

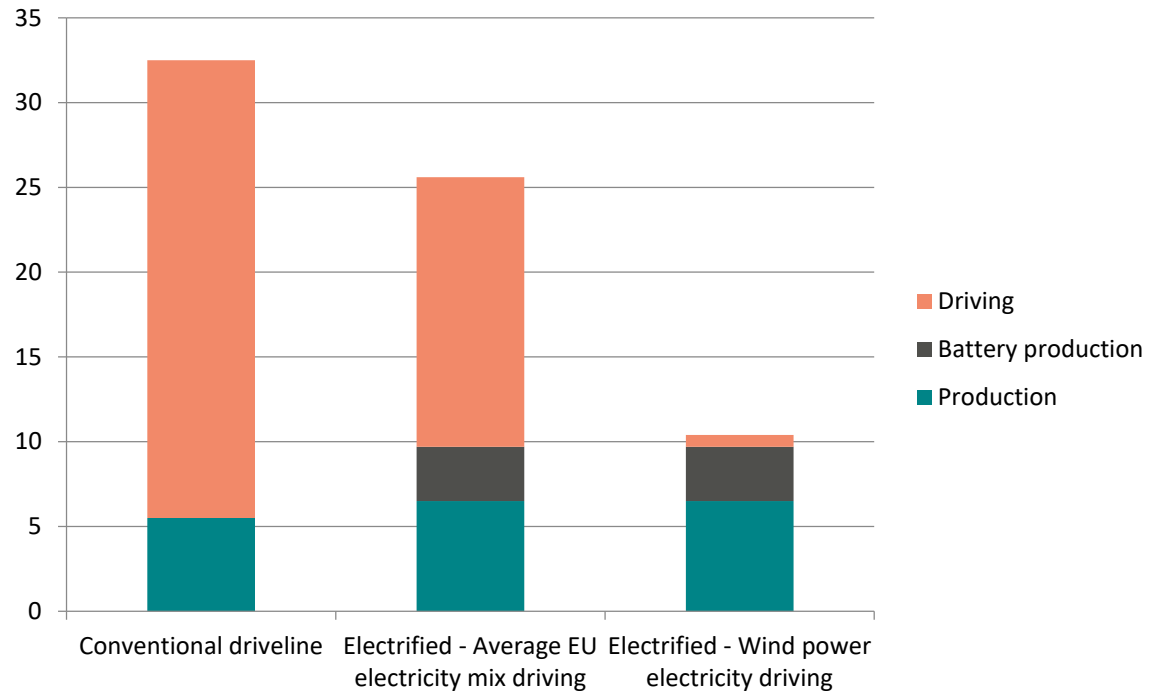


# Electric vehicle batteries

What environmental risks do the batteries add to electric vehicles and how can we handle them?

# Electrification

– a shift in the life cycle environmental impact of cars



- Use phase decreases in importance
- The production phase increases in importance, largely because of the battery

Example medium sized car, 180000km life

Graphics based on LCA results from Ellingsen et al 2016 - The size and range effect: lifecycle greenhouse gas emissions of electric vehicles

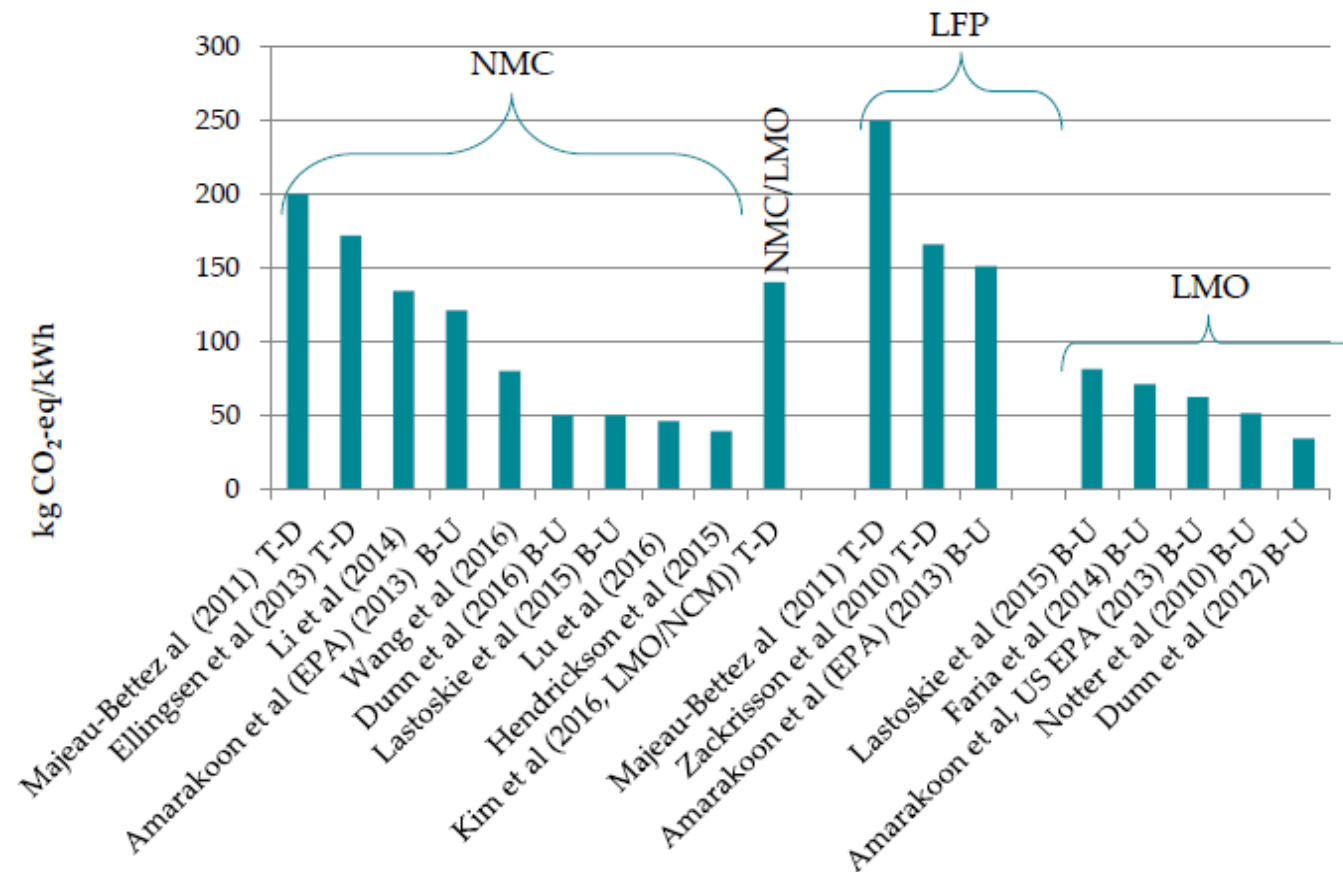
# Battery production impact

- We often talk about battery emissions in terms of kg CO<sub>2</sub>/kWh battery
- Example on previous slide has an impact of 131 kg CO<sub>2</sub>/kWh battery with a 24,4 kWh battery

Unfortunately reality is not as simple as one answer...

# Battery production impact

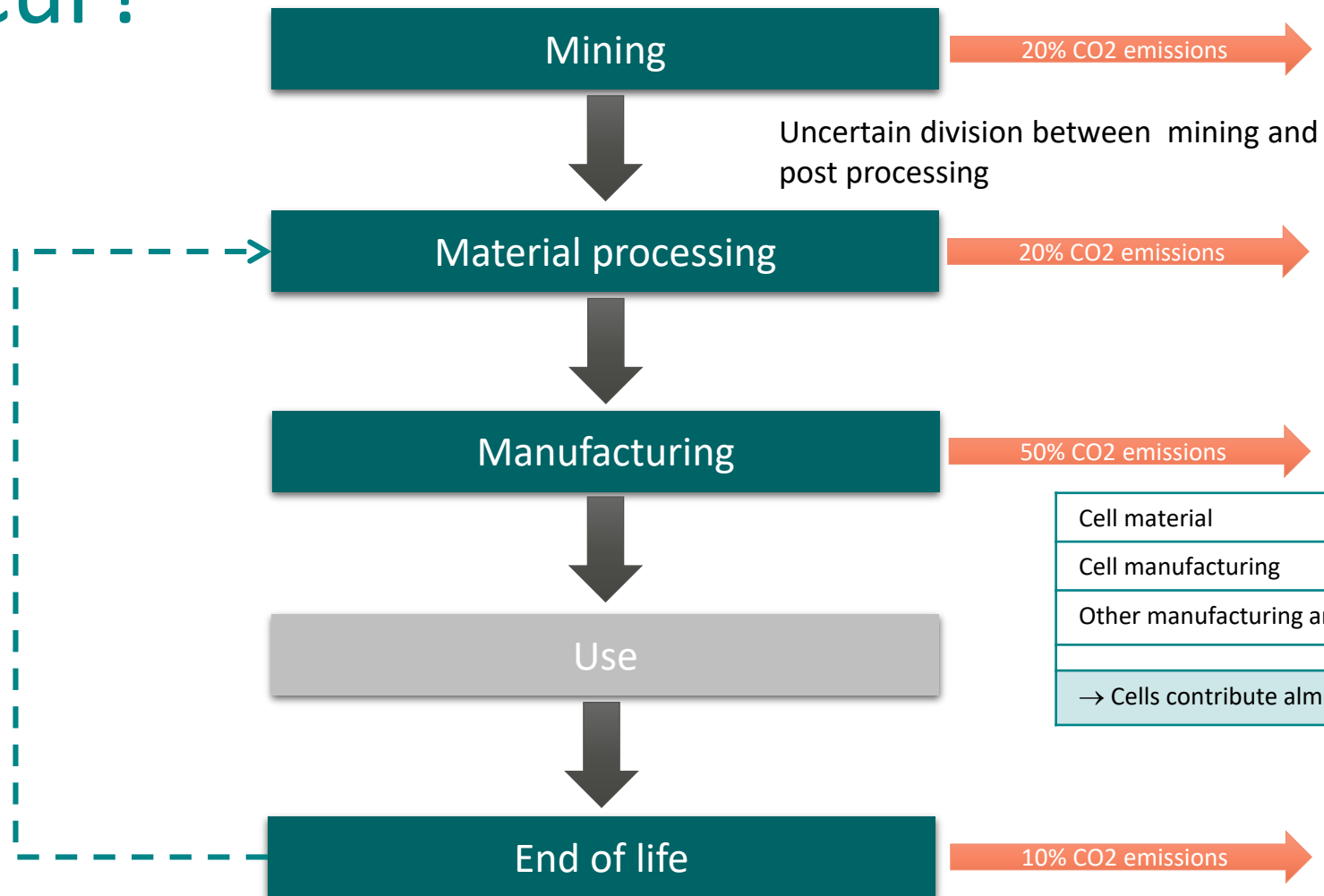
- A review of available LCAs in 2016 showed highly varying results



# Battery production impact

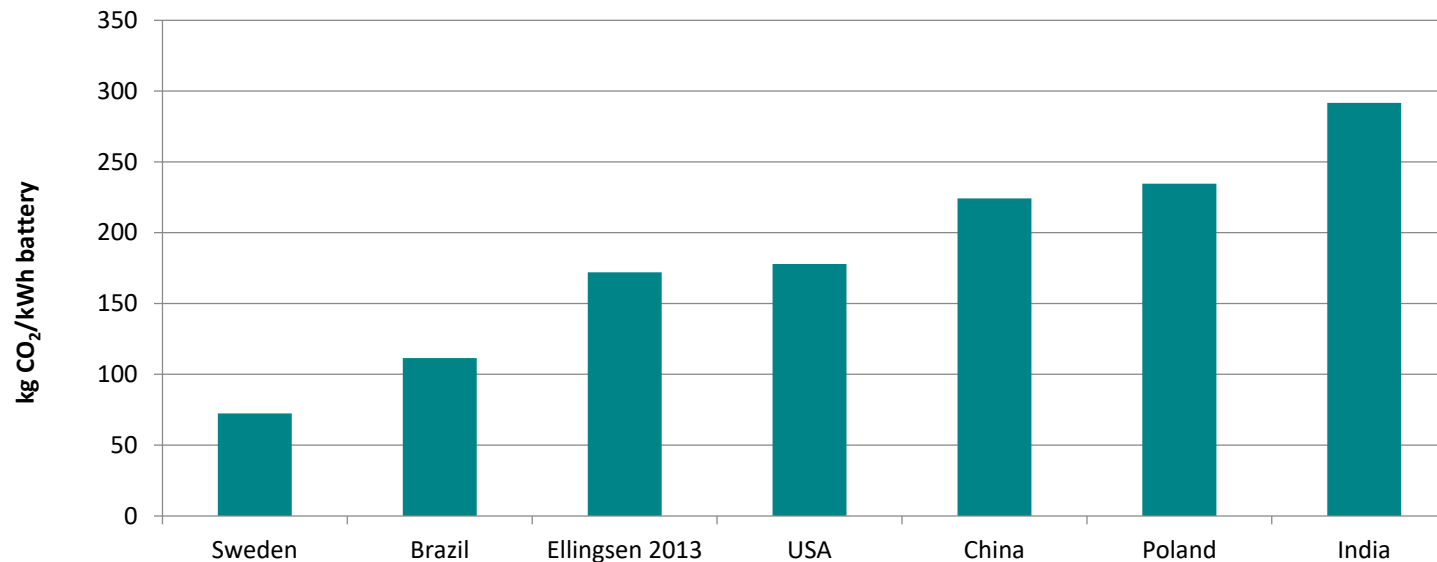
- Conclusion from previous slide?
- There are reasonable variation in the results due to
  - Different production location (i.e. electricity mix in production)
- We need to work hard to get better data
  - From actual production
  - Updated
- The data is good enough to support general conclusions

# Where do the emissions occur?



# Exemplifying improvement potential

- Cells contribute up to 70% - mainly due to use of fossil based electricity
- By only targeting this stage and its electricity the reduction potential is significant!



Graphics based on LCA results from Ellingsen et al 2013 – Life cycle assessment of a lithium-ion battery vehicle pack

# Moving forward

- Realizing energy efficiency and fossil-free electricity in the **high energy** stages of the production.
- Increasing the recycling, and also the processing value of the output
  - Avoided CO2 emissions
  - Material security for large scale adoption
- Batteries have a high processing value and production impact – when we have made them we should use them effectively and for as long as possible!