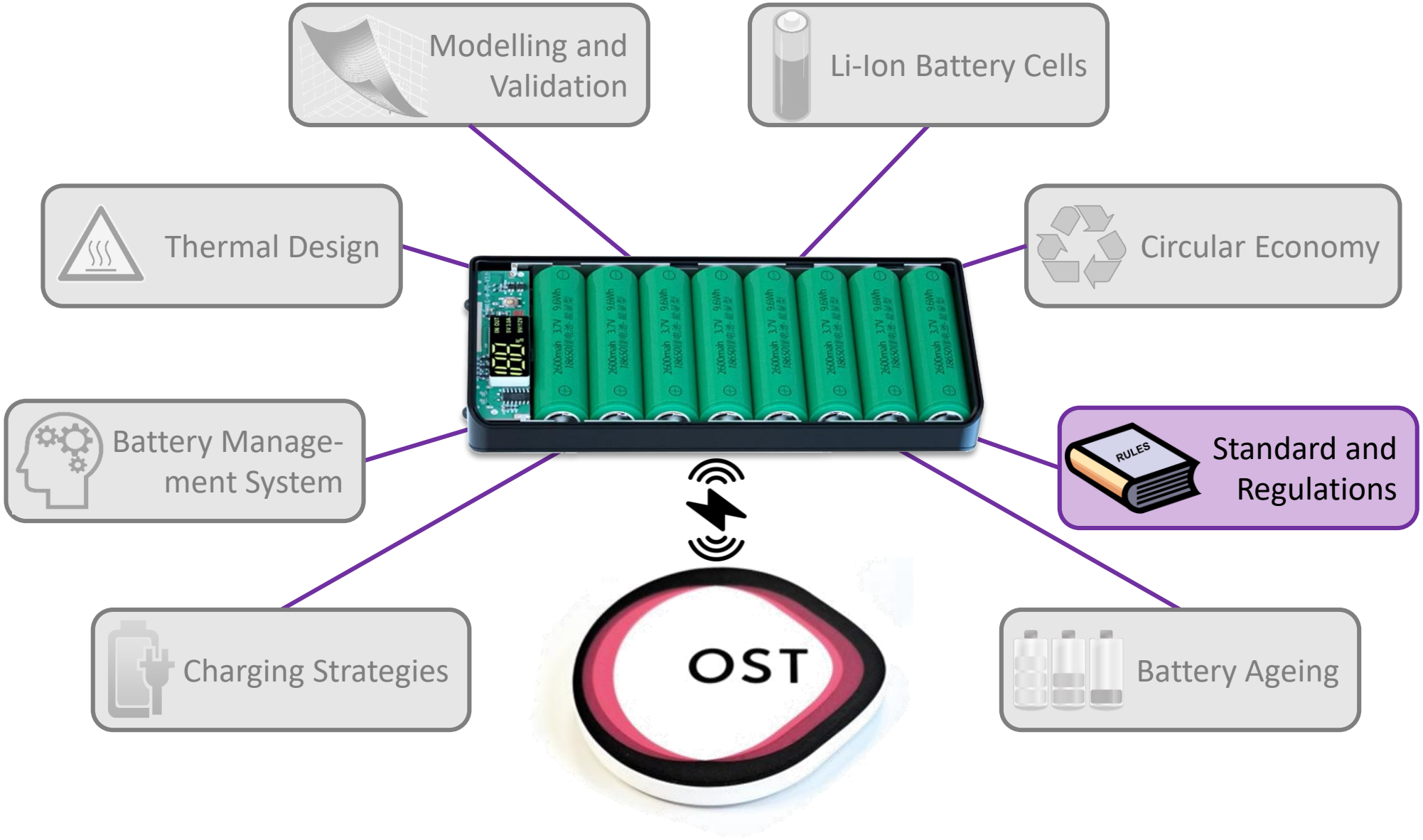
Phases of the consumption curve of the storage capacity Q



3. Cutoff-Point

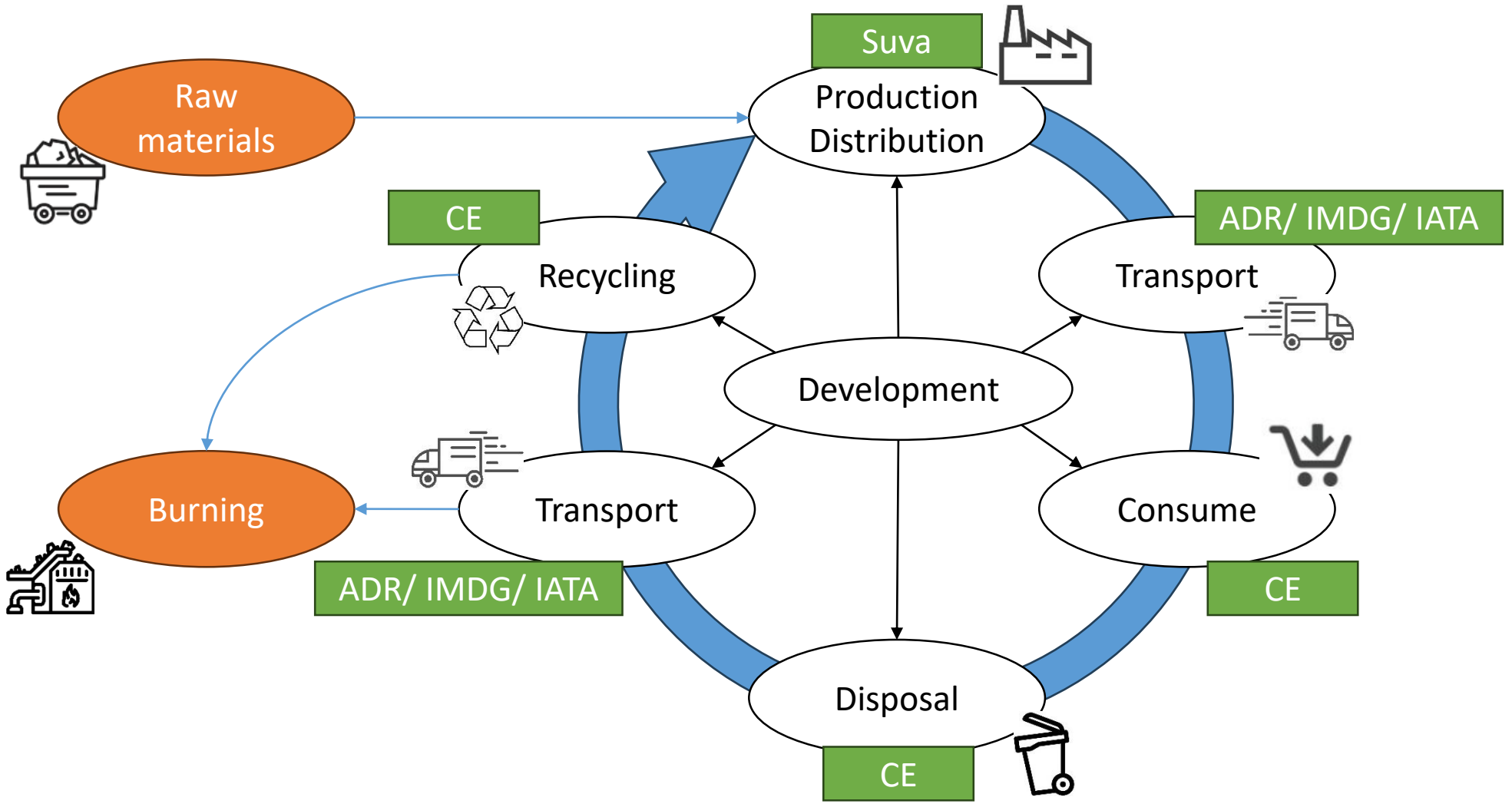
The third phase begins at around 50 ... 85% of the original storage capacity when the “Cutoff-Point” occurs. This marks a rapid drop in capacity over several cycles and signals the end of the battery's service life.

Li-Ion Battery Course

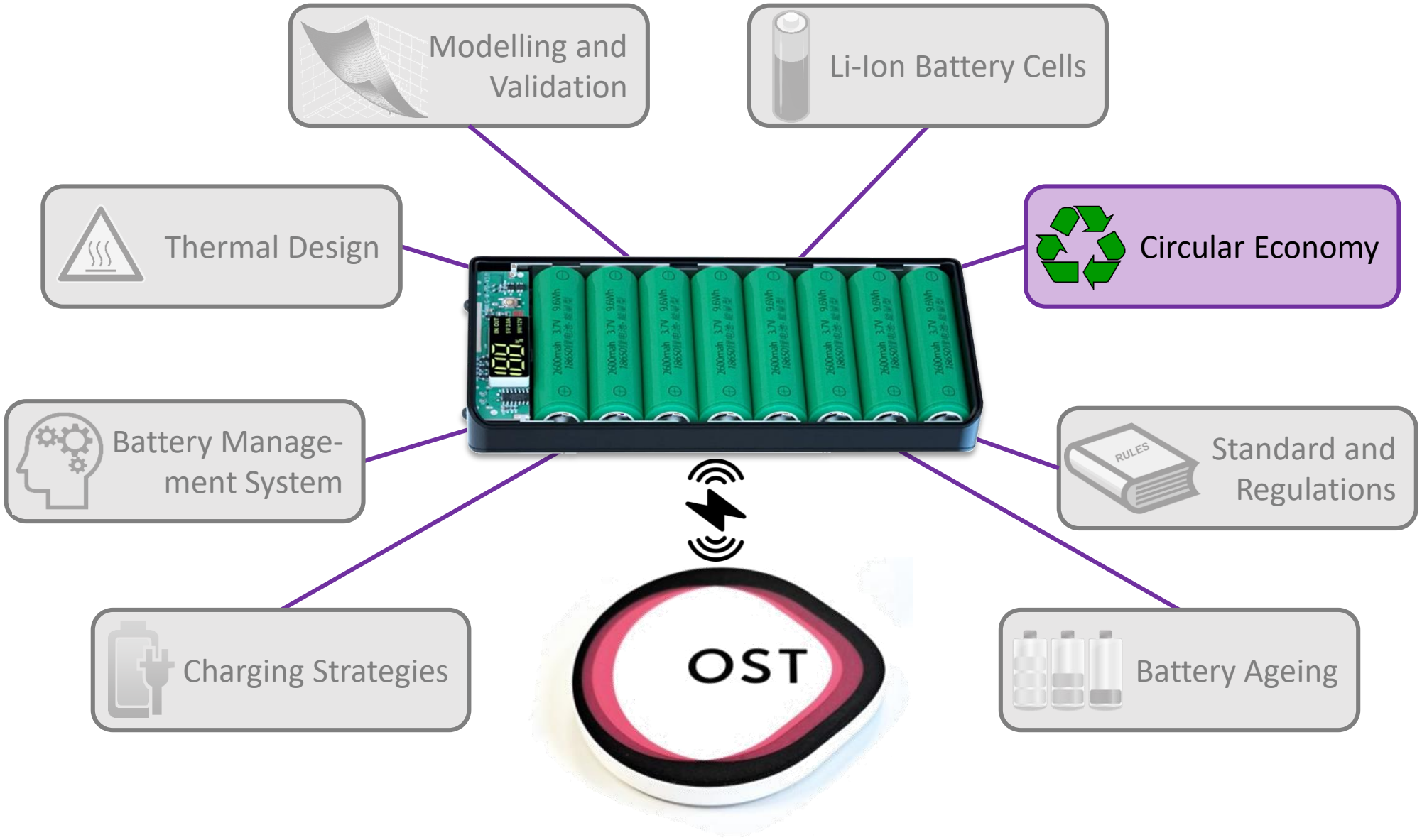


EU targets for environmental protection

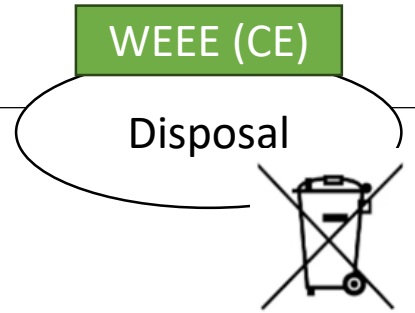
- CE directives and Responsible offices for safety



Li-Ion Battery Course



CE directives (Öko-Design)



- ErP / Eco-Design- directives (Öko-Design)

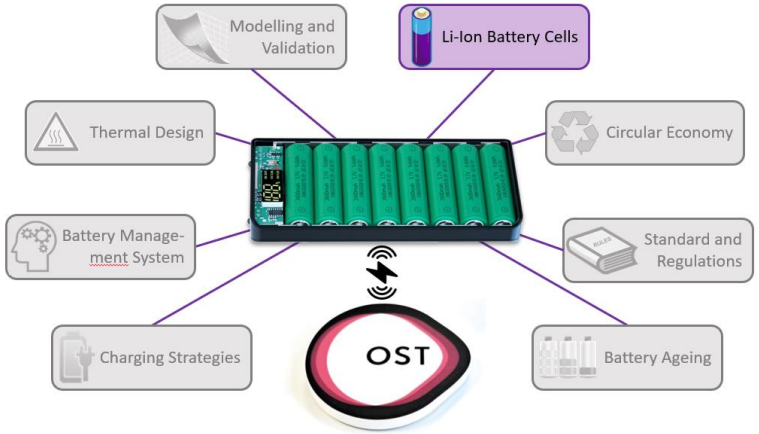
- **Gerätebatterien müssen leicht entfernbar sein:** Ab dem 18. Februar 2027 müssen Gerätebatterien, bis auf wenige Ausnahmen, auch durch Endnutzer aus Elektro- und Elektronikgeräten grundsätzlich entnehmbar und austauschbar sein. Für Batterien in leichten Transportmitteln gilt, dass diese zumindest von Fachpersonal entnommen werden können.

https://www.wko.at/oe/handel/maschinen-technologie/informationen-zur-neuen-eu-batterien-verordnung.
https://www.batteriegesetz.de/themen/die-neue-batterieverordnung-batt2-2023/

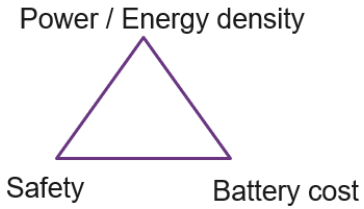
Agenda: Batteries enabling Innovations

- Intro

- Batteries as enabler of Innovations - History
- How to design a Battery-Pack – the most important Steps:



- Future Trends in Batterie Technology



Future trends

1. **Solid-State Batteries**: Solid-state batteries use a solid electrolyte instead of a liquid one, which can significantly improve safety by reducing the risk of leaks and fires. They also offer higher energy density and longer life cycles. Companies and researchers are actively working on making solid-state batteries commercially viable.

2. **Lithium-Sulfur Batteries**: These batteries have the potential to offer much higher energy densities compared to traditional lithium-ion batteries. Lithium-sulfur batteries could be lighter and more cost-effective, making them suitable for applications like electric vehicles and portable electronics.

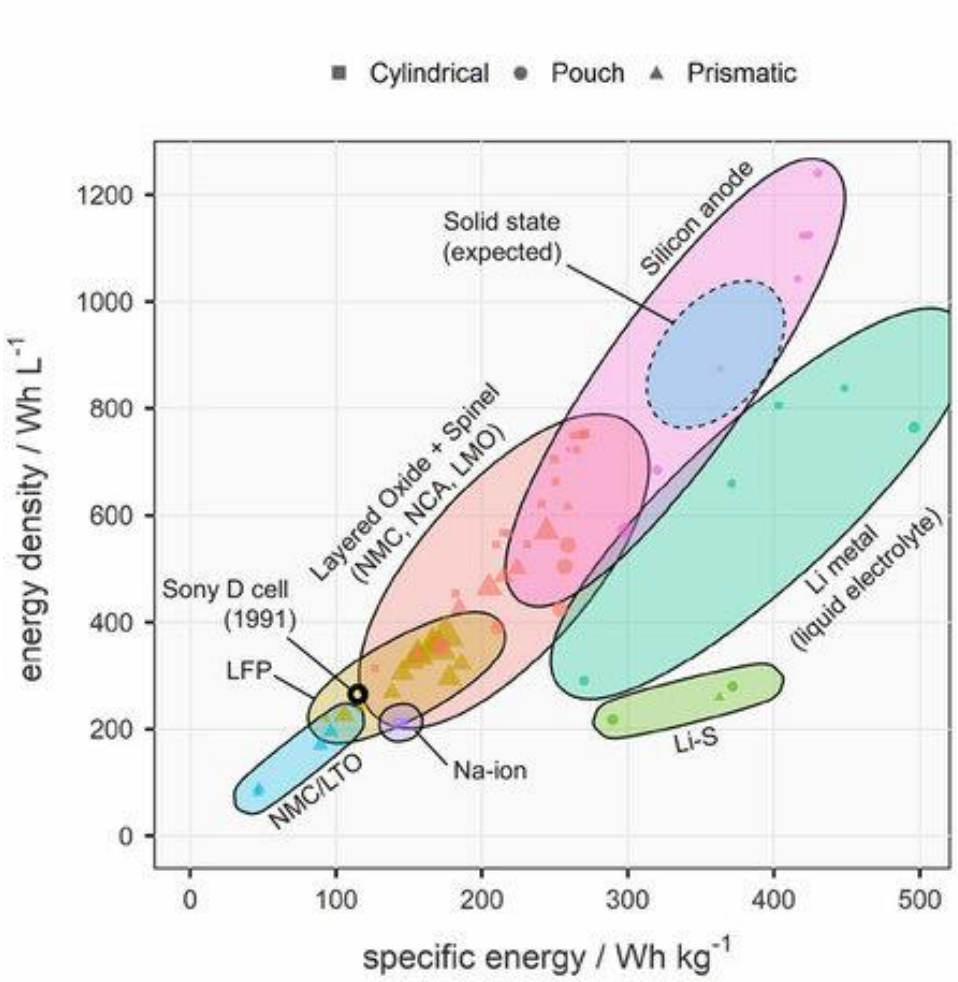
3. **Sodium-Ion Batteries**: Sodium-ion batteries are emerging as a promising alternative to lithium-ion batteries, especially given the abundance and low cost of sodium compared to lithium. They are particularly attractive for large-scale energy storage systems.

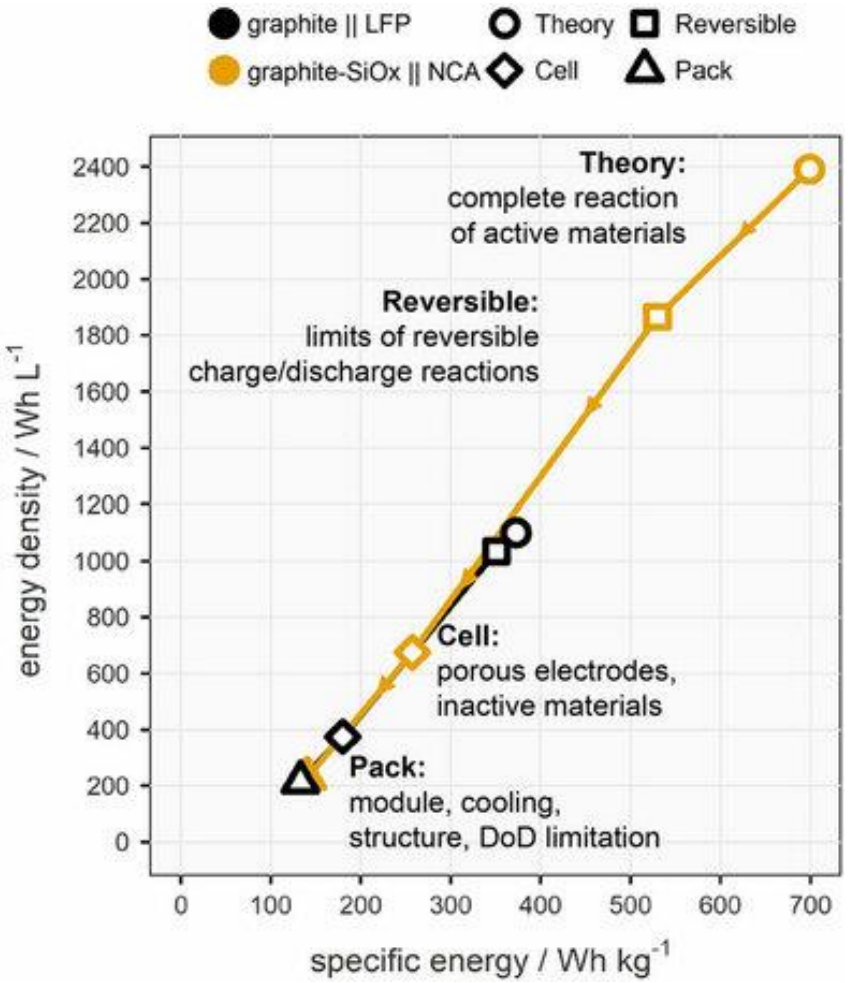
4. **Silicon Anodes**: Replacing graphite anodes with silicon in lithium-ion batteries can significantly increase their energy capacity. Silicon anodes can store more lithium ions, leading to higher energy densities. However, challenges related to silicon's expansion during charging need to be addressed.

Source: https://www.researchgate.net/publication/367435320_A_non-academic_perspective_on_the_future_of_lithium-based_batteries

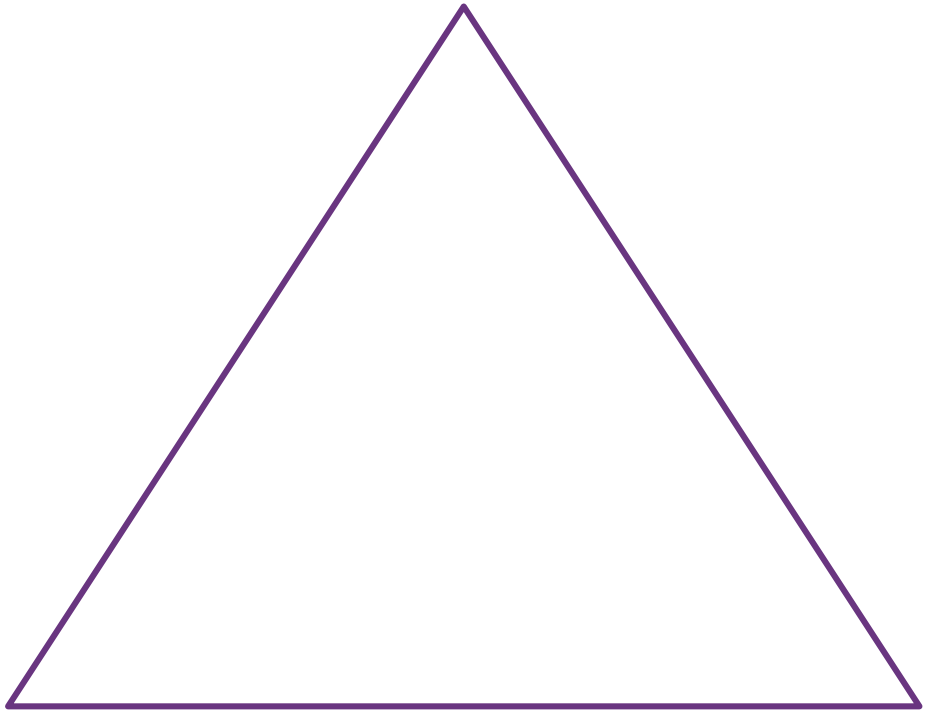
Future Energy densities

- Benzin: 9’500Wh/L





Summary



Innovation potential in your company?

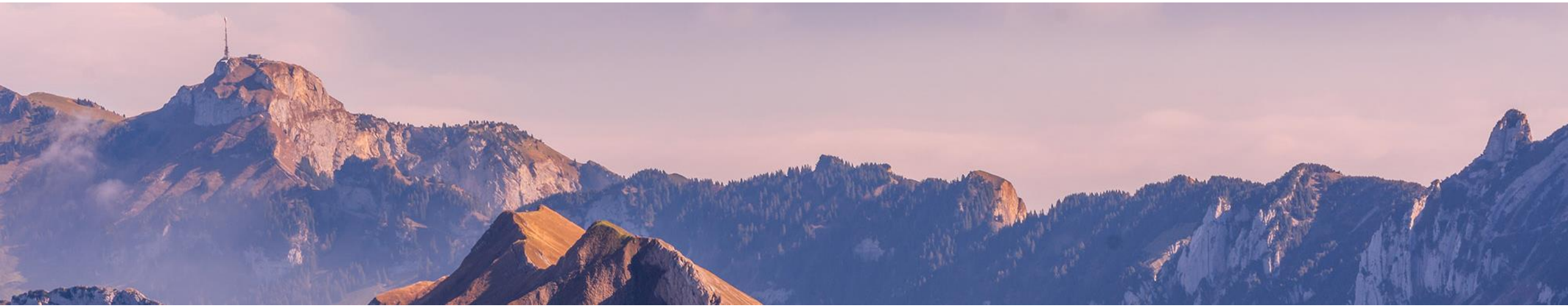
Thank you, please contact us for any questions.

Martin Stöck
Prof. Dr. sc. ETH
Head of Battery Research Group OST
https://www.ost.ch/battery

Tel: +41 58 257 3429
E-Mail: martin.stoeck@ost.ch

Institute for the Development of Mechatronic Systems EMS

OST – Ostschweizer Fachhochschule
Departement Technik
Werdenbergstrasse 4
CH-9471 Buchs / Switzerland



PROGRAMM

THURGAUER TECHNOLOGIE FORUM

▪ Einführung:	Andreas Kasier / Thurgauer Technologieforum
▪ Grundlagenreferat:	Martin Stöck / FH OST
▪ Praxisbeispiel:	Adrian Kummer / Wunderli Electronics
▪ Praxisbeispiel:	Lukas Krüsi / Styromat AG
▪ Diskussion mit Q&A	
▪ Apéro & Networking	

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Adrian Kummer CEO
a.kummer@wue.ch

März 2025

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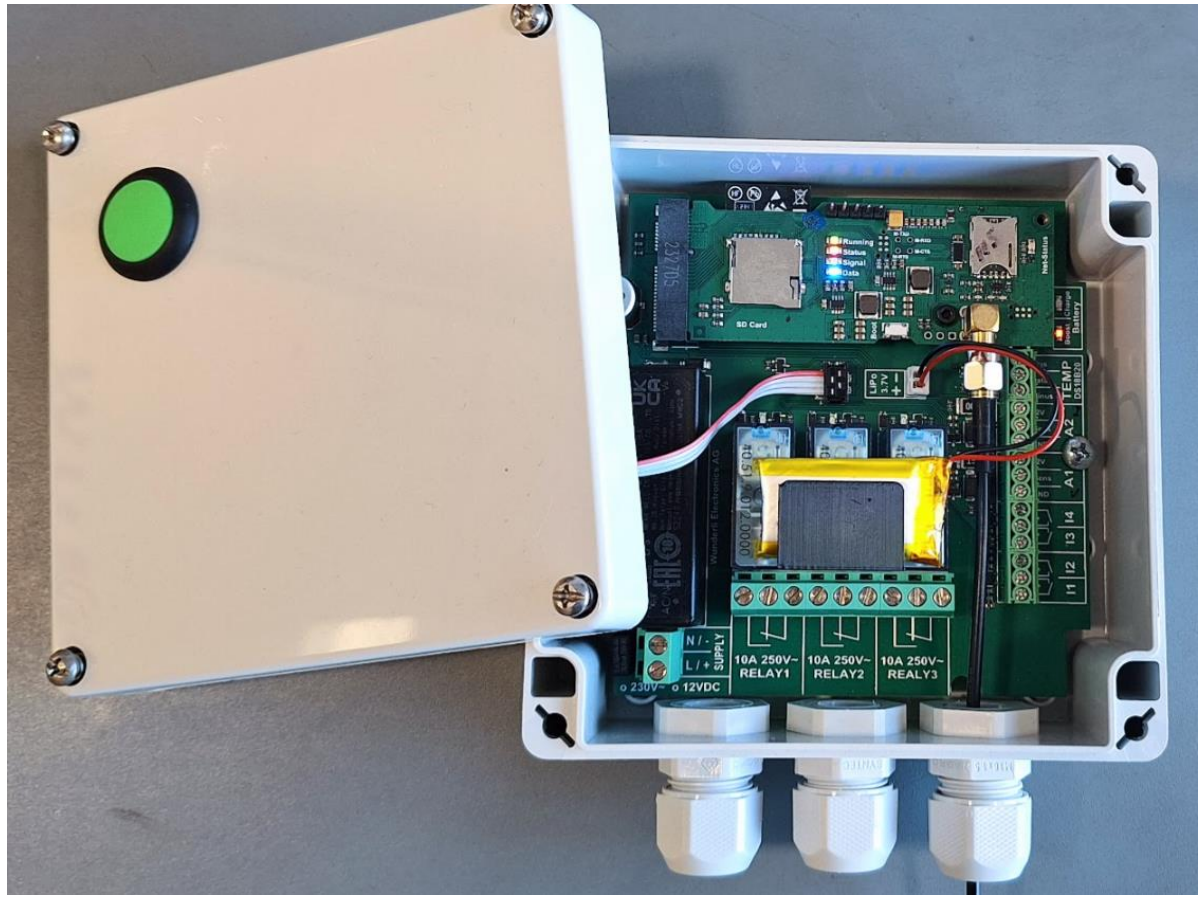
Anwendungsbeispiel: Mobile Heizung



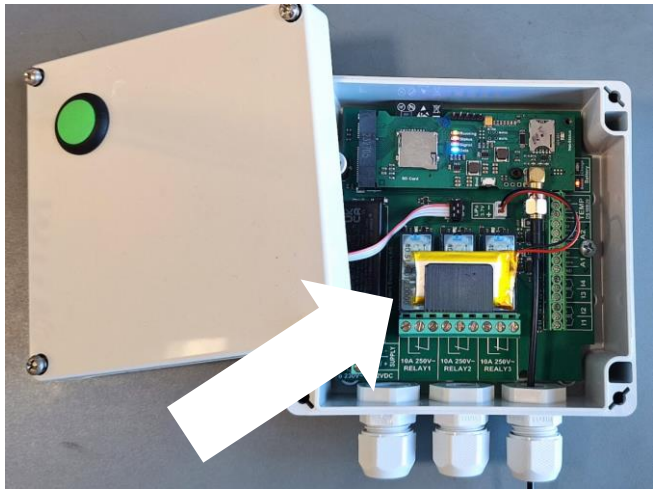
Heizsysteme für:

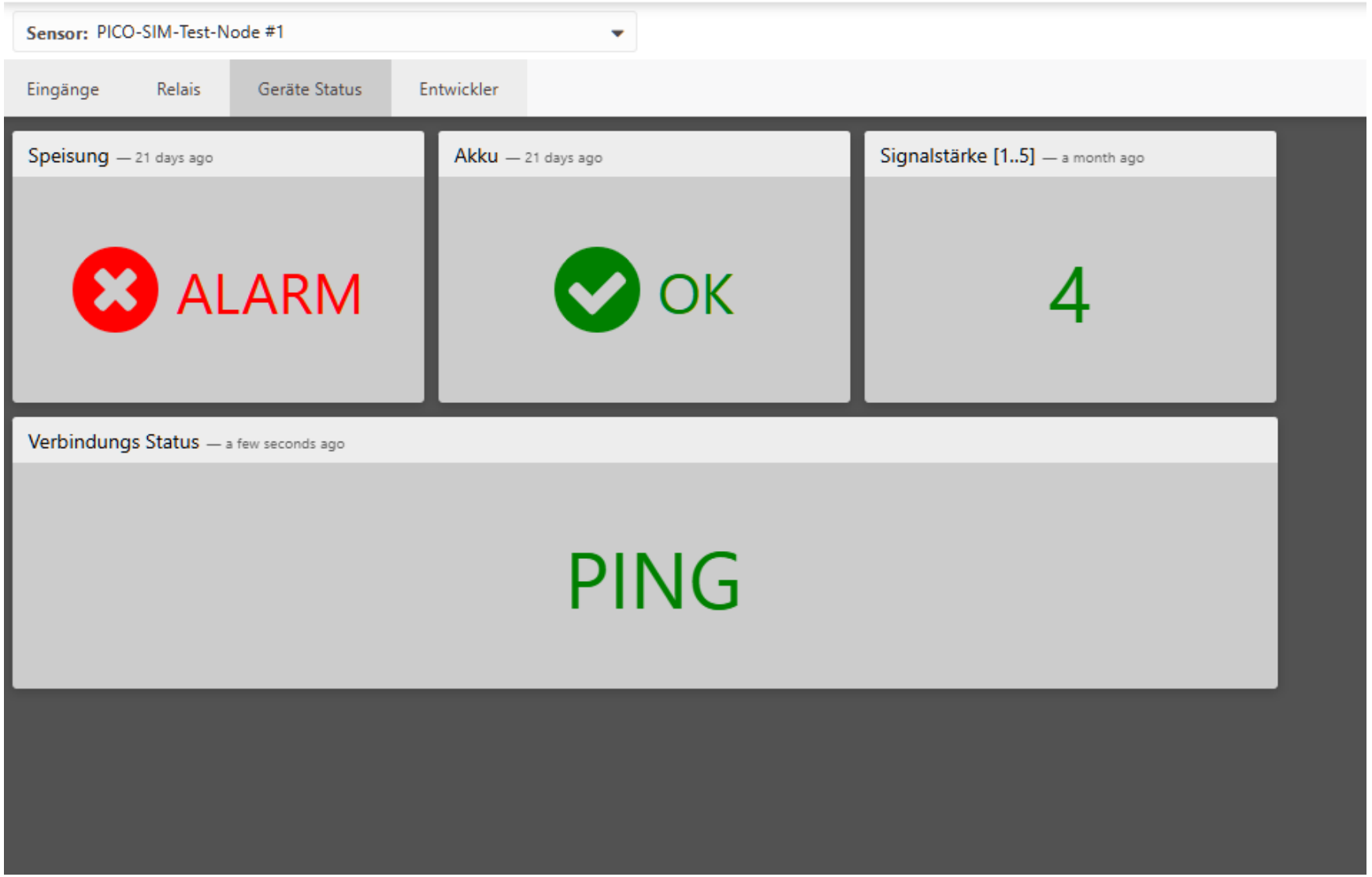
- Winterbaustelle
- Heizungssanierung
- Heizungsausfall
- Eventbeheizung

Anforderung - Mobile Heizung

- Geräte, über Mobile Netz 2G/3G/4G/5G mit der Cloud verbunden.
- SIM-Karte muss Teil der Lösung sein.
- Keine APP via Browser (PC / Smart-Phone) konfigurierbar. Alarmierung via SMS, E-Mail und Anruf.
- Temperaturregelung, Spannungsüberwachung, Pegelmessung des Öltanks, Störungseingänge und Relaisausgänge.
- Spannungsausfall muss übermittelt werden.
  3h autarker Basis-Betrieb des Geräts.

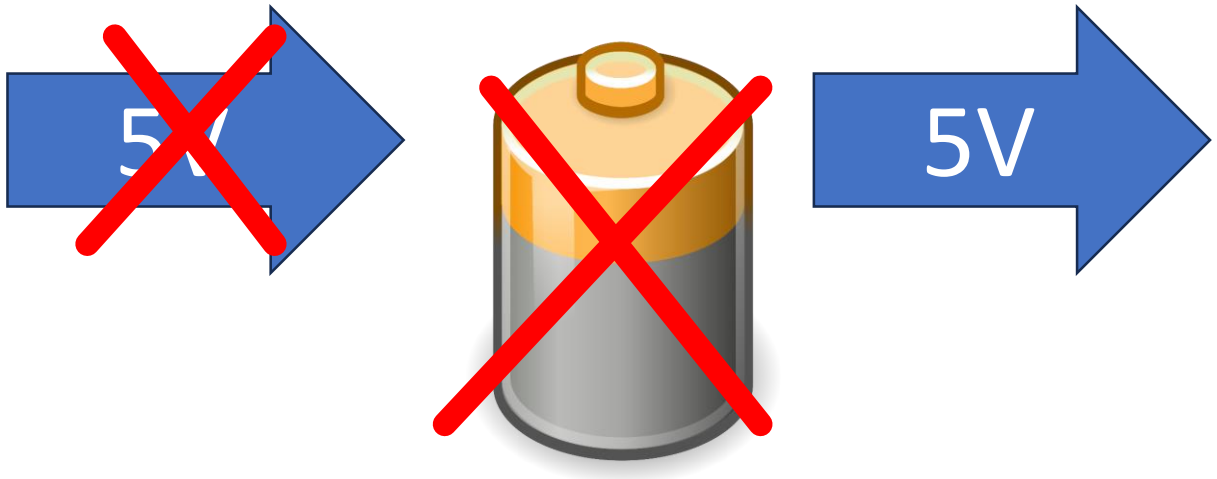
Hardware und Browser Interface





Stromversorgung

- Die Hardware benötigt eine “beefy” Versorgung mit 15W (3A) Peak für den zuverlässigen Betrieb.



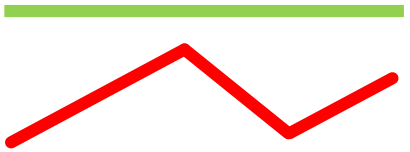
- Kandidaten:
  SuperCap / Li-Ion SuperCap / Li-Polymer / Li-Ion
  Einfachheit, Verfügbarkeit, Energiedichte, Stormabgabe, Bauform, ...

Herausforderungen Li-Po / Li-Ion

- Überladung

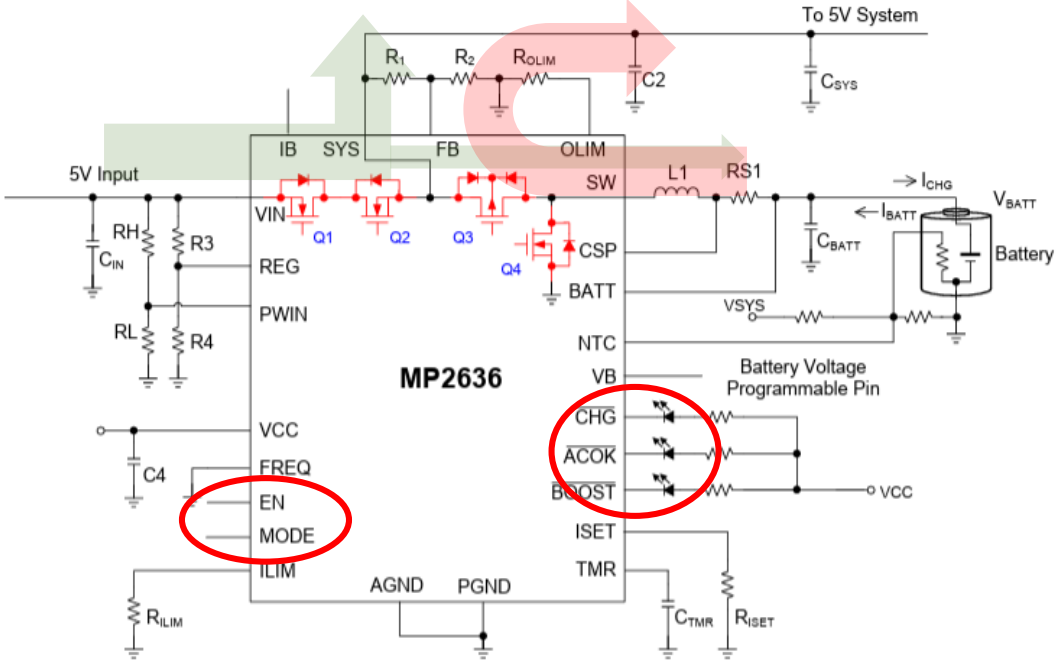
- Tiefentladung

- Spannungspegel 5V
  Li-Po Akku 3V-4.2V



MP2636 - 3A Lader

- Ladestrom- und Ladespannungsbegrenzung
- In 5V, Out 5V mit Booster
- Betriebsmodus Wahl
  - Charging
  - Pass Through only
  - Sleep (OFF)
- Akku Temperatur Überwachung
- Stromüberwachung Boost-Betrieb
- Unterspannungsabschaltung fehlt, jedoch
  - mittels Betriebsmodus extern
  - oder durch Battery Protection Circuit

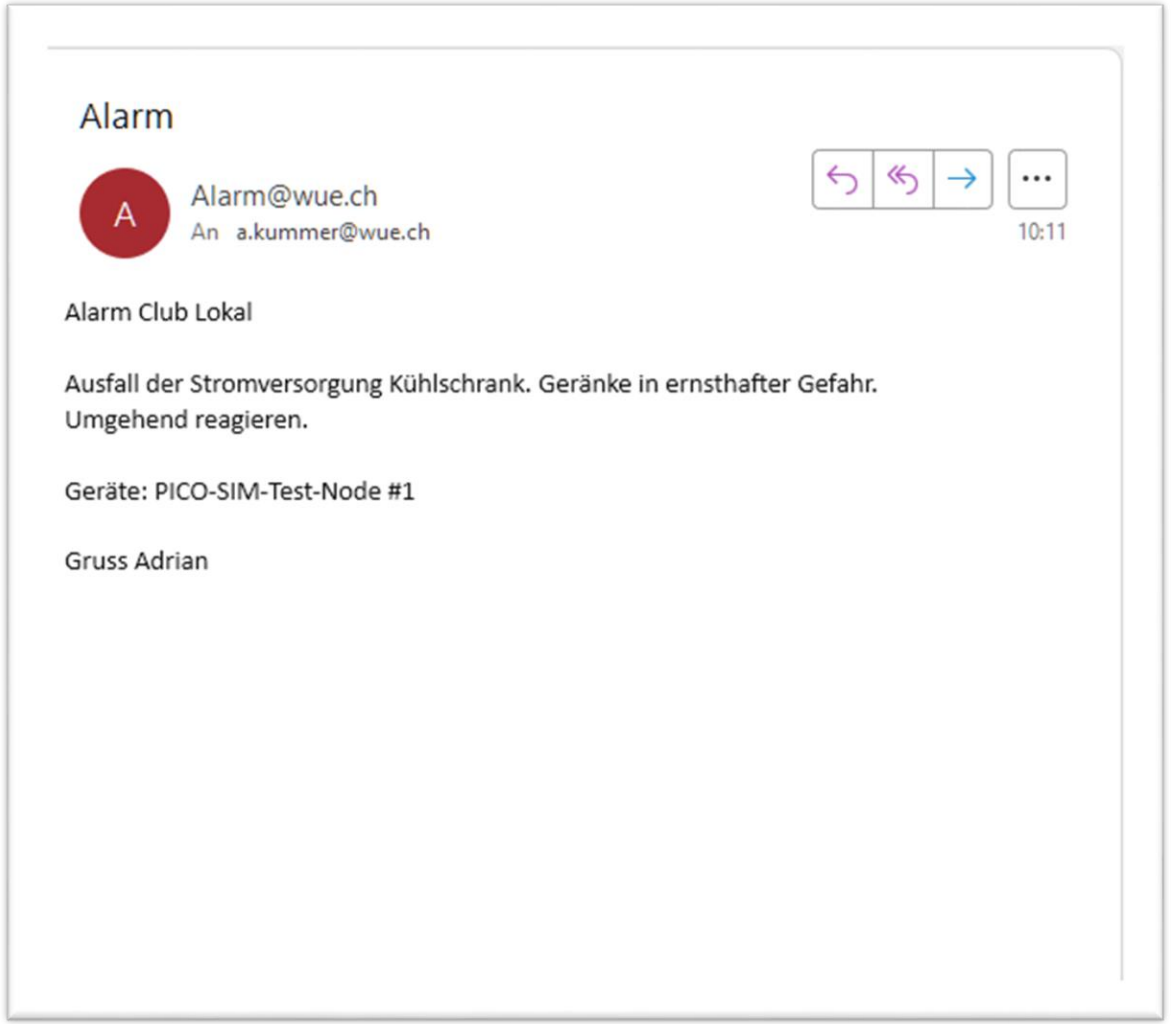


Source: Monolithic Power Systems

Herausforderung => Ausblick

- Abdeckung mobiler Netze
  LoRaWAN, TTN, LTE Cat M1 (LTE-M), NB-IoT, 5G, …
- SIM/eSIM Preis pro MB oder Monat relativ hoch
  200Byte alle 5min ca. 2MB
- Akku ist ein Fremdkörper im Produkt
- Akku Lebensdauer ist endlich (Zyklen)

Demo: Spannungsüberwachung



WUNDERLI

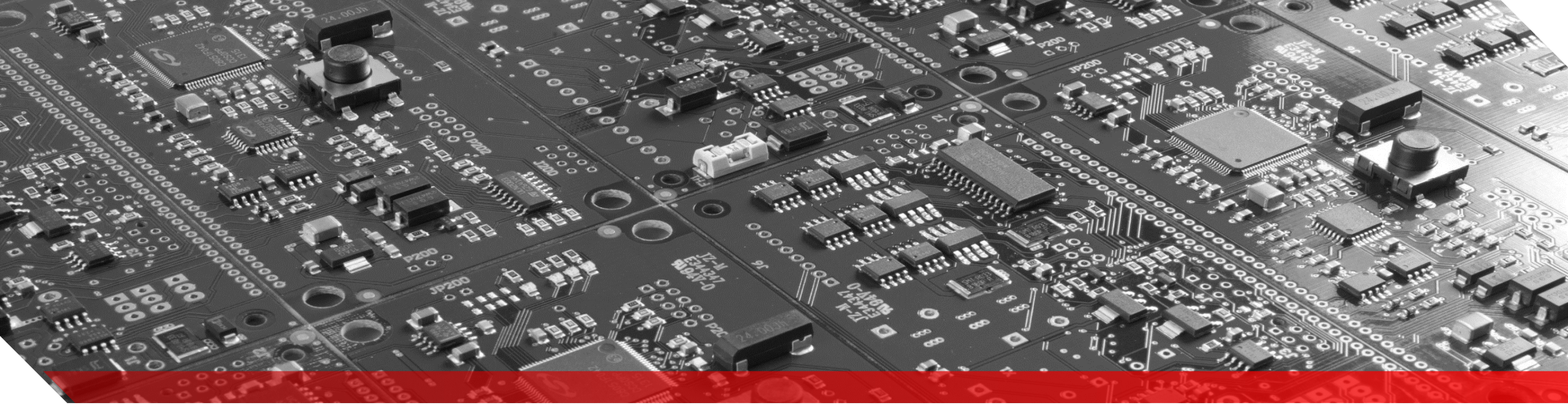
Electronics AG

Oberfeldstr. 13 | CH-8570 Weinfelden

PROGRAMM

THURGAUER TECHNOLOGIE FORUM

▪ Einführung:	Andreas Kasier / Thurgauer Technologieforum
▪ Grundlagenreferat:	Martin Stöck / FH OST
▪ Praxisbeispiel:	Adrian Kummer / Wunderli Electronics
▪ Praxisbeispiel:	Lukas Krüsi / Styromat AG
▪ Diskussion mit Q&A	
▪ Apéro & Networking	



THURGAUER TECHNOLOGIEFORUM

Energiespeicher-Technologien & ihre Anwendungsmöglichkeiten

Veranstaltung vom 20.03.2025 in Amriswil

Lukas Krüsi

20.03.2025

STYROMAT SWISS

Styromat AG
Firmenportrait

- Styromat AG seit 1983
- Entwicklung und Produktion von Elektroniklösungen im Kundenauftrag
- Seit Sommer 2016 bei Lukas Krüsi (Geschäftsführer und Inhaber)
- Bruder Jonas Krüsi seit Oktober 2017 (Entwicklungsleiter und Inhaber)
- Rund 25 Mitarbeiter
- Insgesamt 7 Ingenieure für Produktentwicklungsprojekte
- Kunden grossmehrheitlich CH, wenig EU-Raum
- Kompetenzen und Produktionsmaschinen für Bestückung, Löten, Prüfen und Montieren von Elektroniksystemen
- Elektronik Service-Dienstleistungen als Fertigungspartner (Bauteilemanagement, Produktions-kostenoptimierungen, Prototypenfertigung etc.)
- Qualitätsmanagement ISO9001:2015

Unsere Kompetenzen

Das Dienstleistungsspektrum der Styromat AG

Entwicklung

- Elektronik-Hardware
- Firmware
- Applikations-Software
- Mechanik
- Mechatronische Systeme
- EMV-Zertifizierungsbegleitung

Industrialisierung

- Optimierung Herstell-unterlagen
- Prototypenfertigung
- Aufarbeitung / Digitalisierung von Unterlagen
- Testings / Zulassungen

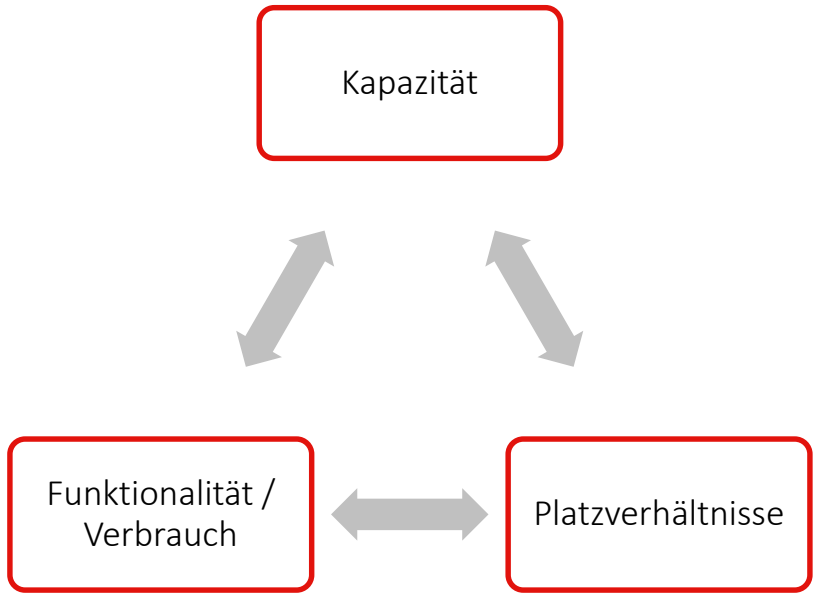
Produktion

- Beschaffung / AVOR
- SMT und THT-Bestückung
- Baugruppenmontage
- Kabelkonfektion
- Reinigung / Lackierung / Programmierung / Prüfung

Services

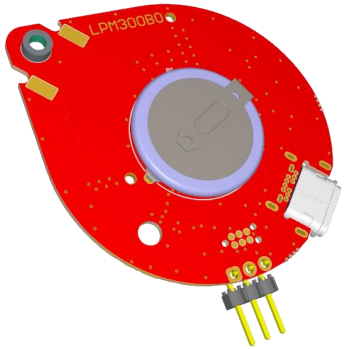
- Bauteilmanagement
- Lagerung von Einzelteilen (Last Time Buy)
- Firmware-Updates
- Reparaturen ganzer Geräte
- Lieferkettenüberwachungen

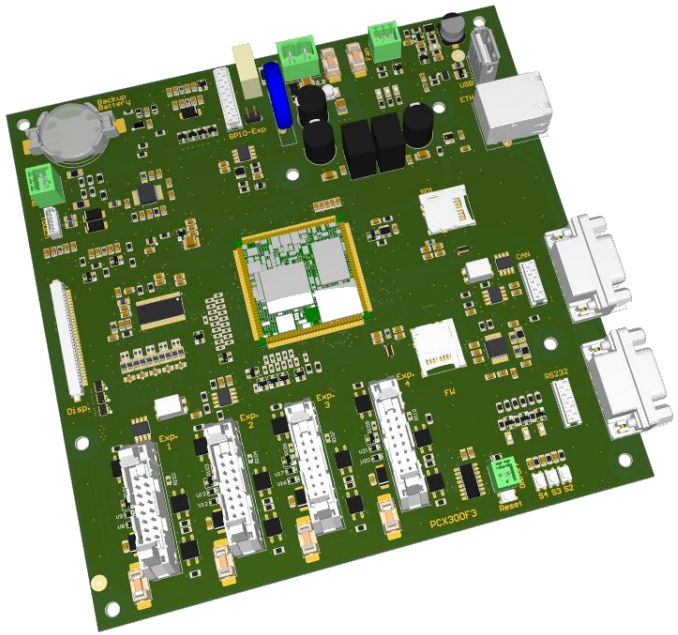
Unsere Herausforderungen bei Batterie-Anwendungen

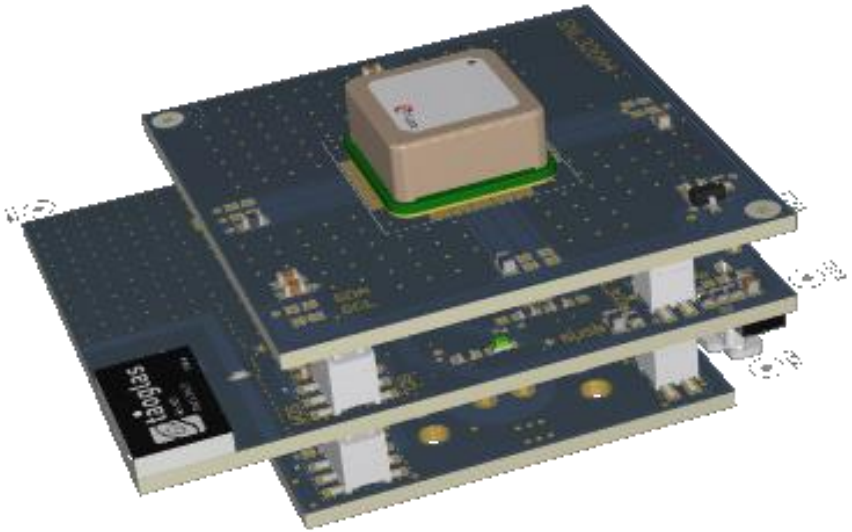


- Was wenn die Batterie leer ist?
- Wie und wie schnell lade ich den eingesetzten Akku wieder auf?
- Wie kontaktiere ich die Batterie mit der Elektronik?
- Wie schütze ich die Batterie / Elektronik vor äusseren Einflüssen?
  - Feuchtigkeit, Temperatur, Vibration, etc.
- Wie vermeide ich ungewollte Verluste?
- Wie sieht die Lebensdauer aus?
- Wie steht es um die Nachhaltigkeit?
- Wie sind die Regulatorien?
- Was kostet die Batterie im Serienprodukt?
- etc.

Einige Anwendungs- und Einsatzbeispiele





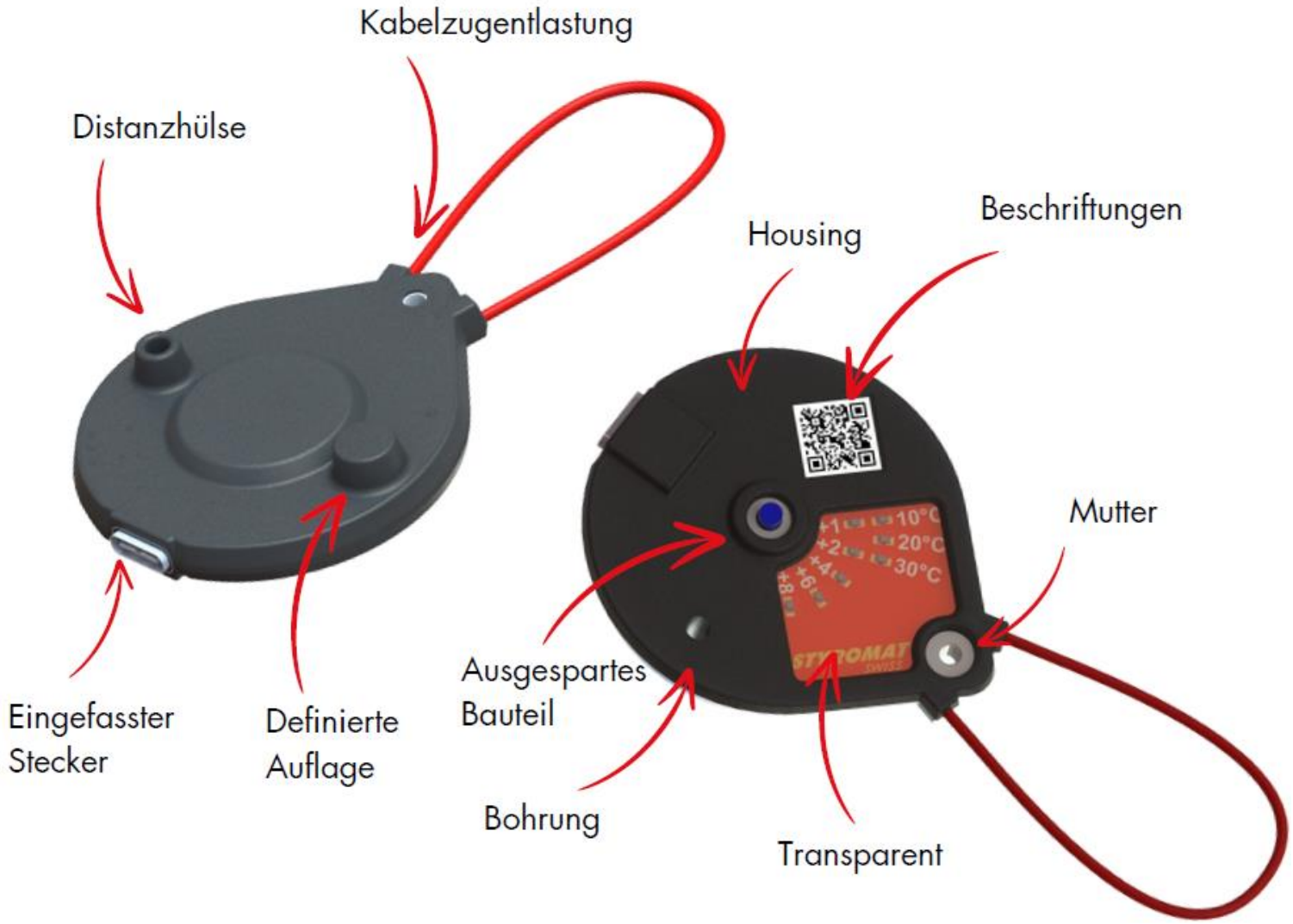


Parkfeld-Detektor

Reinigungsmaschine

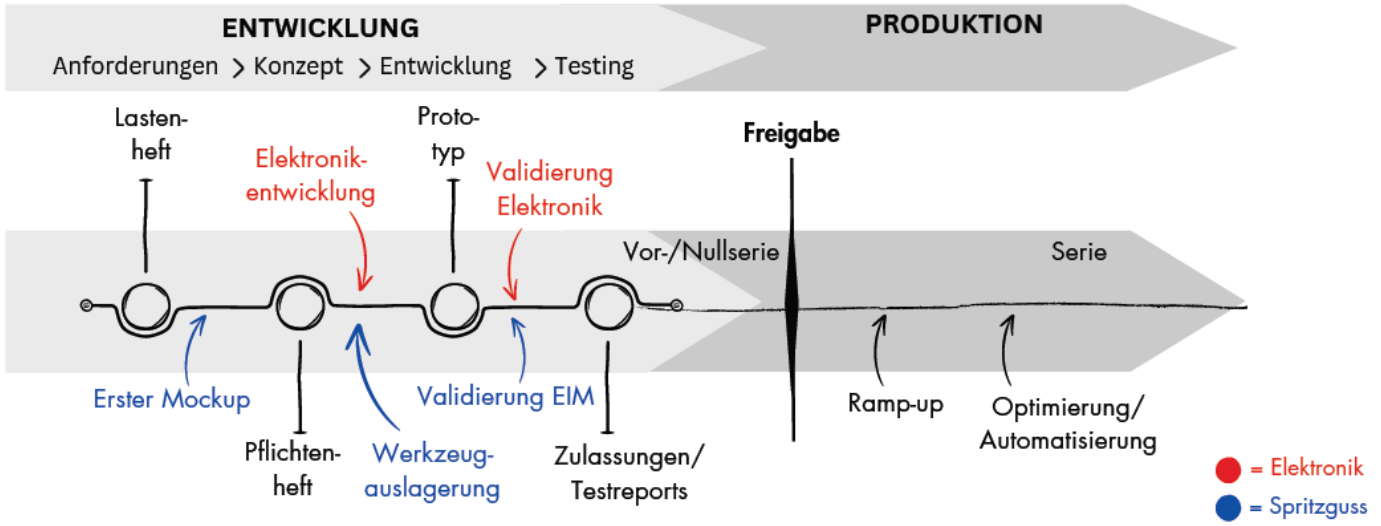
Der Schutz – eine Spezialität von uns

EIM: Electronic Insert Molding



Vorgehen und Vorteile

- Schutz von kritischen Elektronikbauteilen vor verschiedenen äusseren Einflüssen
- Höherwertige Integration unterschiedlicher Produktfunktionen
- Dank kurzer Zykluszeiten auch für sehr grosse Stückzahlen geeignet
- Viele Freiheiten in der Formgebung und Materialisierung (auch UL)
- Reduktion von Einzelteilen führt zu Kostenvorteilen und weniger Fehlern
- Miniaturisierung von ganzen Elektronikbaugruppen
- Schnelle Realisation erster Mockup/Prototypen dank neuer Fertigungsverfahren

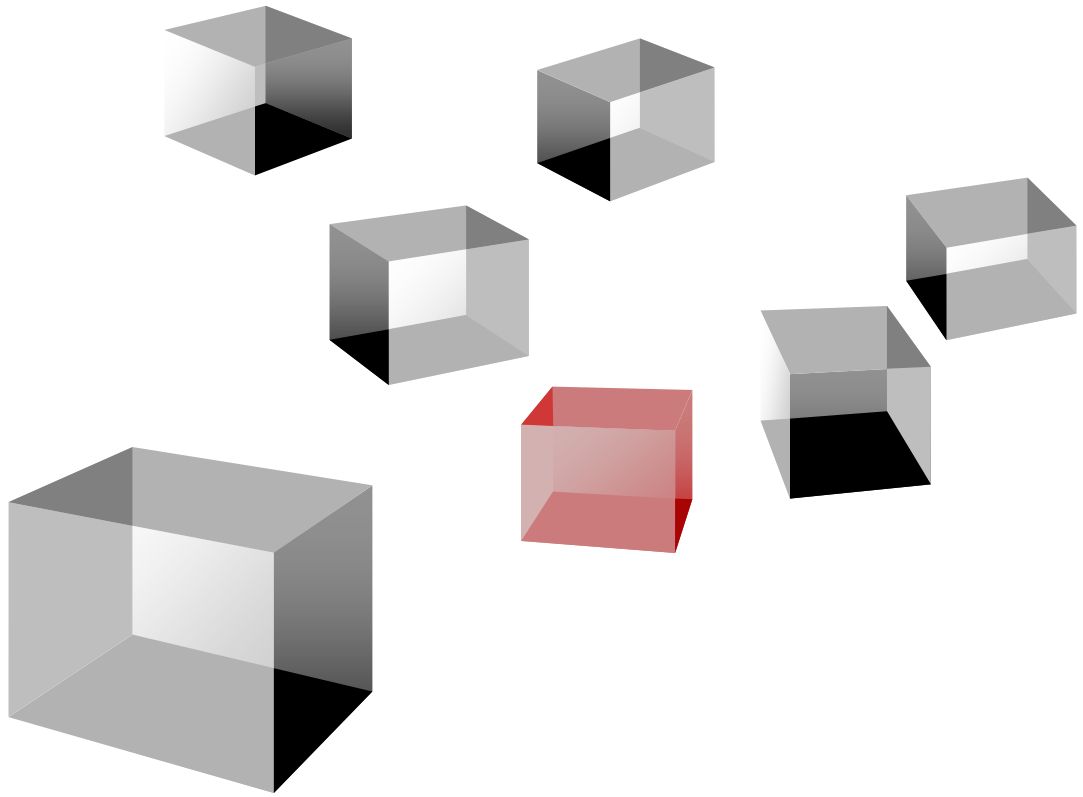


Styromat AG

Kundenorientierte Elektronikdienstleistungen in bester Schweizer Qualität

Weinfelderstrasse 113
CH-8580 Amriswil

Tel. +41 (0)71 414 04 40
www.styromat.ch



Ihr Kontakt:

Lukas Krüsi
CEO / Inhaber

Q&A

THURGAUER TECHNOLOGIE FORUM

Martin Stöck
IDEE / OST FH

Adrian Kummer
Wunderli Electronics

Lukas Krüsi
Styromat

THURGAUER
TECHNOLOGIE
FORUM

NÄCHSTER INNOVATIONSANLASS

22.05.2025

Prozesse digitalisieren mit der «Power Platform»
– Potenziale entdecken und konkret umsetzen

Träger

IHK Industrie- und Handelskammer Thurgau

GEWERBE THURGAU

Thurgau

Hauptsponsor

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