Abfallverwertungstechnik & Abfallwirtschaft

"Li-Ion-Battery Recycling – From Research Idea to Industrial Plant Solution

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MONTAN UNIVERSITÄT

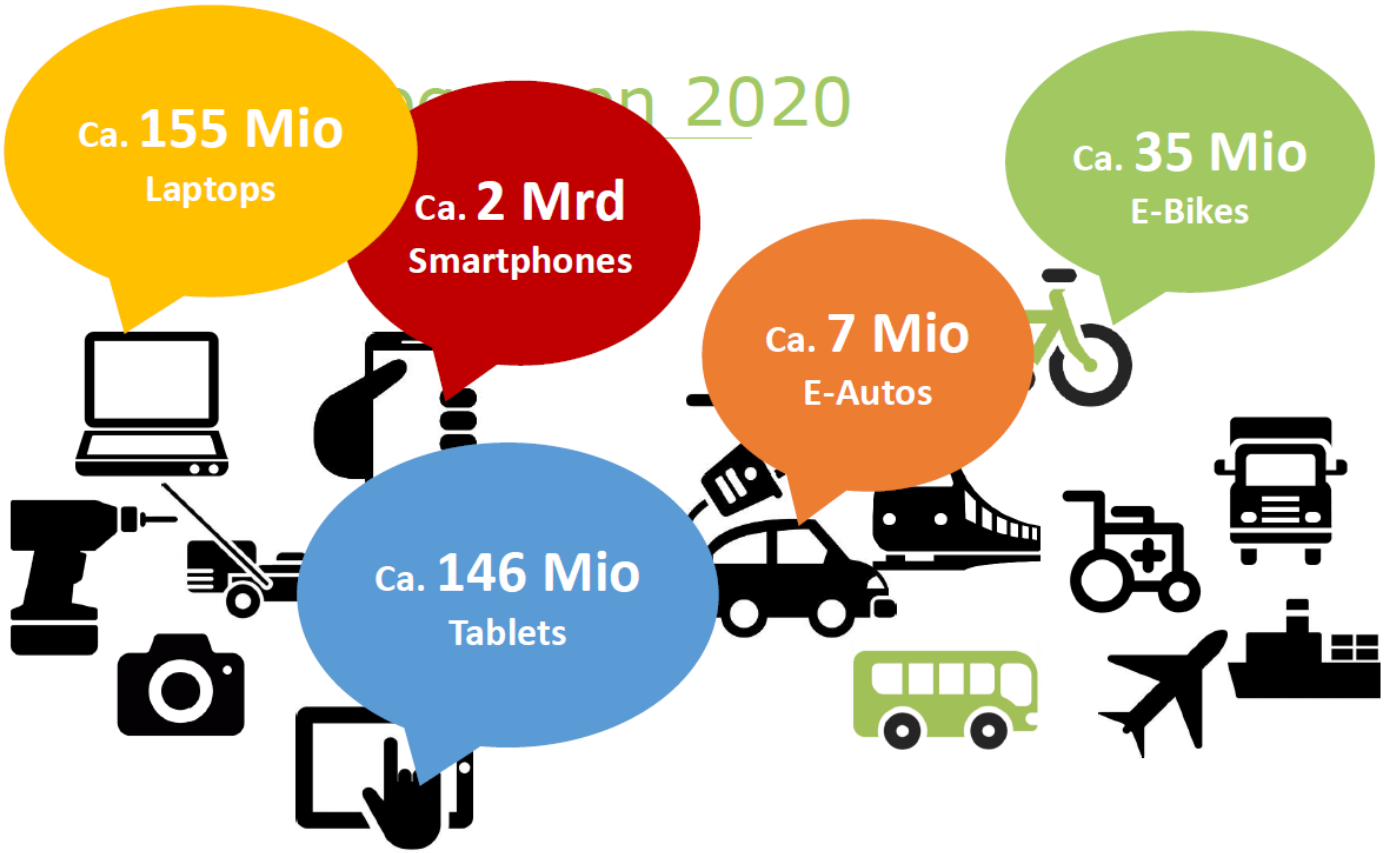
Content

1. Challenges of Li-Ion-Battery Recycling
2. What about Lithium?
3. Recycling solutions
4. Fire risk
5. Conclusion

1. Challenges

Large increase in volume

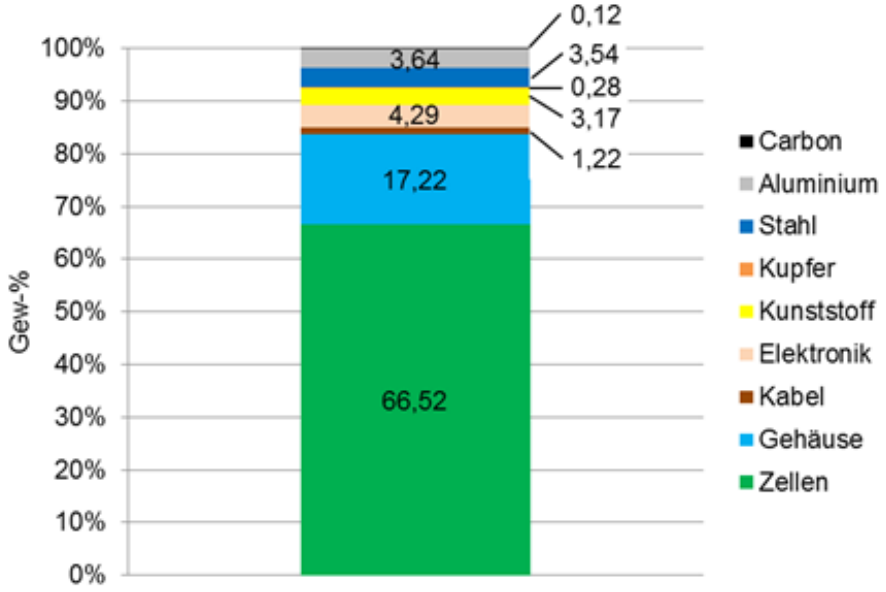
Every product becomes **waste** – it is just a **question of time**!



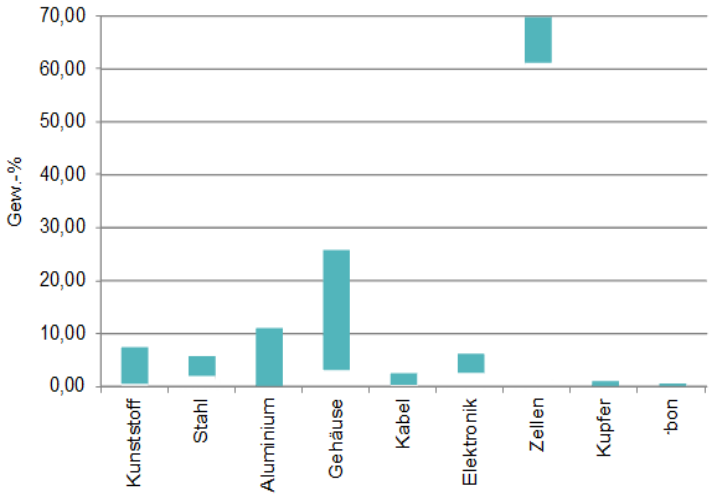
Weltweite Prognosen (units), Quelle: Statista.com

Very different material composition

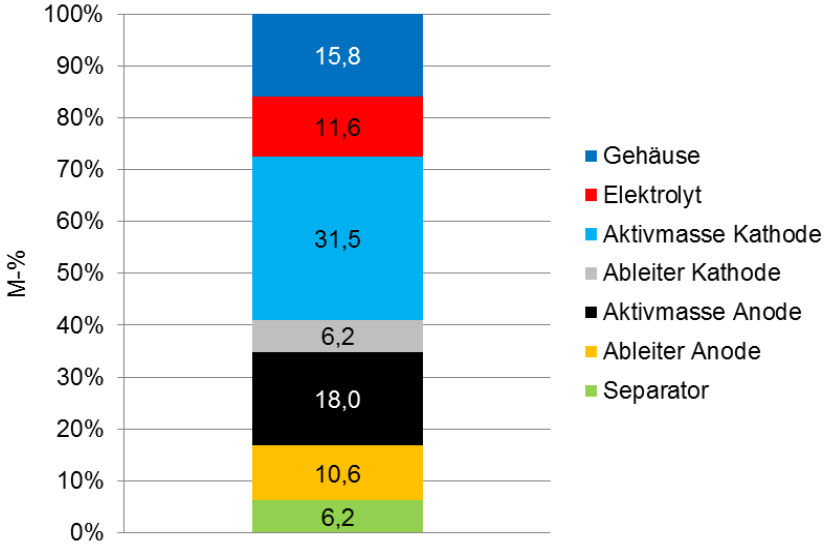
ESS average



ESS range



Cell average



Recycling process
must deal with changing chemical and material composition over a long time

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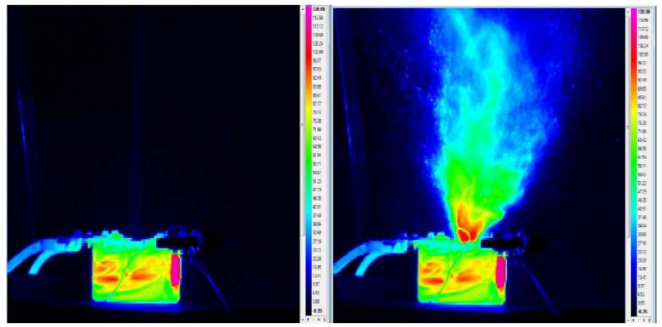
Challenges of processing

- Flammable material
  - Organic solvents
  - plastic
- Electrically stored energy (ignition source)
- Risk of short circuit
  - Improper storage
  - Damaged cells and batteries
- Thermal load



- High voltage and state of charge
- Flammable and toxic electrolyts
- Exhaus gas volumes and composition by thermal treatment (compounds with fluorine)
- Thin foils with coating – separating the coating
- Separating thin foils of Cu and Al
- Enrichment of Co and Ni

Challenges of safety

- Safe **transport** and **collection**
- **Problem of storage**

Quelle: Saubermacher

https://grs-servicegmbh.de/portfolio/gefahrgutbehaelter-fuer-lithiumbatterien/

Quelle: Saubermacher

Challenge of presorting

- goal: sorting of different LIB by activ materials

QR-Code

Data Matrix

Barcode

- wish: allow clear assignment of cells by cell chemistry
- To get high concentrated output fraction

3

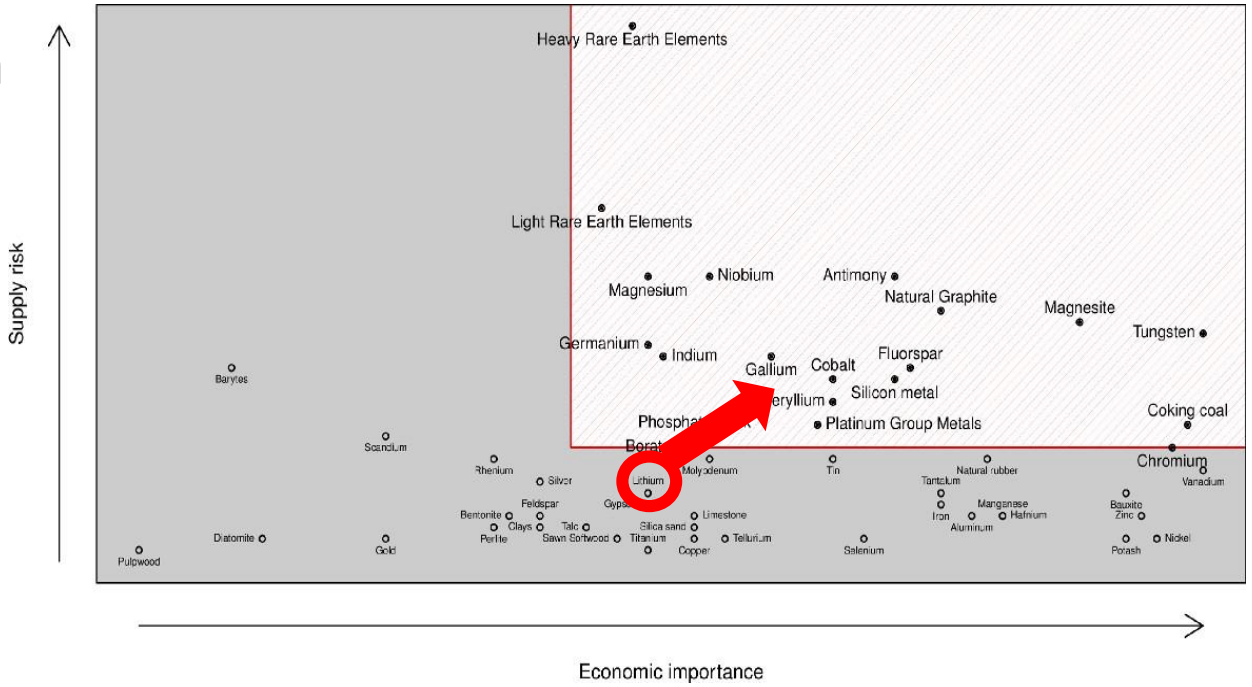
Li

Lithium

6.941

Is it about Lithium ?

- By definition of EU ?
- **NO**
- … but maybe on the way



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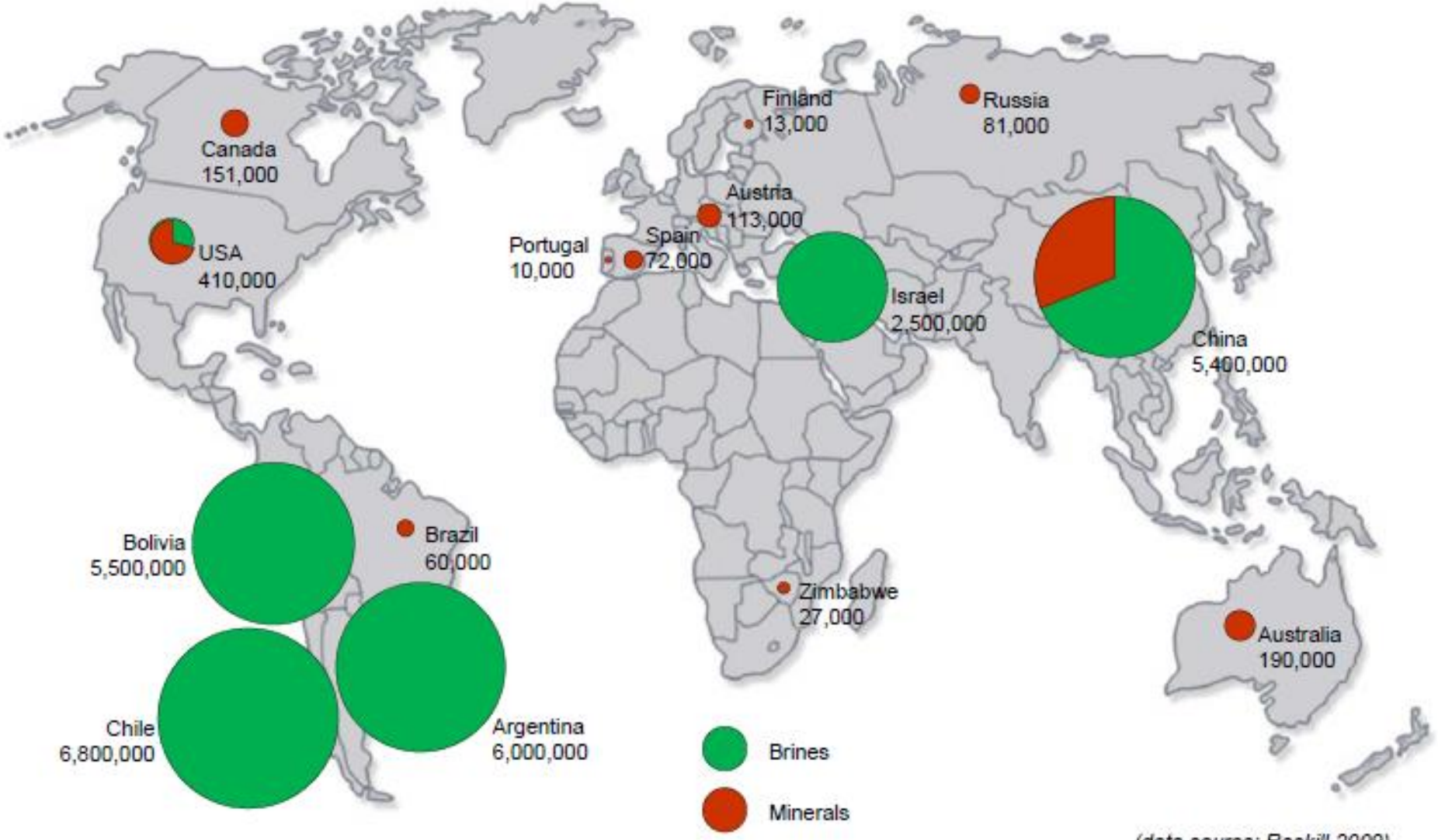
Where are the Li ressources?

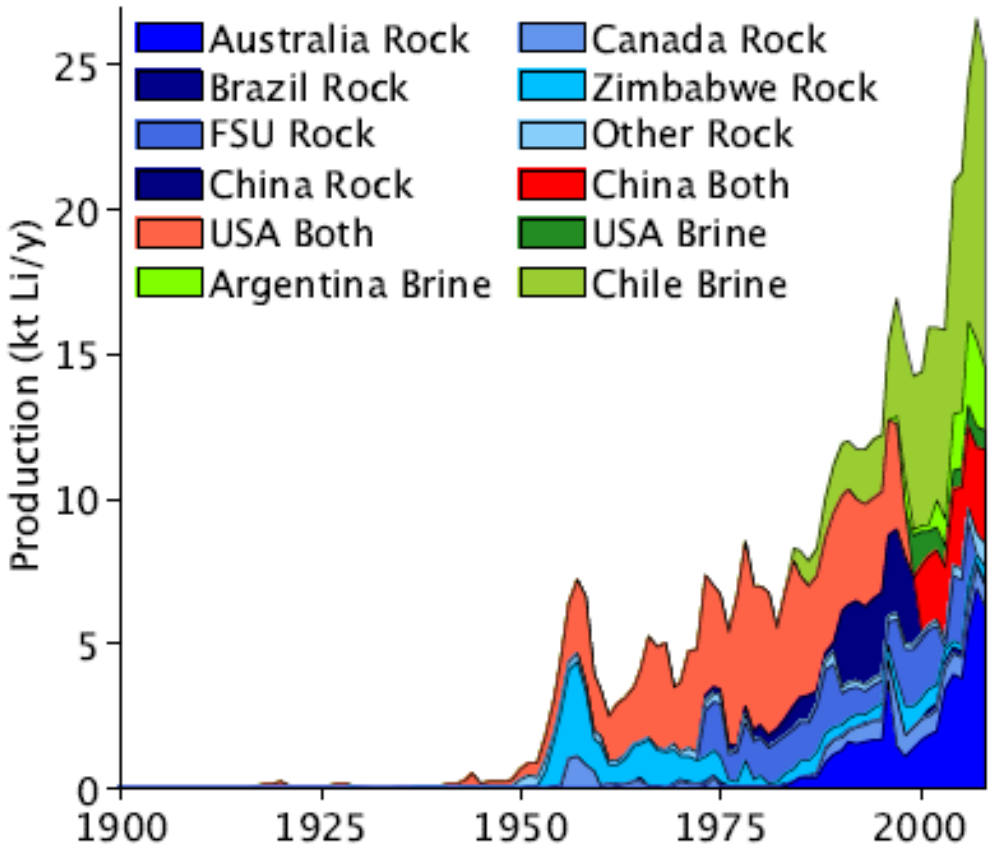


(data source: Roskill 2009)

S. Ziemann 2014

Primary Lithium production

Figure 1. World production of lithium by country and mineral type (blue colours are rock, green colours are brines and red colours contain both rock and brine—see electronic supplement for a spreadsheet file of these values) [2,4–13].



2017

43.000 t

https://investingnews.com/daily/resource-investing/energy-investing/lithium-investing/lithium-producing-countries/

Cu 600 times
Al 1700 times
Fe 45 000 times
of production

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Are we running out of Lithium?

Derzeitige Li Produktion ca. 43 000 t/a (2017)

2050 erwartet: 305 – 485.000 t/a

Nur aus **Salzseen**:

Statische Reichweite bei derzeitigem Bedarf: **1450 Jahre**

Würden wir **485.000 t/a** benötigen: 108 Jahre

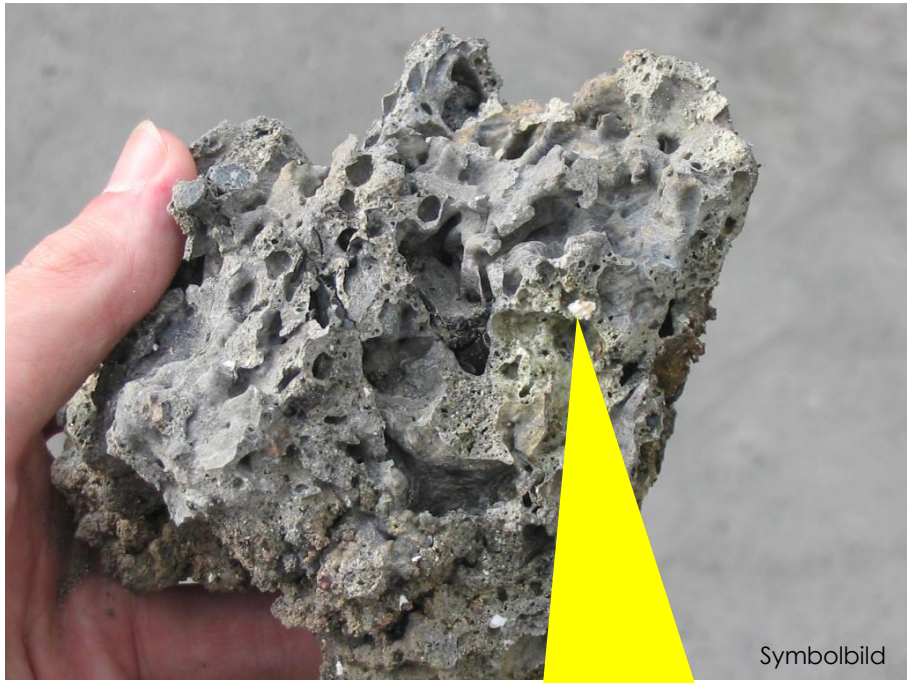
Is recycling of Li technically feasible?

Can Li recycling compete with mining?

Is it possible to recycle Lithium ?

YES,
by pyrometallurgical Recycling process

Umicore Battery Recycling facility, Hoboken, Belgium.



Special Li-minerals in slag
Possibility for recycling of Li

Recycling solutions

Research projects at Montanuniversität

Re2Ba

seit 2014

eMPROVE

seit 2014

LIBRES

2010 bis 2014

BAT-Safe

seit 2015

HYDRA

Seit 2018

MAGNA

SAMSUNG

SAMSUNG SDI

MONTAN UNIVERSITÄT

WWW.UNILEOBEN.AC.AT

Saubermacher

ERA

Elektro Recycling A

KTM

AVL

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Redux Recycling GmbH

- Eines der führenden Batterie Recyclingunternehmen in Europa
- Marktanteil von 40% im Bereich Haushalts-und Gerätebatterien
- 2 Betriebsstätten in Offenbach und Bremerhaven
- 80 Mitarbeiter in DE
- Universelle- und patentierte eigene Recyclinganlagen

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Verwertung

Energiespeicher-
system (ESS)

Masse:	255 kg
Spannung:	675 V
Nennenergie:	27,6 kWh

Verwertung

Energiespeicher-system (ESS)

↓

Demontage

↓

Entladung

Entladestation in Offenbach mit Netzeinspeisung

Verwertung

Energiespeicher-system (ESS)

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Demontage

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Entladung

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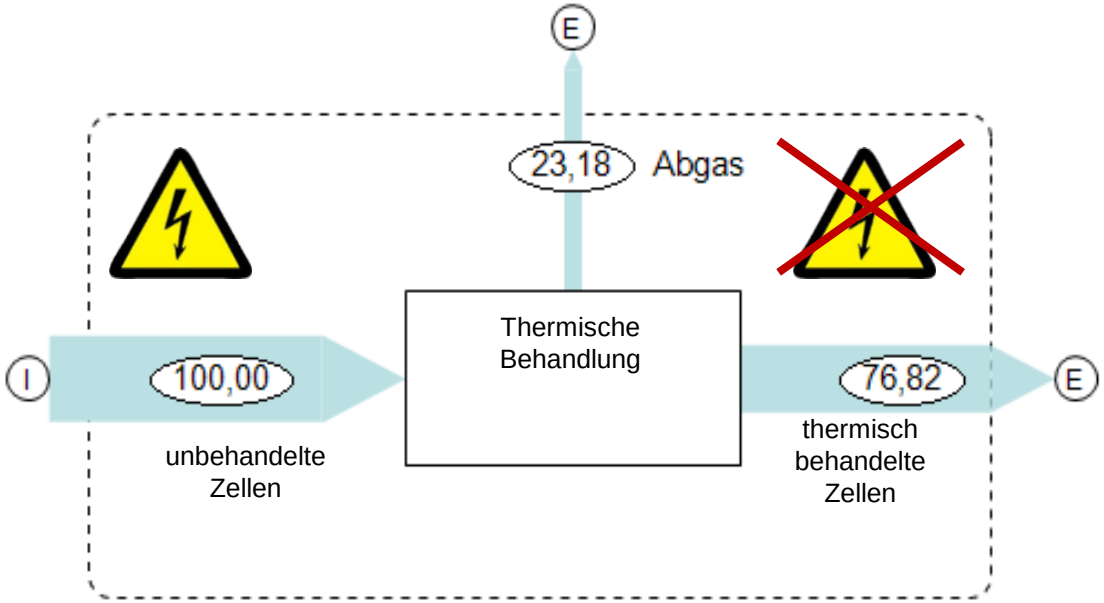
Thermische Behandlung → Abgasreinigung



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Verwertung

Energiespeicher-system (ESS)

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Demontage

↓

Entladung

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Thermische Behandlung

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Mechanische Aufbereitung

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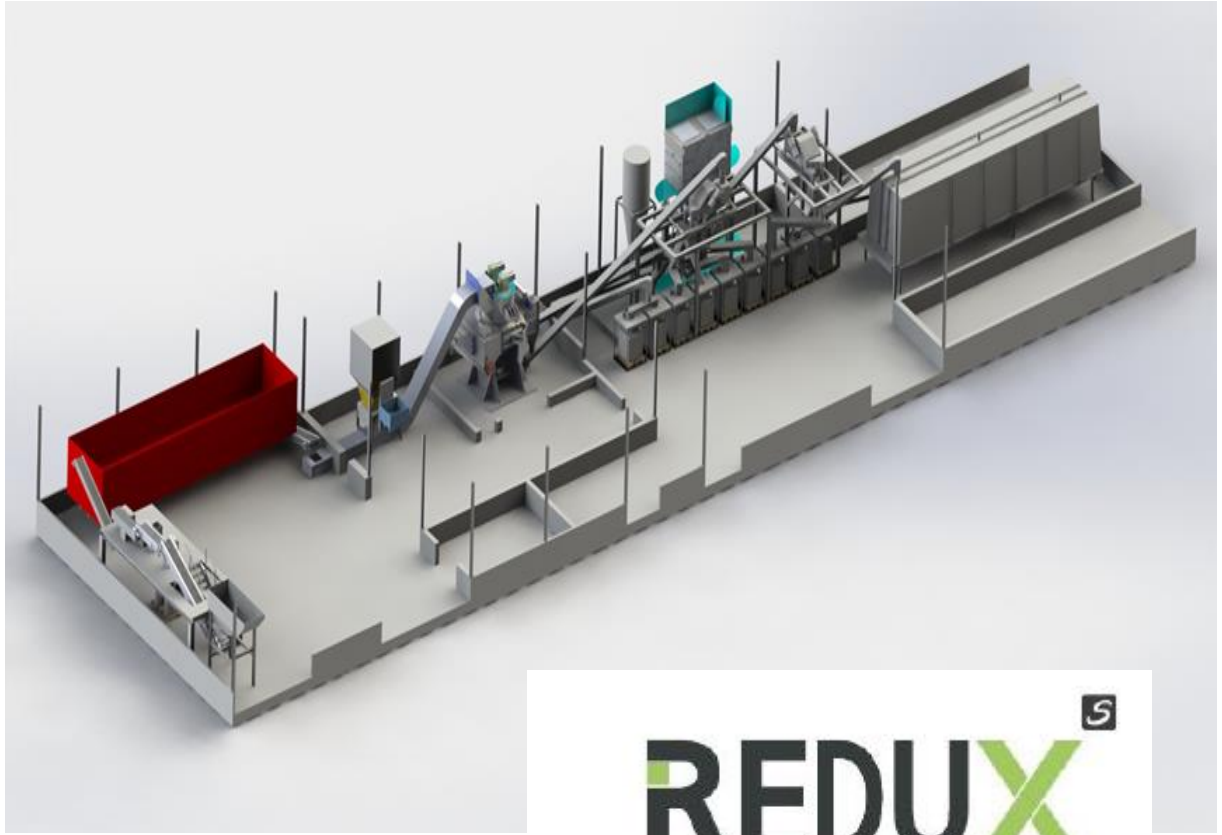
Aktivmaterial | NE-Metalle | Fe-Metalle

Technikum

Recycling plant in Bremerhaven

Result of cooperative research



- Capacity 10.000 t/a
- throughput: 5 t/h
- Output

Al

Al/Cu

Activmaterial

Start June 2018

REDUX
Smart battery recycling.

Saubermacher

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Impressions from the new recycling plant

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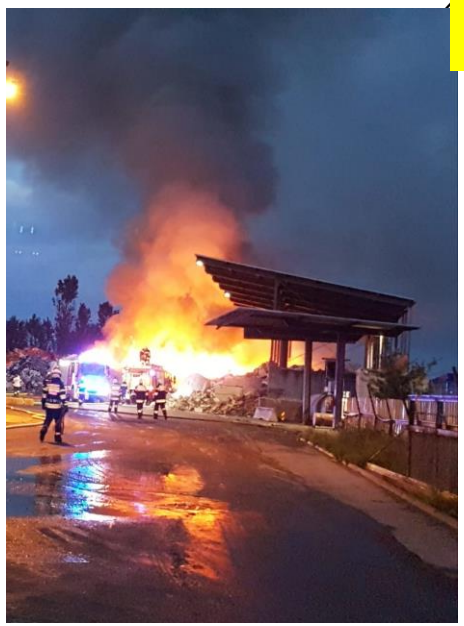
Fire risk in waste plants !

tätten

Just fires in **waste plants** of **Styria** with cause **battery**



2017 BA Fohnleiten

2018 Müllex

2017 Peggau

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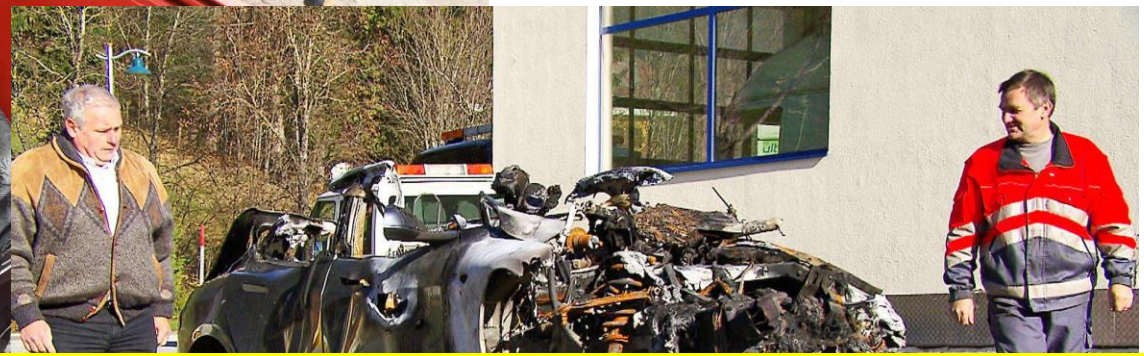
Fire in battery recycling plant

Fire at REDUX, Offenbach caused by stored Li-Ion Battery
15.May 2019

Problem Crash e-cars



OEMs should immediatly start a research projekt called

„What to to do and how to recycle crash e-cars“

Today we dont know.

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Conclusion

- No fear – we are **not running out of Li**
- Li-Recycling is not our target, **it is about Co, Ni, Cu, Al and steel**
- A **new battery recycling plant** in Bremerhaven
- We must solve the **challenge of fire risk**
- What to do with **crash e-cars** ?

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