

Towards a more sustainable electric vehicle



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November 12, 2018

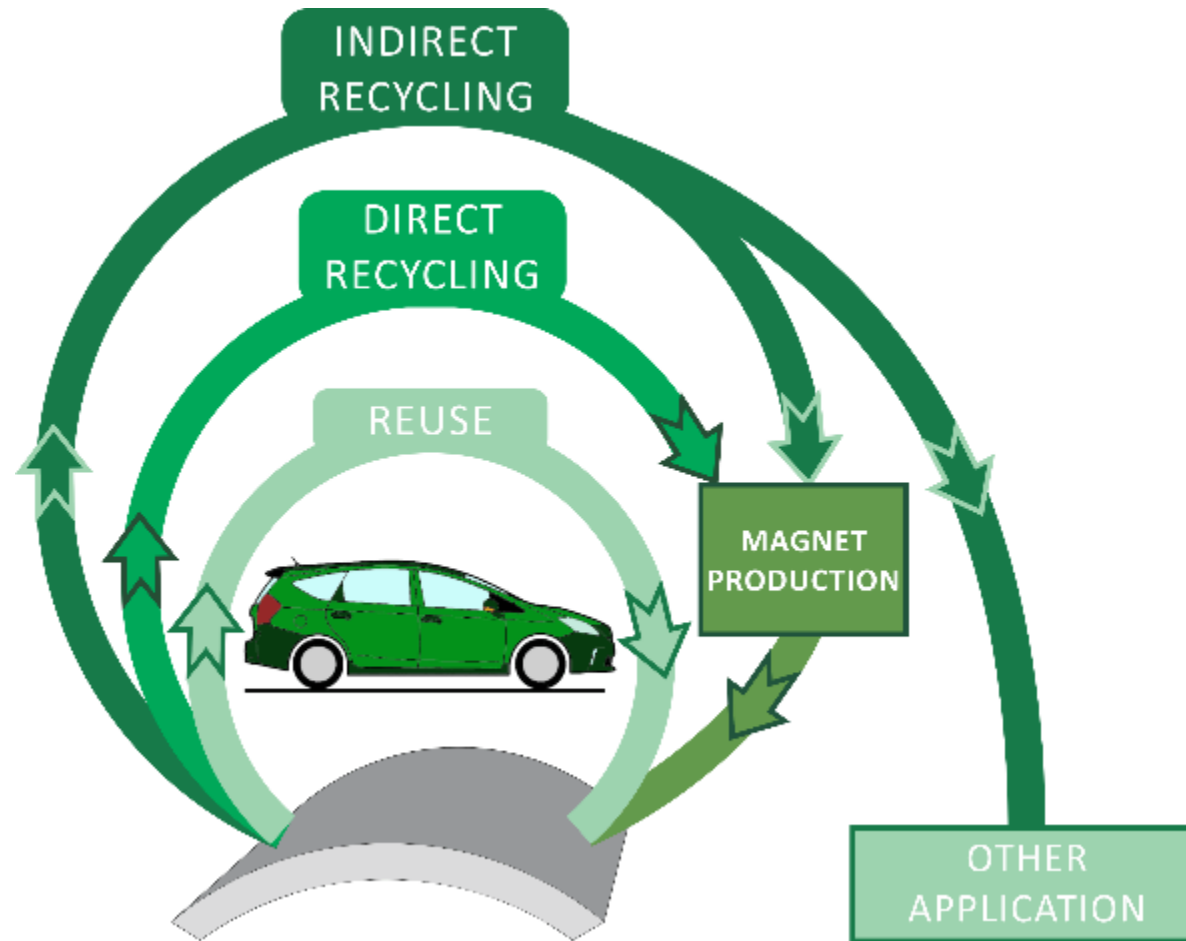
Rare Earth Elements (REEs)

Clean tech?

The problem?

- >Relatively cheap
- >Chinese monopoly
- >REEs are not recycled

DEMETER - European Training Network for the Design and Recycling of Rare-Earth Permanent Magnet Motors and Generators in Hybrid and Full Electric Vehicles



Indirect recycling



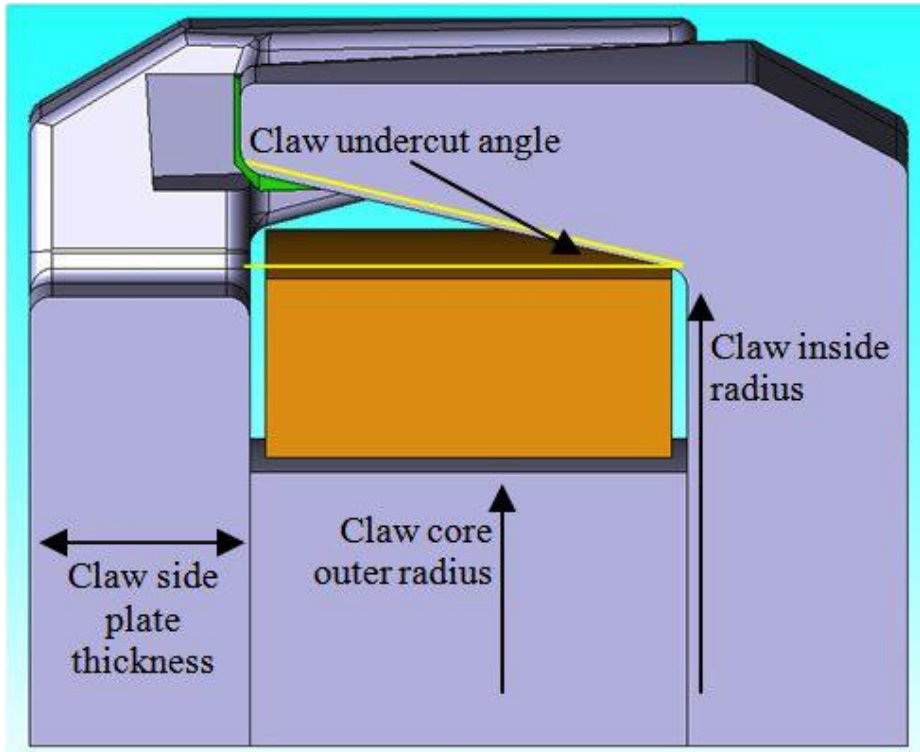
Direct recycling – hydrogen decrepitation (HD)



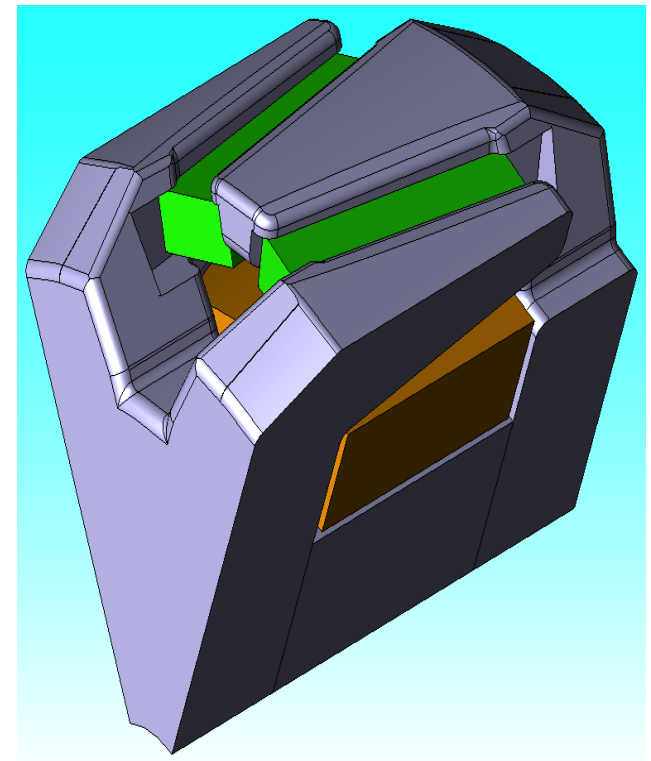
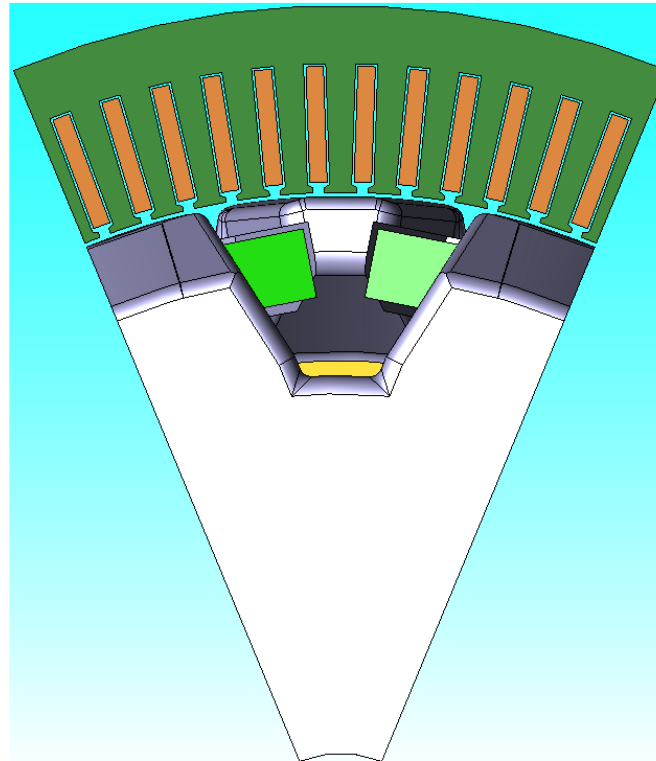
Speed: 7X

Reuse

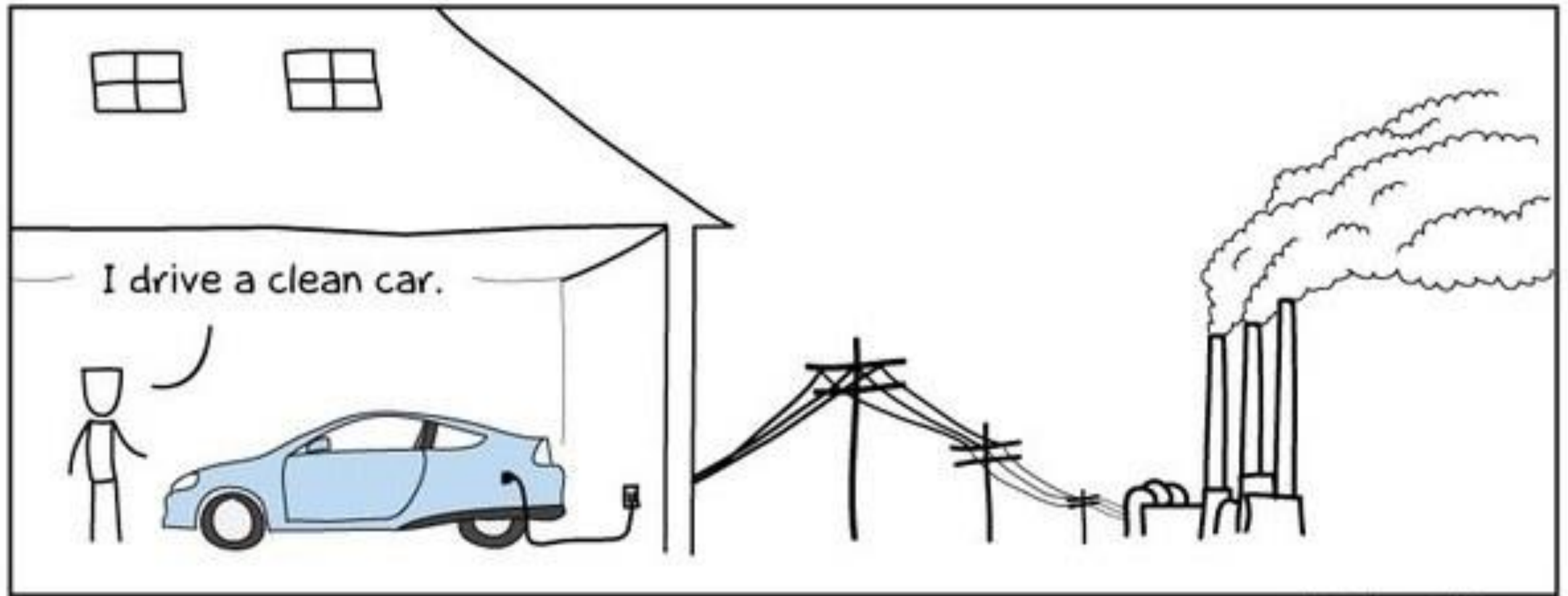
- Design for reuse



- Design for recycling



Recycled magnets increases the energy



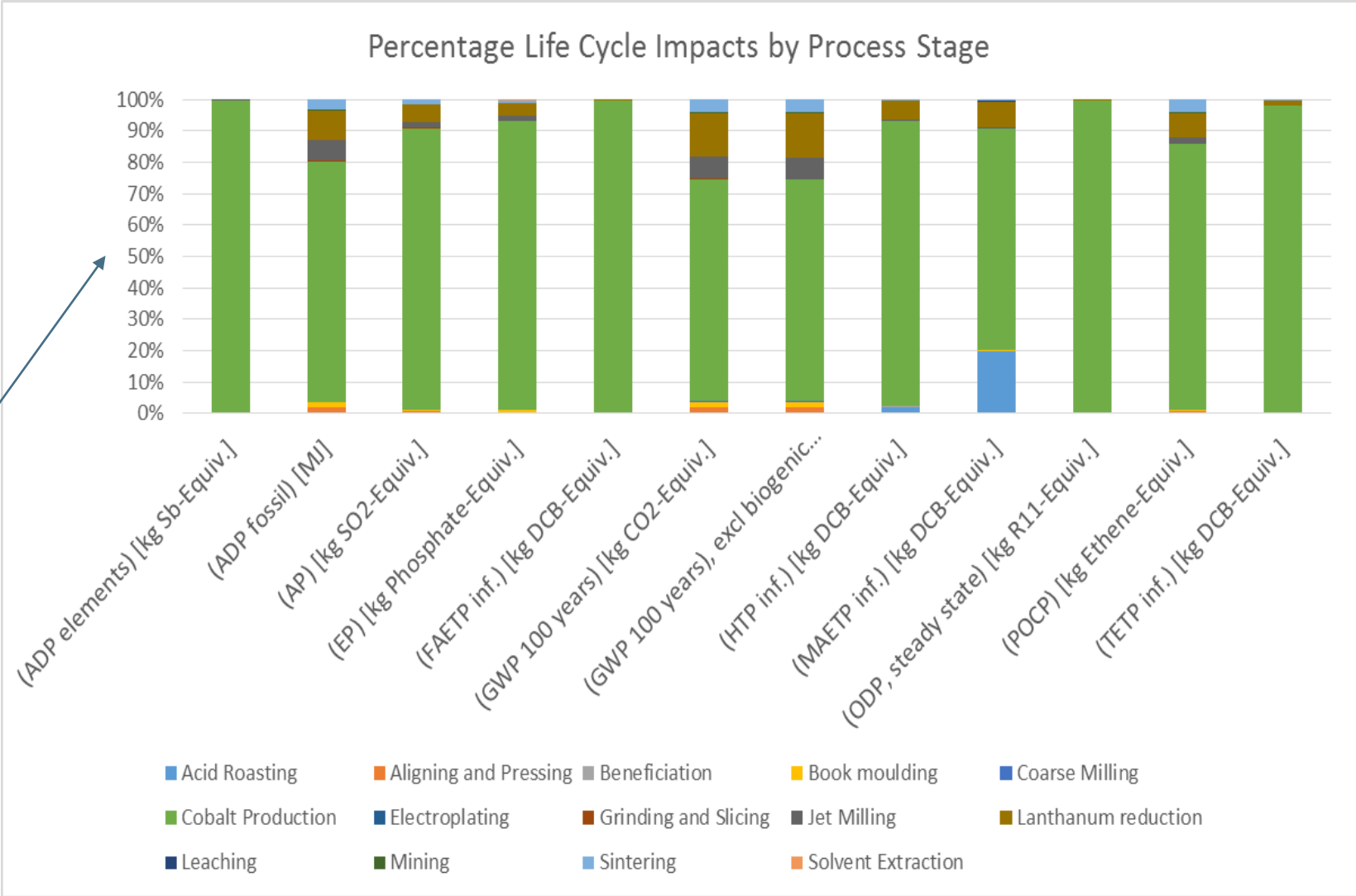
thedoghousediaries.com

My role in the project

We don't just need technology...we need assessments.

Cobalt production dominates all impacts in SmCo production

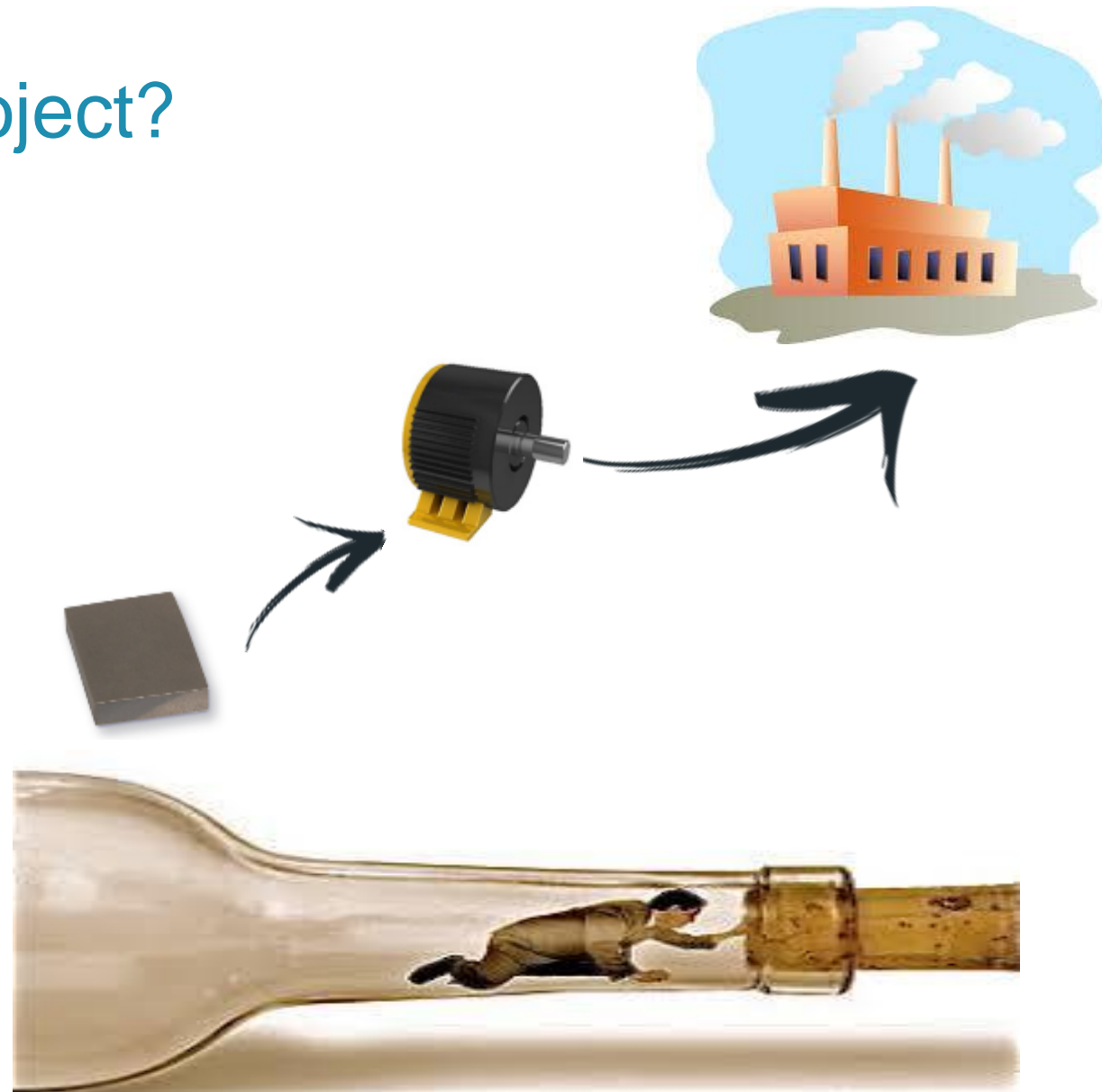
Life cycle assessment of new recycling/reuse routes for REE magnet (H)EVs



What can we learn from this project?

- Indirect route employs **expensive**, but safe chemicals
- Direct route poses health and **safety risks** at industrial scale
- Reuse route is still in the **prototyping and simulation** stages

Bottlenecks in each phase of the **end of life** supply chain



DEMETER full value chain & network



Importance of training and research

- European Commission has invested a lot in critical raw materials projects (FP7, Horizon2020)
 - Many of which are geared specifically at **REE recovery**
- At the current low REE prices, and the low amount of EoL electric vehicles, it is very difficult to set up a profitable REE supply chain in Europe
 - With the onslaught of (H)EVs on the market, this will change very quickly and we want to be **ready!**
- Keep competence in critical raw materials technology active in Europe
 - Early stage researchers in the **MSCA ETN projects** are able to gain industrial experience
 - Develop **new breakthrough technologies** and ways to **assess their validity**

Conclusions...what about an industrial implementation?

- Hopefully we ensure that these technical routes are not only environmentally better, but also economically attainable at an industrial scale.
 - There may be a need for upscaling indicators
- The only way we're going to change the EV and REE industry is by implementing sustainable solutions for these magnets.
 - We don't need just technology; we also need assessments
- We must keep growing knowledge and expertise within the EU.
- Learn how to make these technical solutions compete



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DEMETER
Concluding Symposium

Rare-earth
permanent-magnet
motors and the e-mobility
revolution

5-7 February 2019 - Leuven, Belgium

5-7 February, 2019 in Leuven, Belgium

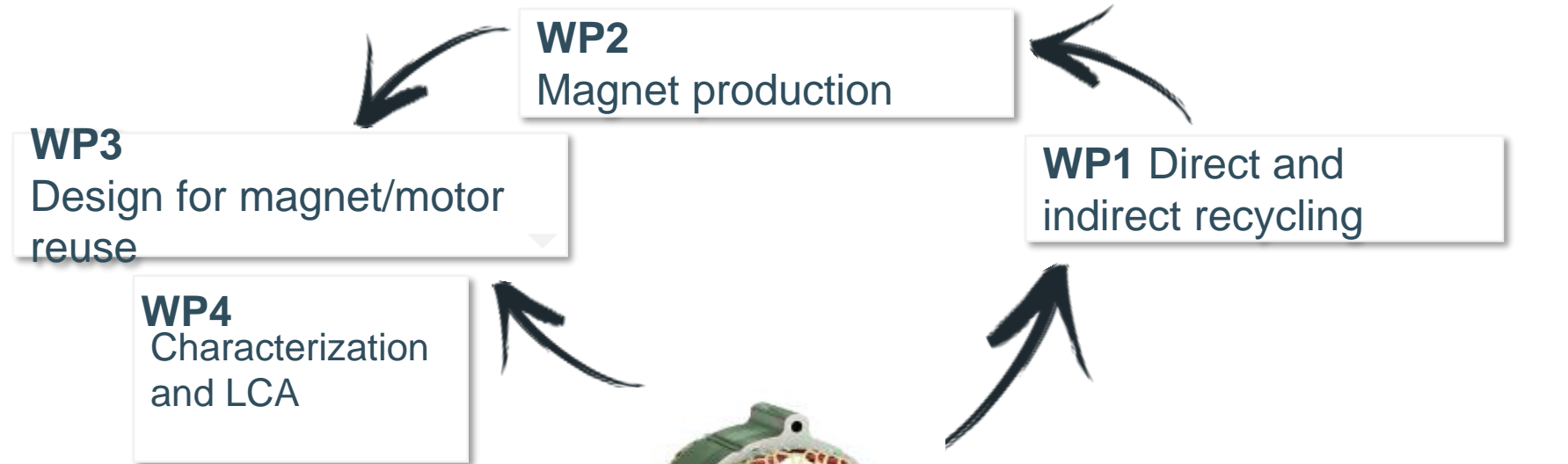
<https://symposium.etn-demeter.eu/>

- **LECTURES by 14 WORLD CLASS EXPERTS from INDUSTRY, ACADAMIA and the EUROPEAN COMMISSION**
- **TOPICS**
 - The future of REE permanent magnets
 - The future of (H)EVs
 - Recycling of REE permanent magnets
 - Are REEs still critical?
- **POSTER PITCHES**
- **TWO PANEL DEBATE SESSIONS**




Thank you!

Horizon 2020: MSCA-ETN DEMETER

"European Training Network for the Design and Recycling of Rare Earth Permanent Magnet Motors and Generators in Hybrid and Full Electric Vehicles"



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 ETN DEMETER Project
 <http://etn-demeter.eu/>