

# World Sustainable Energy Days 2020

## Life Cycle Assessment of Electric Vehicle Batteries

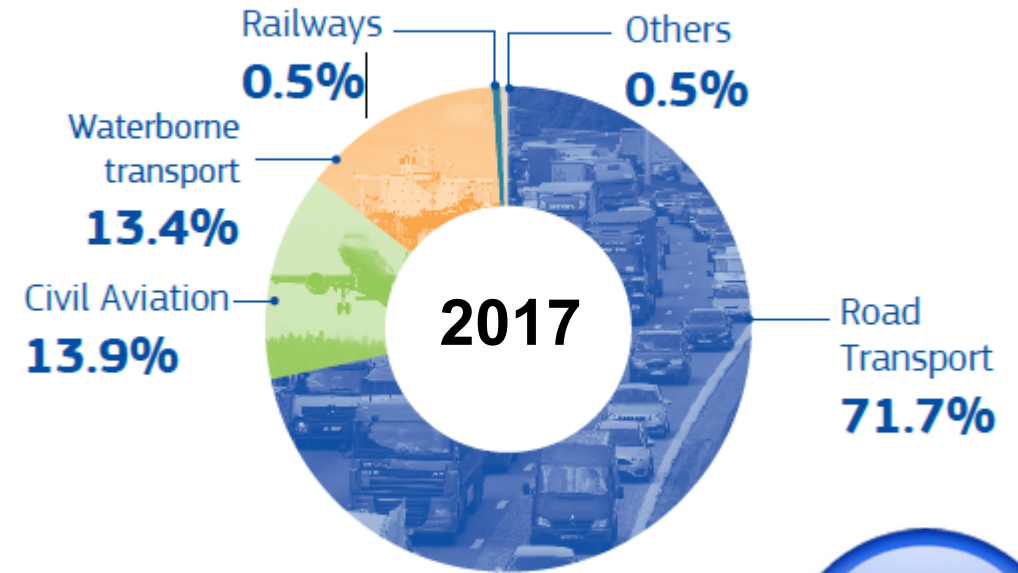
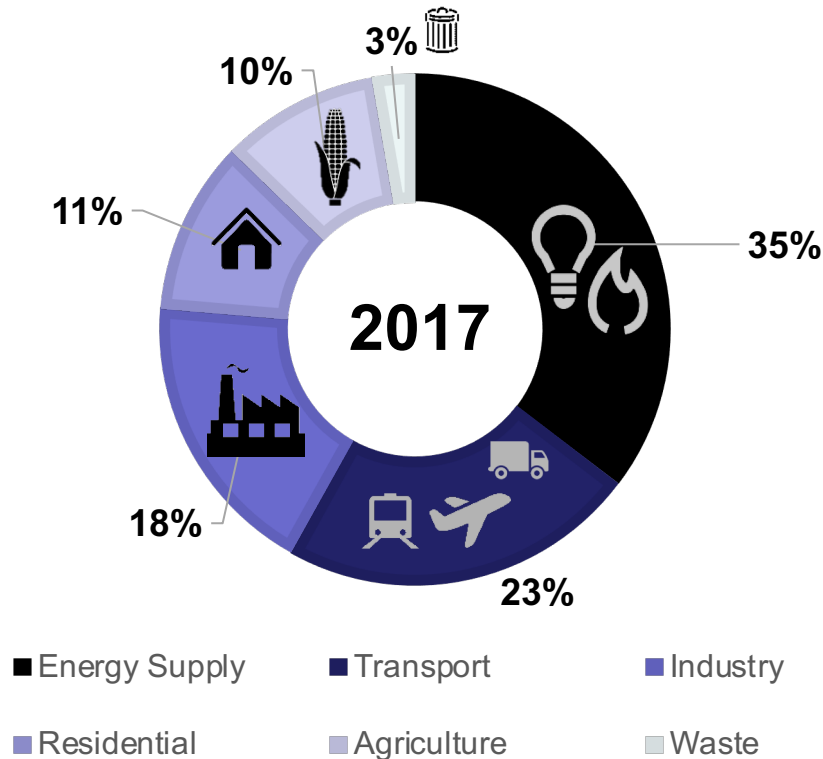
Wels, 6 March 2020

**Lluc Canals Casals & Victor Ferreira**  
lcanals@irec.cat



## General concern

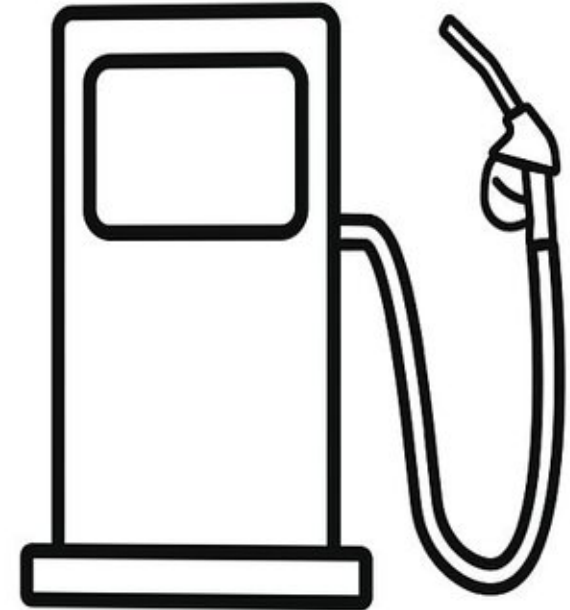
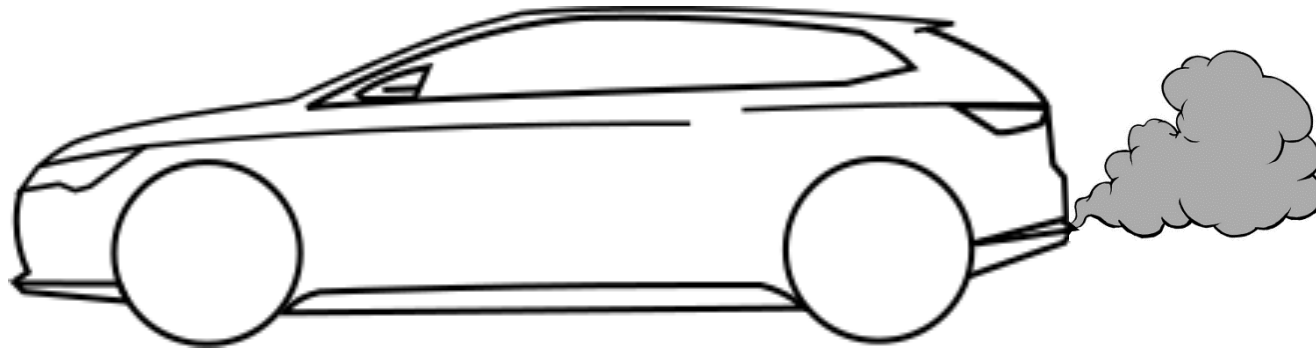
### Greenhousegas (GHG) emissions



Sources: European Energy Agency & Statistical Pocketbook 2019

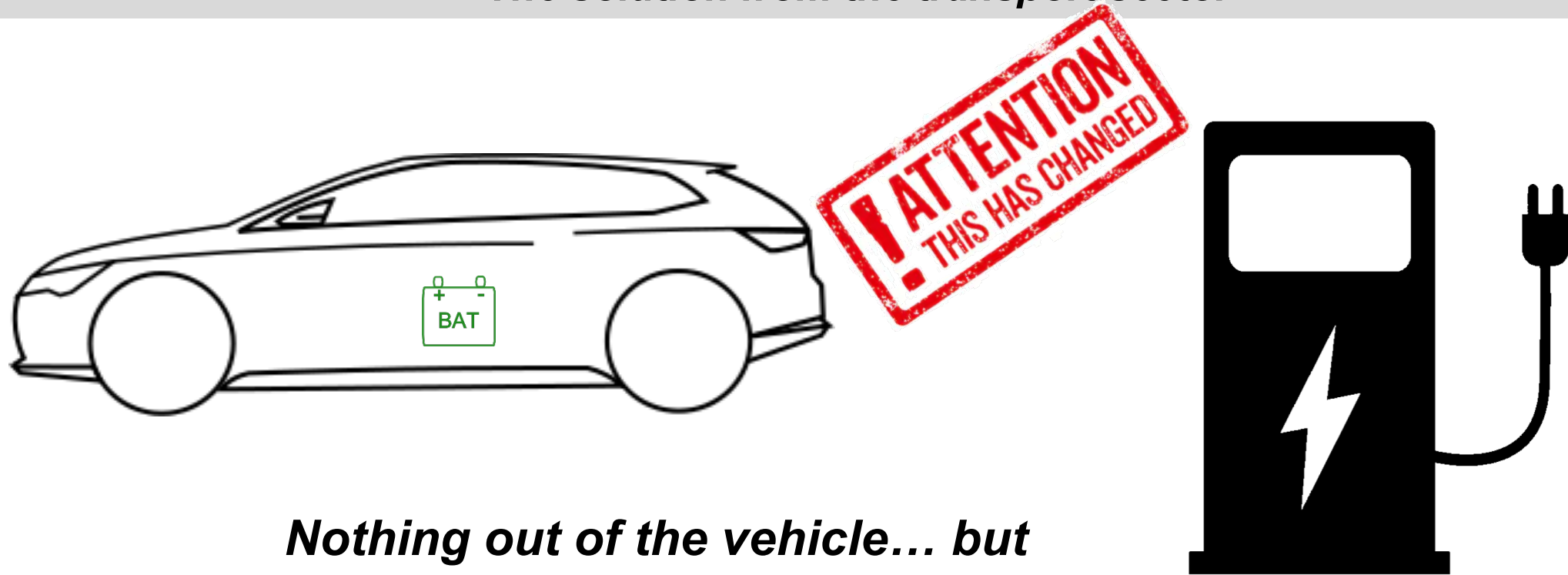
# Why the Life Cycle Assessment of Electric Vehicles?

*The solution from the transport sector*



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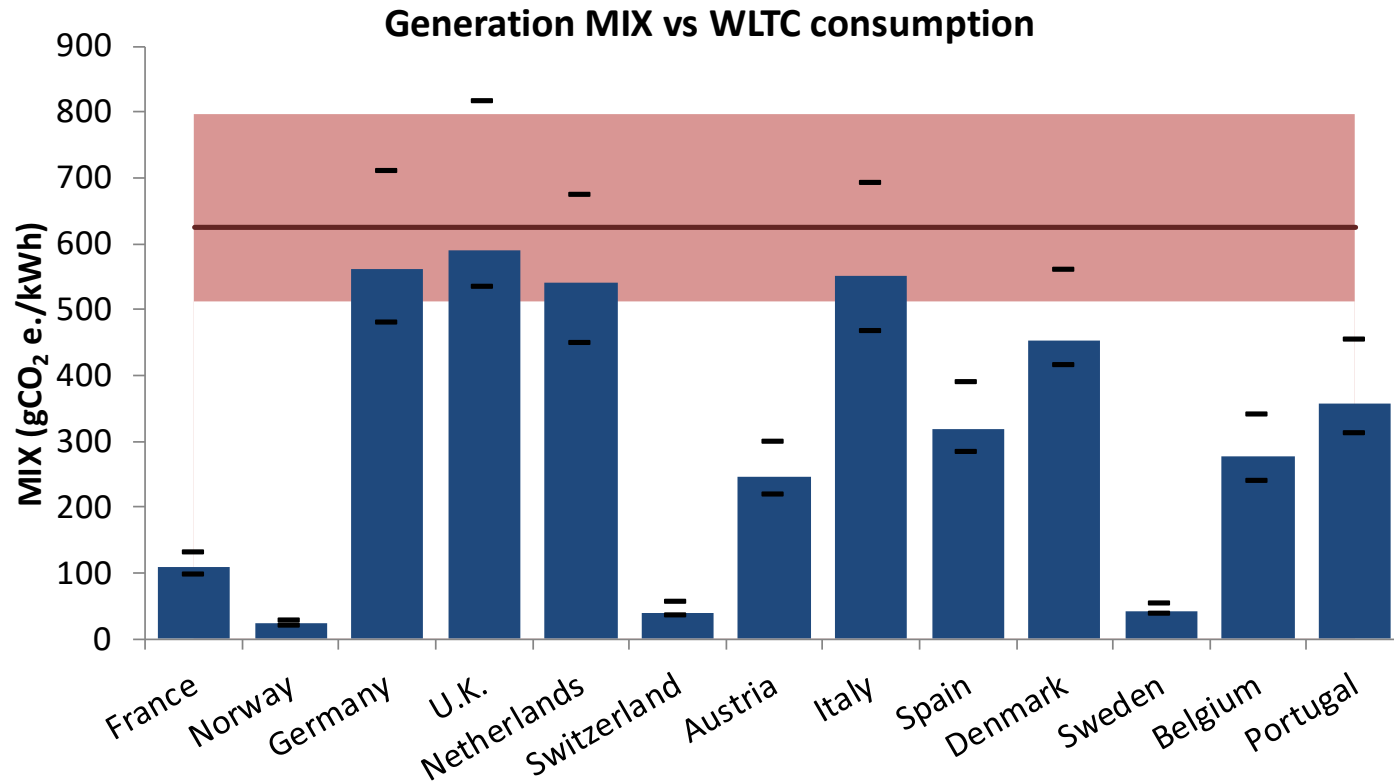


*Pushing the responsibility  
to another sector*

LCA is useful to evaluate the truth behind this jokes

## A linear look

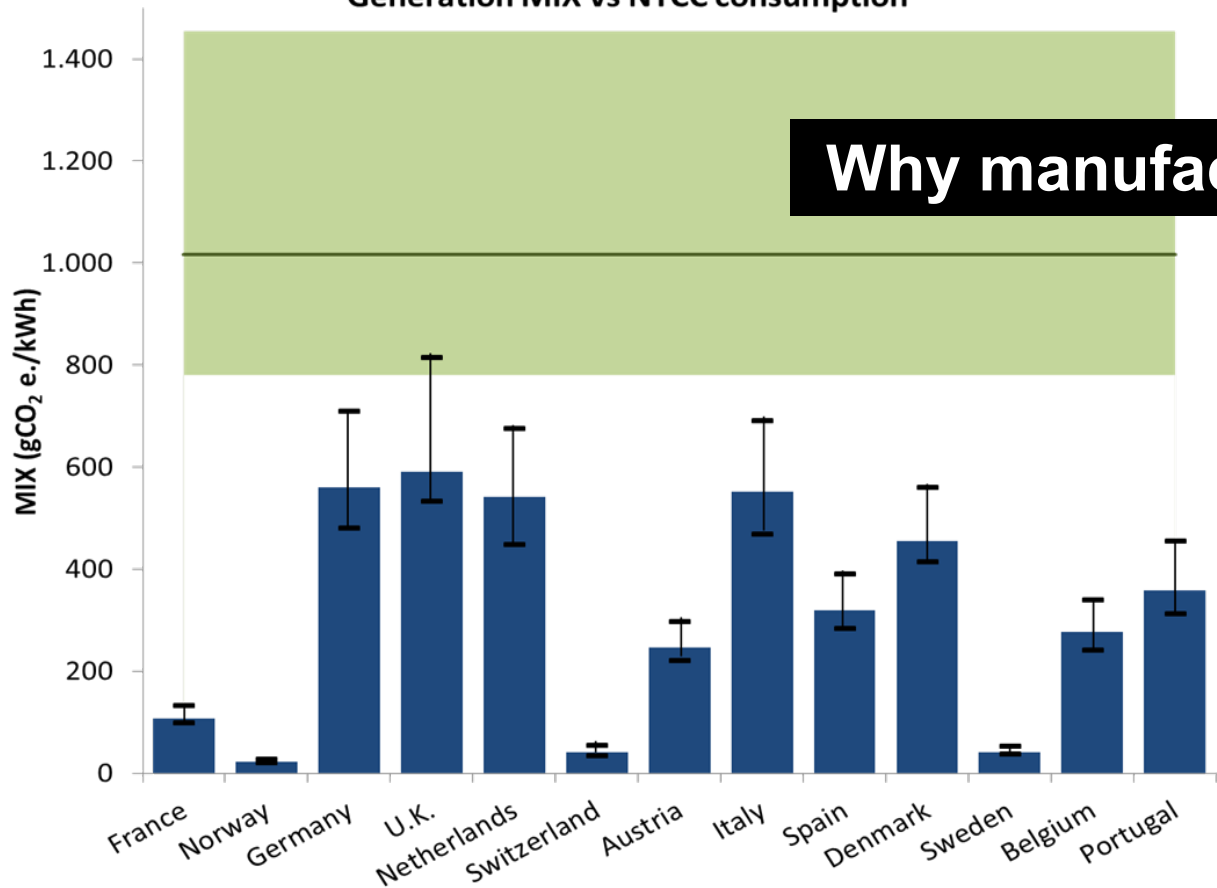
### The electricity MIX matters



Source: Sustainability analysis of the electric vehicle use in Europe for CO<sub>2</sub> emissions reduction

## A linear look

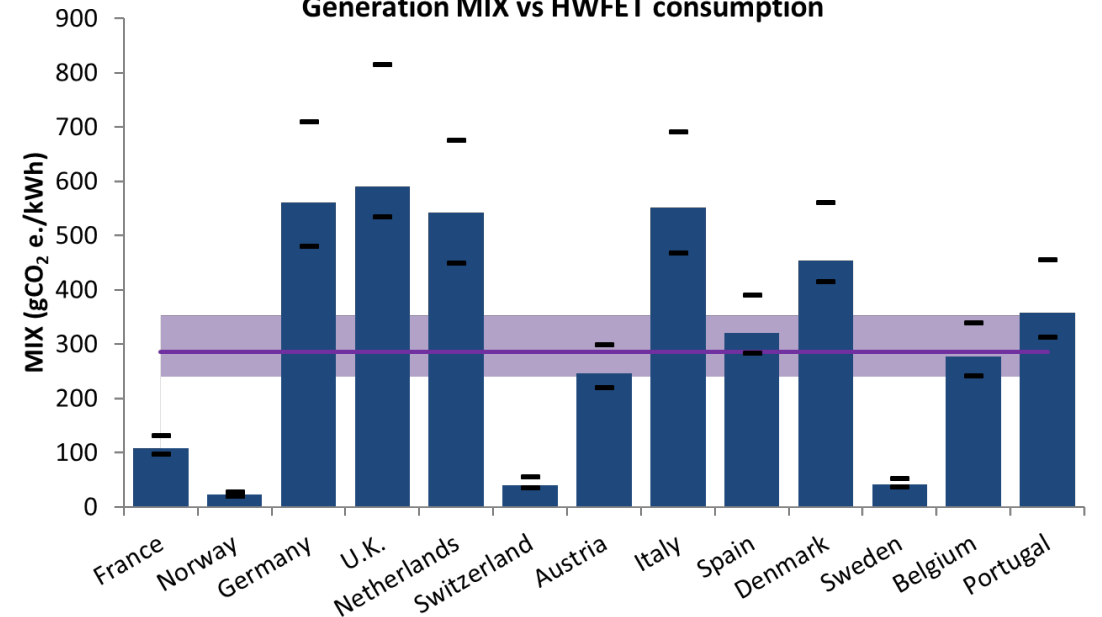
Generation MIX vs NYCC consumption



**EV are not meant for highways!**

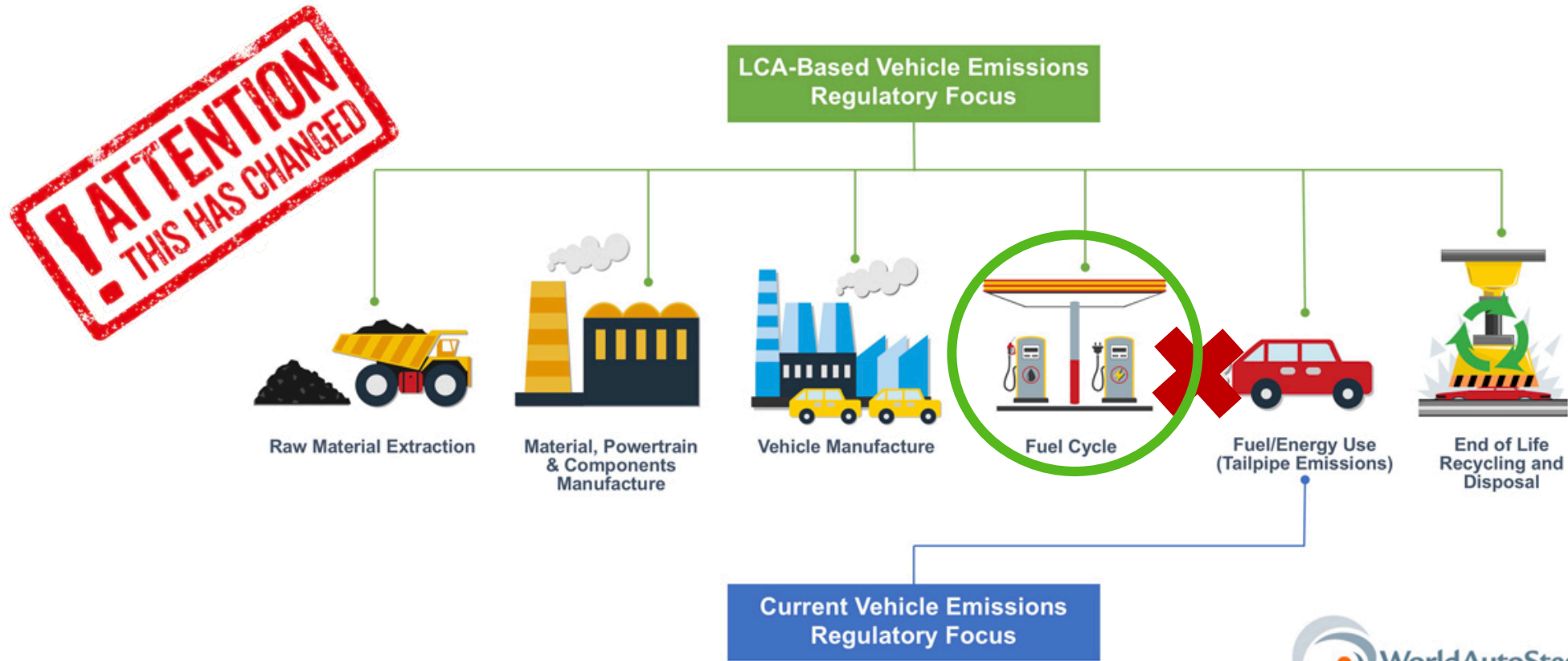
**Why manufacture EVs range higher than 200 km?**

Generation MIX vs HWFET consumption



Source: Sustainability analysis of the electric vehicle use in Europe for CO2 emissions reduction

## A linear look



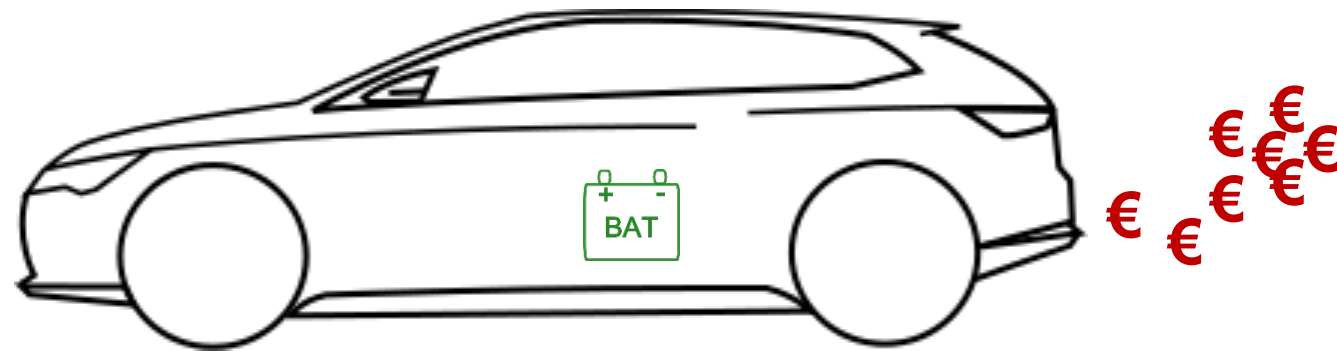
## *A circular look*



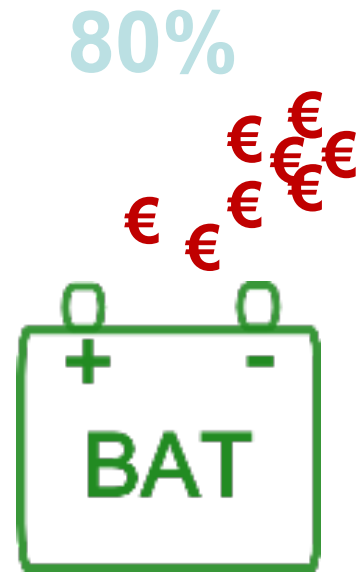
Source: Hi4csr Project

# Life Cycle Assessment of Electric Vehicles

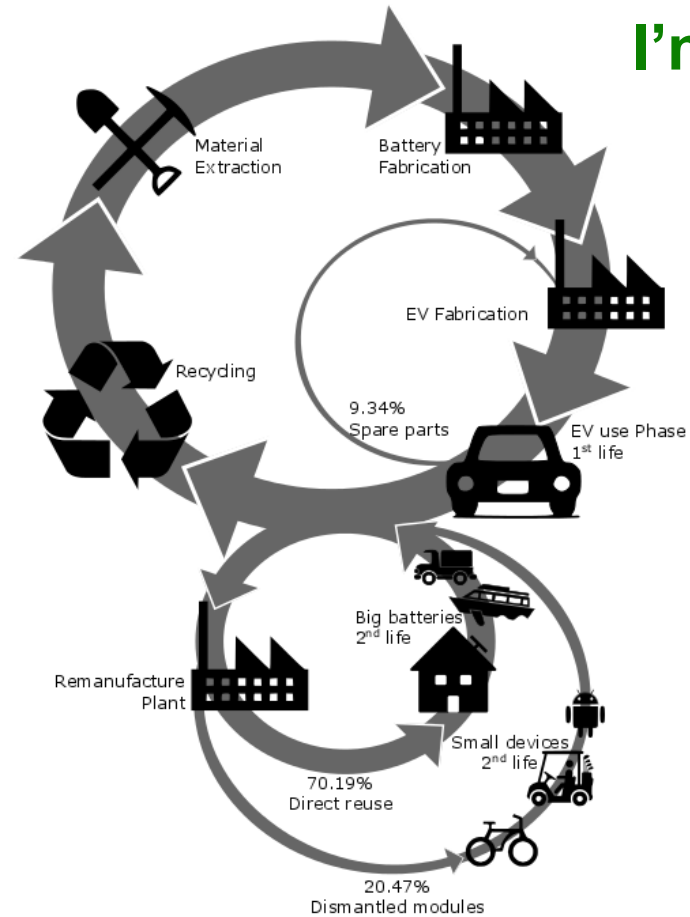
*A circular look*



## *A circular look*



## A circular and re-circular look

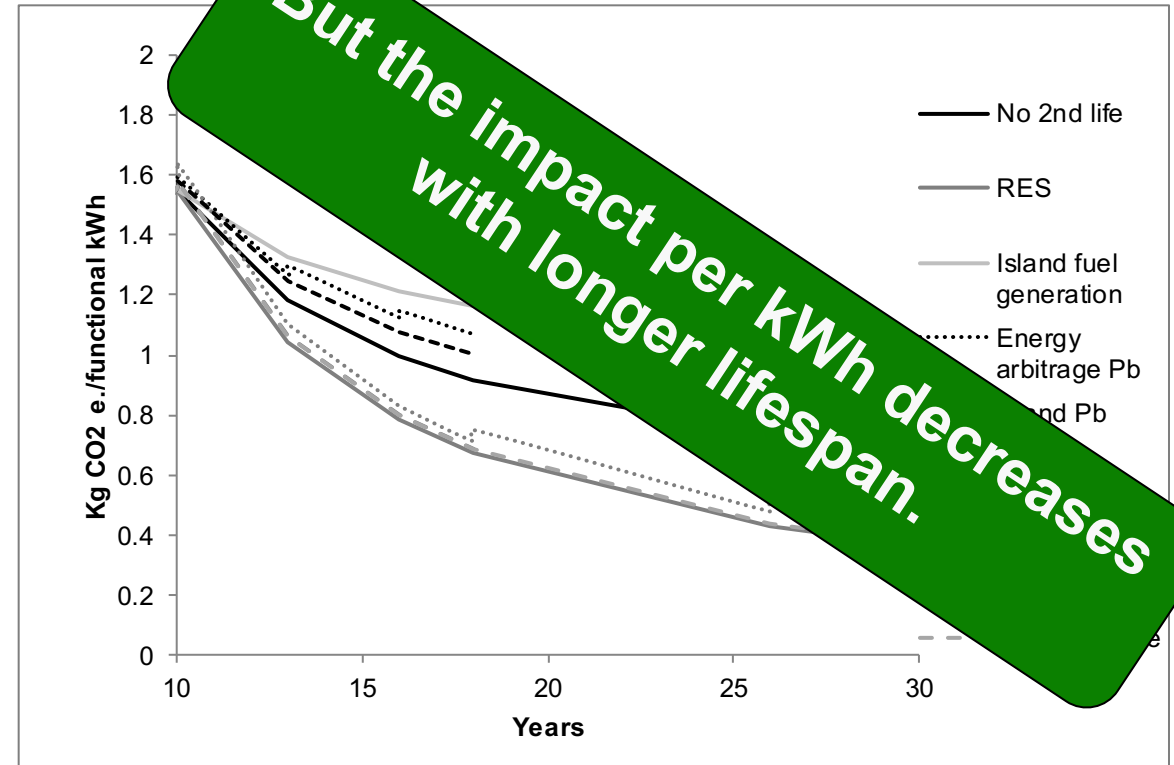
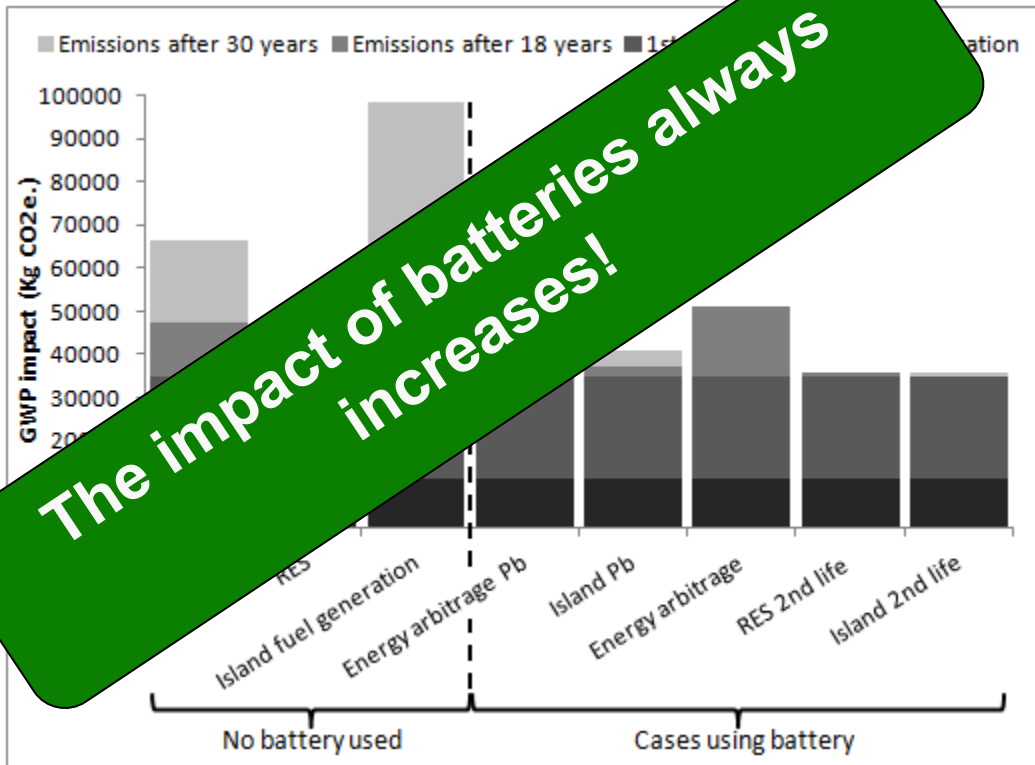


I'm overlapping,  
I know  
I stop

Source: Electric vehicle battery reuse: Preparing for a second life

## The impact of batteries beyond the EV

- Considering the 2<sup>nd</sup> life...



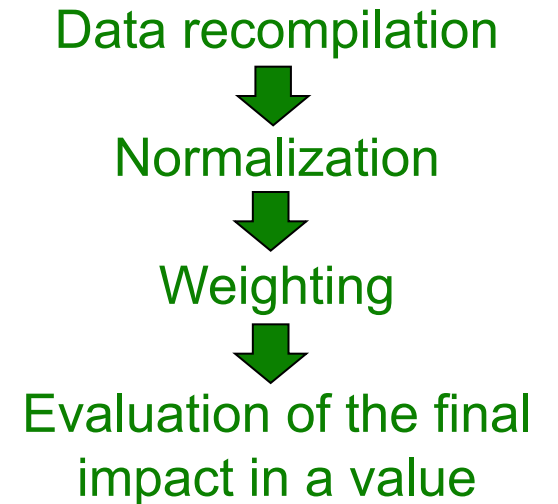
Source: Second life of electric vehicle batteries: relation between materials degradation and environmental impact

*GWP is not the only category to look at*

Midpoint categories

Impact category / Indicator	Unit
Global warming	kg CO <sub>2</sub> -eq
Ozone depletion	kg CFC-11-eq
Acidification of soil and water	kg SO <sub>2</sub> -eq
Eutrophication	kg PO <sub>4</sub> 3--eq
Photochemical ozone creation	kg ethene-eq
Depletion of abiotic resources – elements	kg Sb-eq
Depletion of abiotic resources – fossil fuels	MJ
Human toxicity	1,4-DCB-eq
Fresh water aquatic ecotoxicity	1,4-DCB-eq
Marine aquatic ecotoxicity	1,4-DCB-eq/sup>
Terrestrial ecotoxicity	1,4-DCB-eq
Particulate matter <sup>1</sup>	kg PM2.5 eq
Energy Demand	MJ

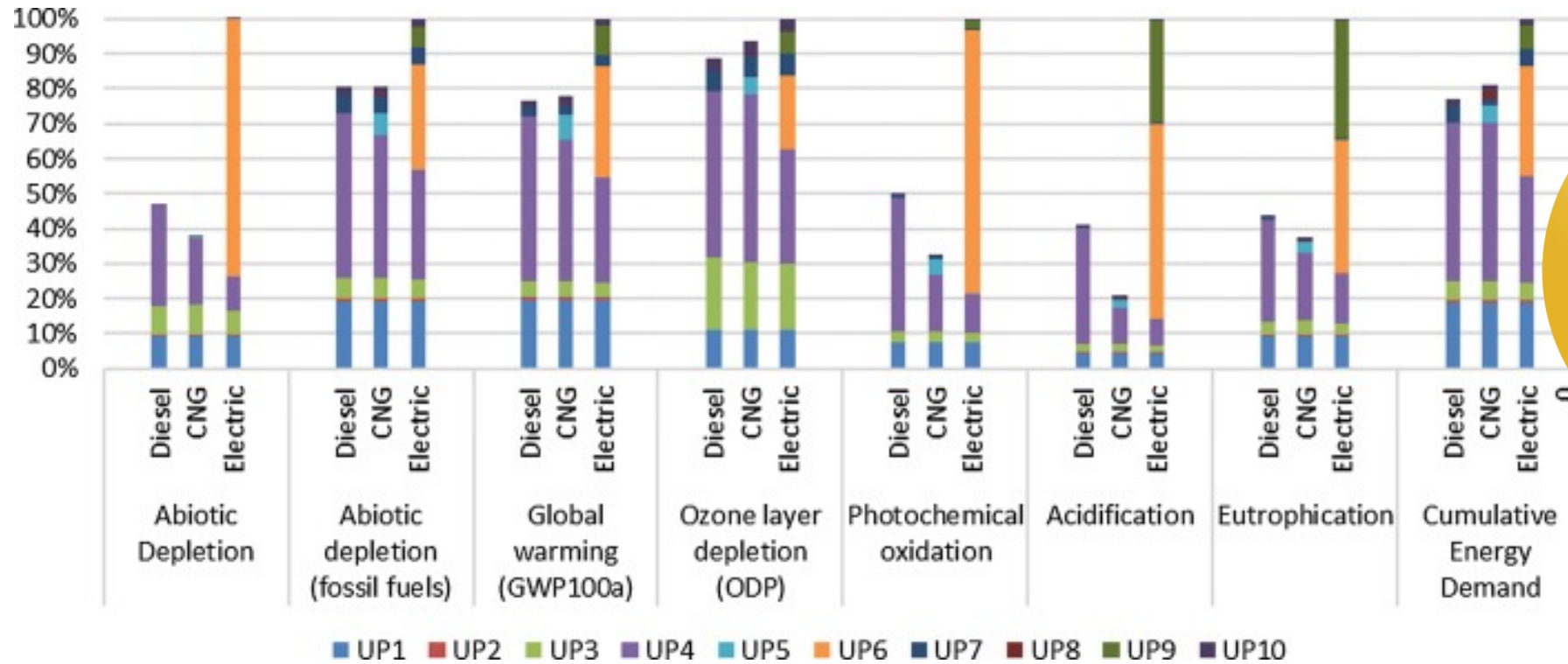
Endpoint categories



Environmental impact

## Recent results

### Production phases



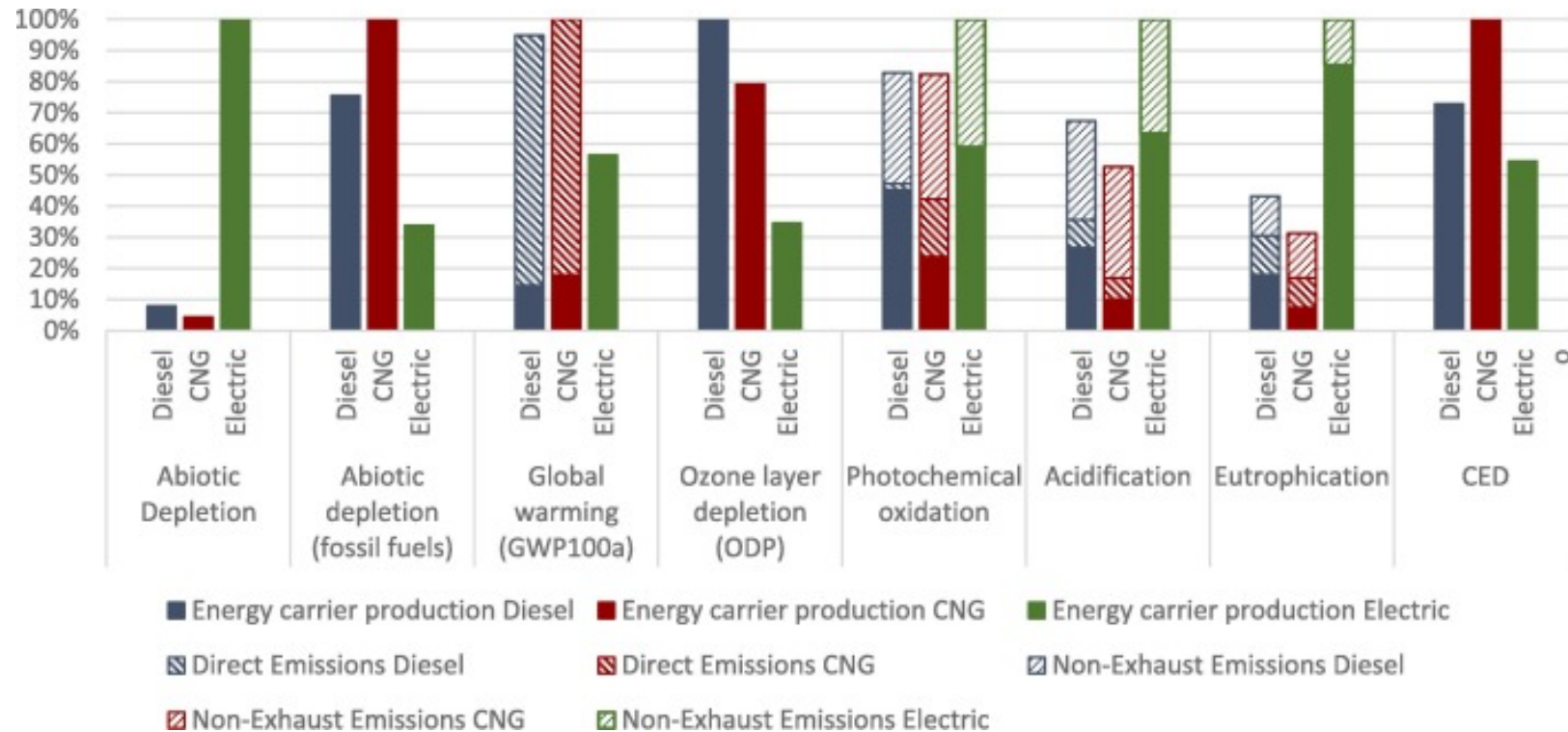
64 kWh battery!



Source: The transport of goods in the urban environment: A comparative life cycle assessment of electric, compressed natural gas and diesel light-duty vehicles

## Recent Results

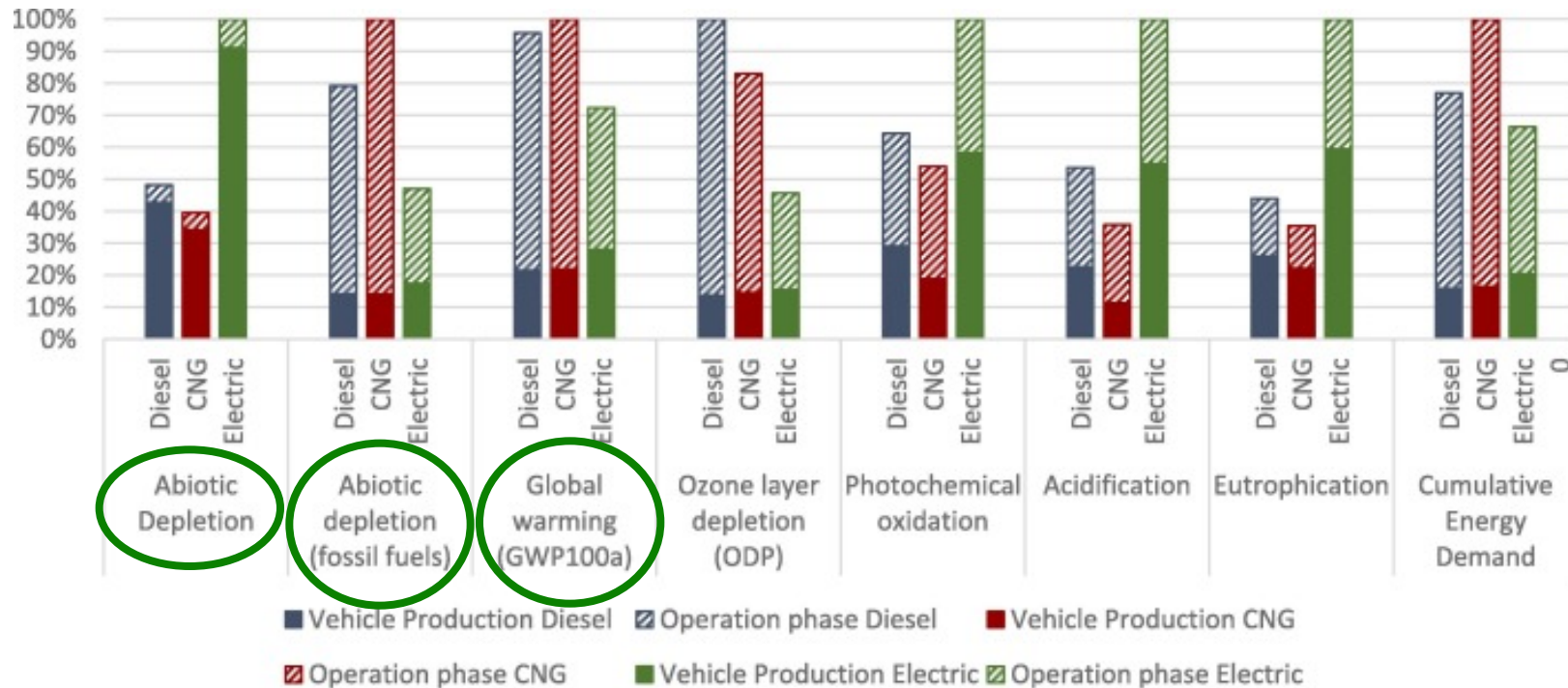
### Use phases



Source: The transport of goods in the urban environment: A comparative life cycle assessment of electric, compressed natural gas and diesel light-duty vehicles

## Recent Results

### Complete LCA (No second life)



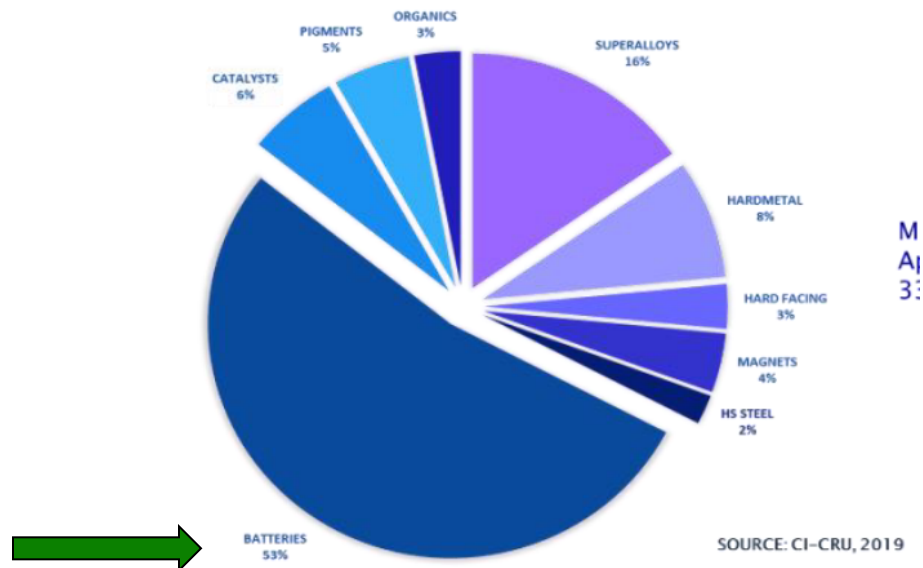
Can be reduced by using cleaner electricity!



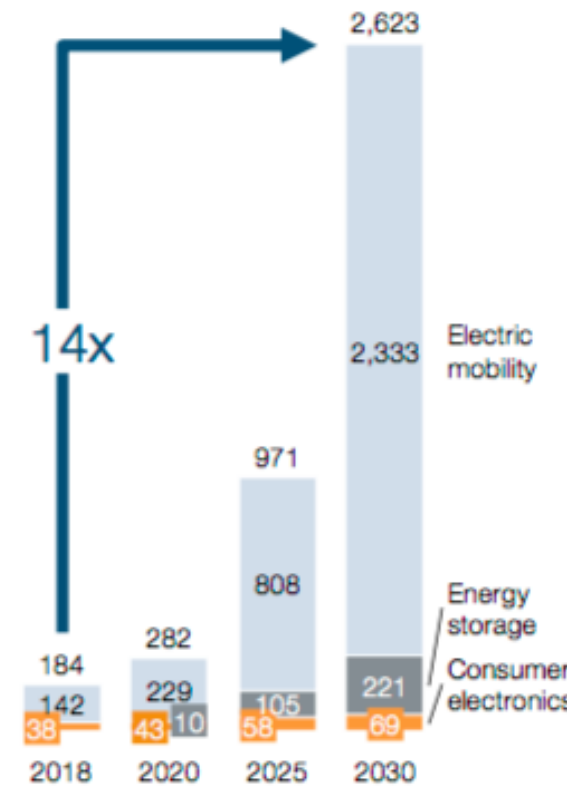
Source: The transport of goods in the urban environment: A comparative life cycle assessment of electric, compressed natural gas and diesel light-duty vehicles

## What to do?

- Reduce production impact by:
  - Work on new battery technologies
  - **Not falling into building huge batteries**
- Clean the source of electricity

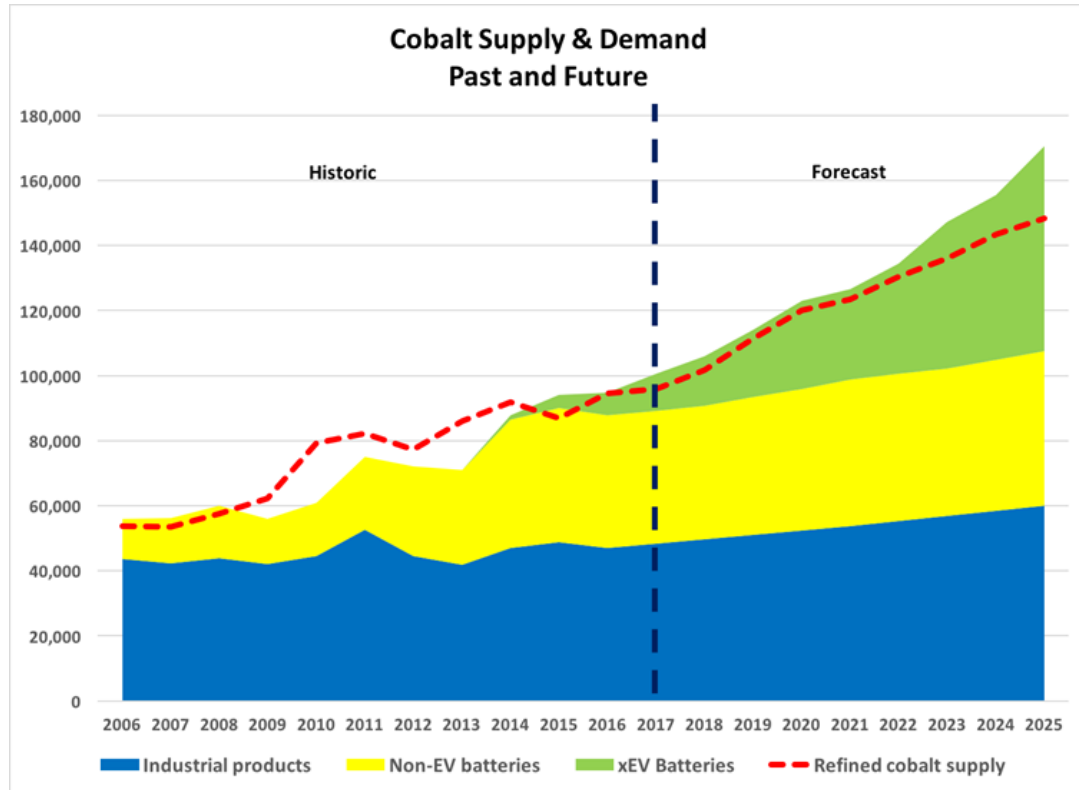


Global battery demand by application  
GWh in 2030, base case

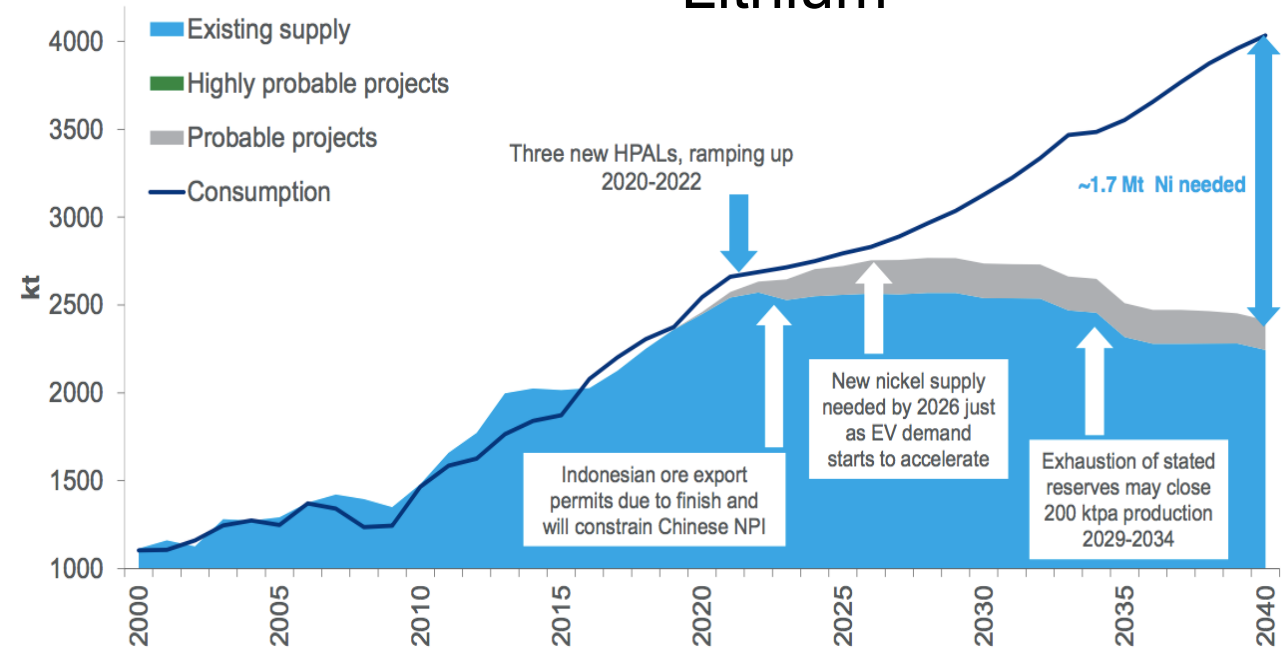


## Critical materials

It seems that we can face some scarcity issues!



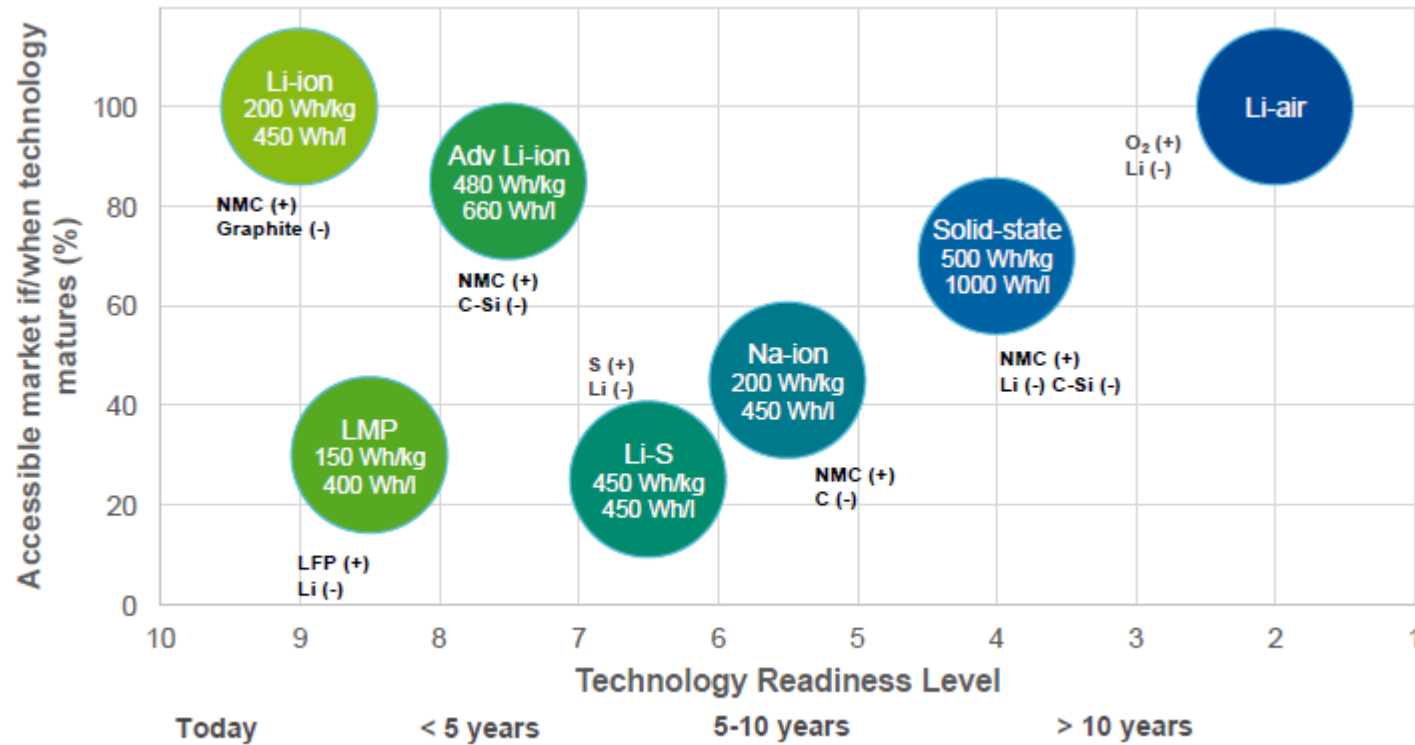
Future additional supply requirement



Source: Wood Mackenzie

## *New opportunities*

It seems that we can face some scarcity issues!



## *New opportunities*

The H2020 COBRA project ID: 875568

COBalt-free Batteries for FutuRe Automotive Applications

- New materials
- New packaging/casing
- Design to dismantle
- Design for 2<sup>nd</sup> life



## *What does LCA is useful for?*

- To give response to jokes
- As a support to policy makers
- As an industrial design tool to:
  - identifying critical elements
  - to comply with environmental standards
  - design for 2<sup>nd</sup> life
  - eco-design

