Life Cycle Inventory Analysis: Production

Second eLCAr Workshop

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COOPERATION

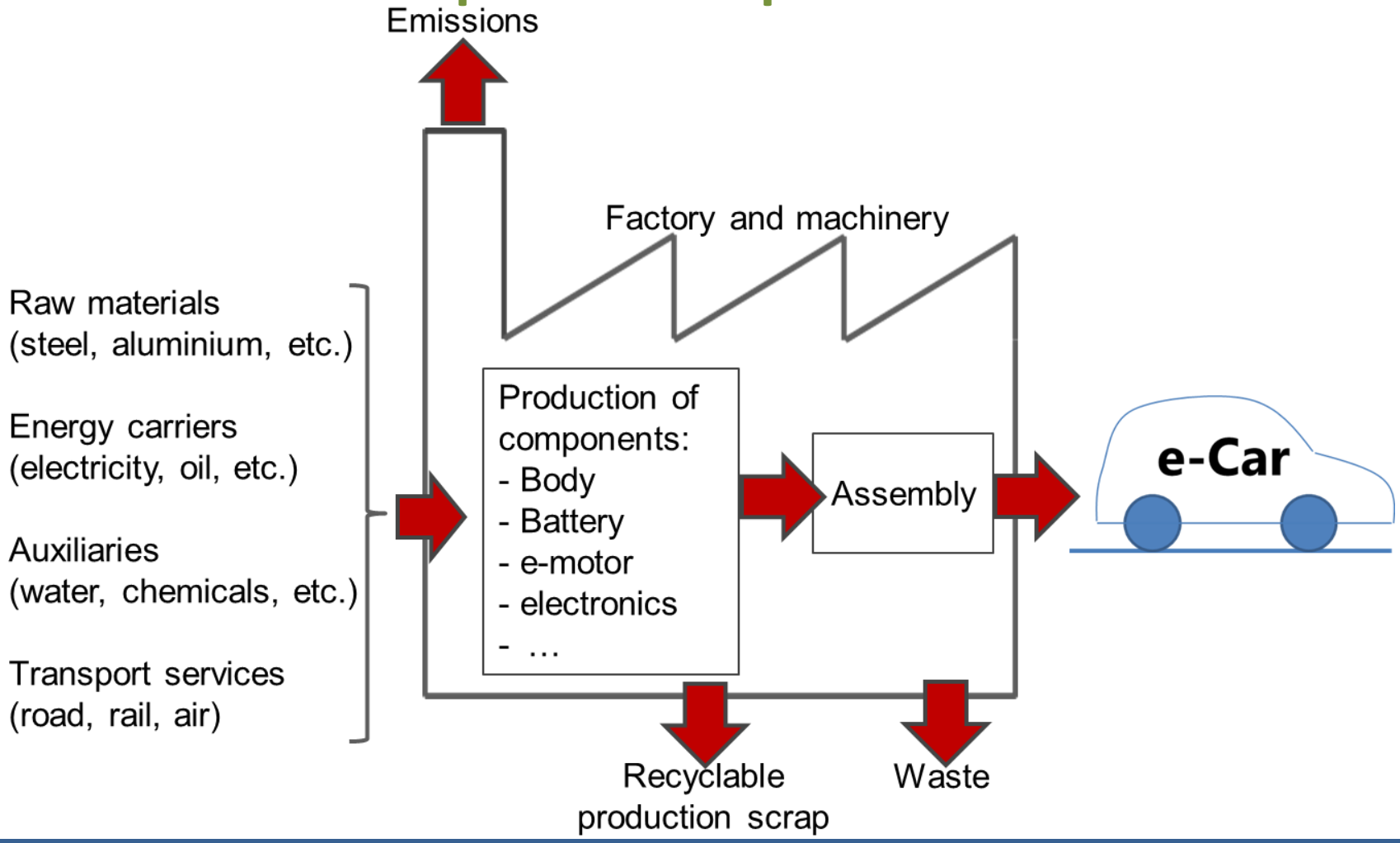
Outline

- Workflow of LCI Analysis
- System boundaries: production phase
- Planning data collection
- Data collection
- Data gaps and future technologies

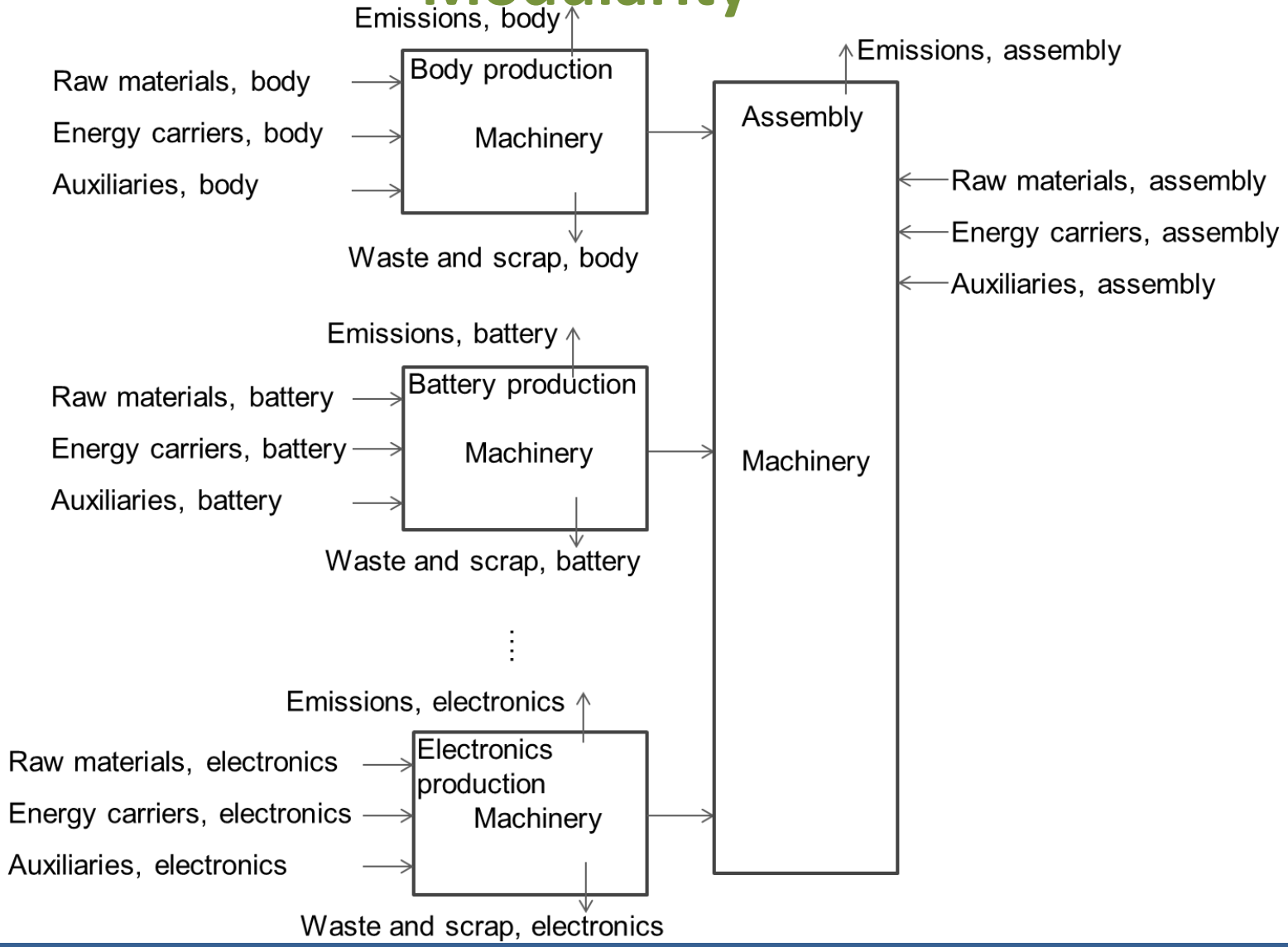
Life Cycle Inventory (LCI) Analysis

- Identifying processes within the system boundaries
- Planning data collection
- Data collection
- Solving multifunctionality
- Modelling the system
- Calculating the LCI results

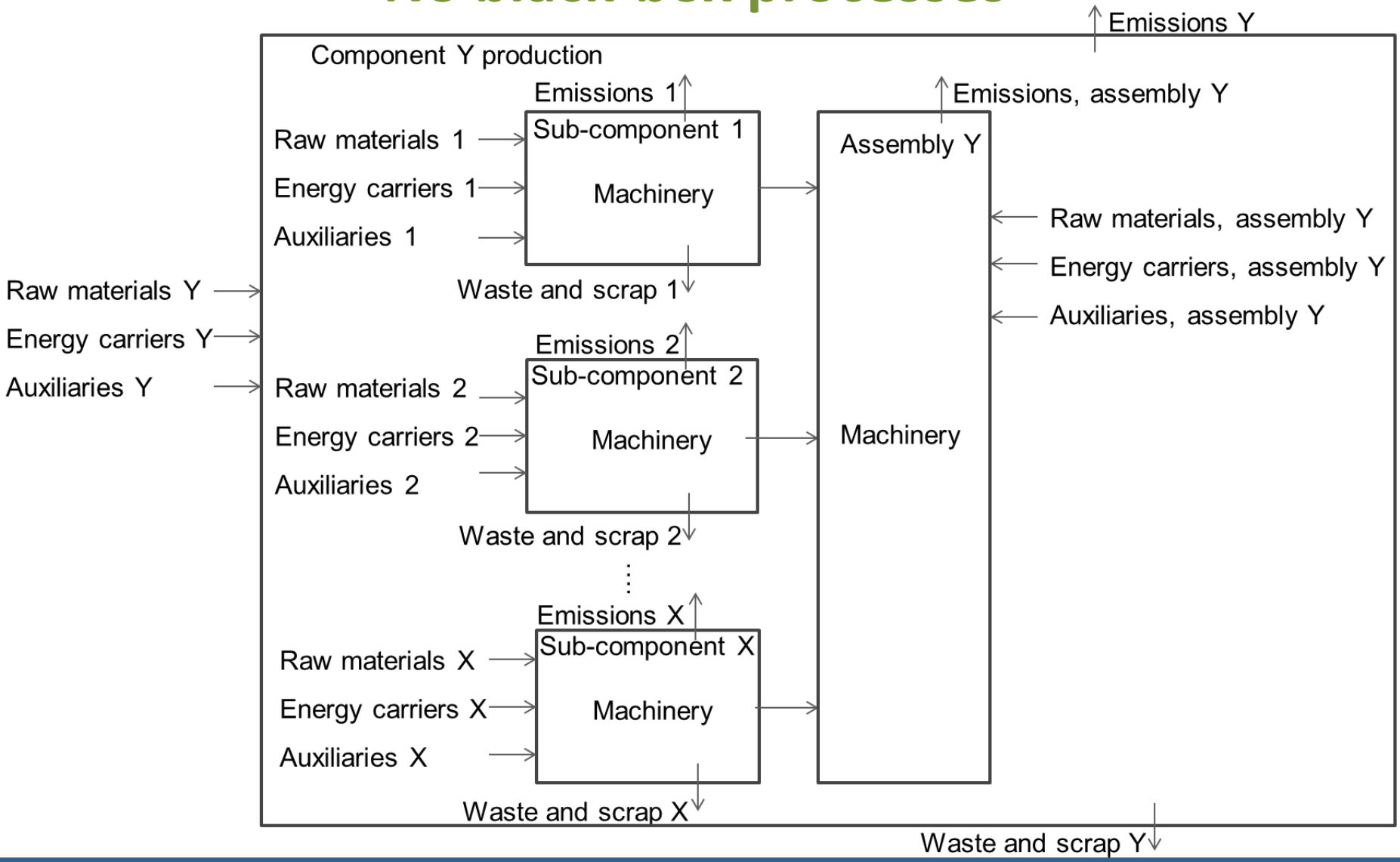
Identifying processes within the system boundaries: production phase



Modularity


Emissions, body
Raw materials, body
Energy carriers, body
Auxiliaries, body
Body production
Machinery
Waste and scrap, body
Emissions, assembly
Assembly
Raw materials, assembly
Energy carriers, assembly
Auxiliaries, assembly
Emissions, battery
Raw materials, battery
Energy carriers, battery
Auxiliaries, battery
Battery production
Machinery
Waste and scrap, battery
Machinery
Emissions, electronics
Raw materials, electronics
Energy carriers, electronics
Auxiliaries, electronics
Electronics production
Machinery
Waste and scrap, electronics

No black-box processes

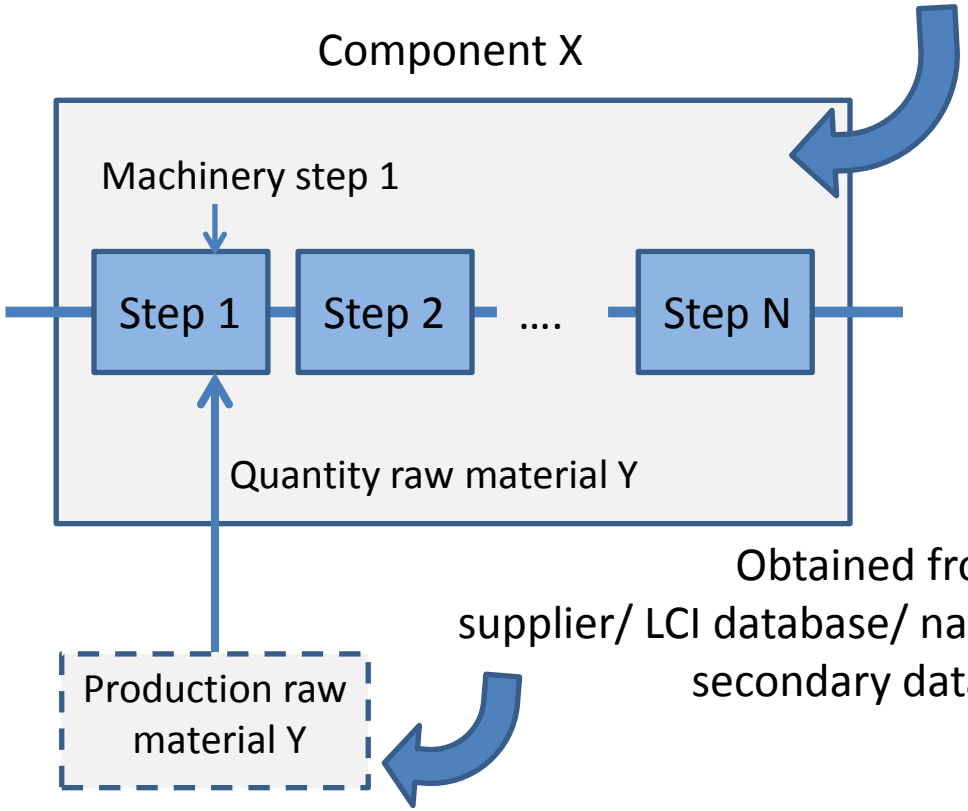


Key processes in production

- Subdivision into the key production steps
- Subdivision into the key components
- Subdivision into unit processes. Identification of:
  - Raw materials
  - Energy carriers
  - Machinery types
  - Auxiliaries/ Transports/ Other services
  - Emissions/ Wastes/ Scrap
  - …

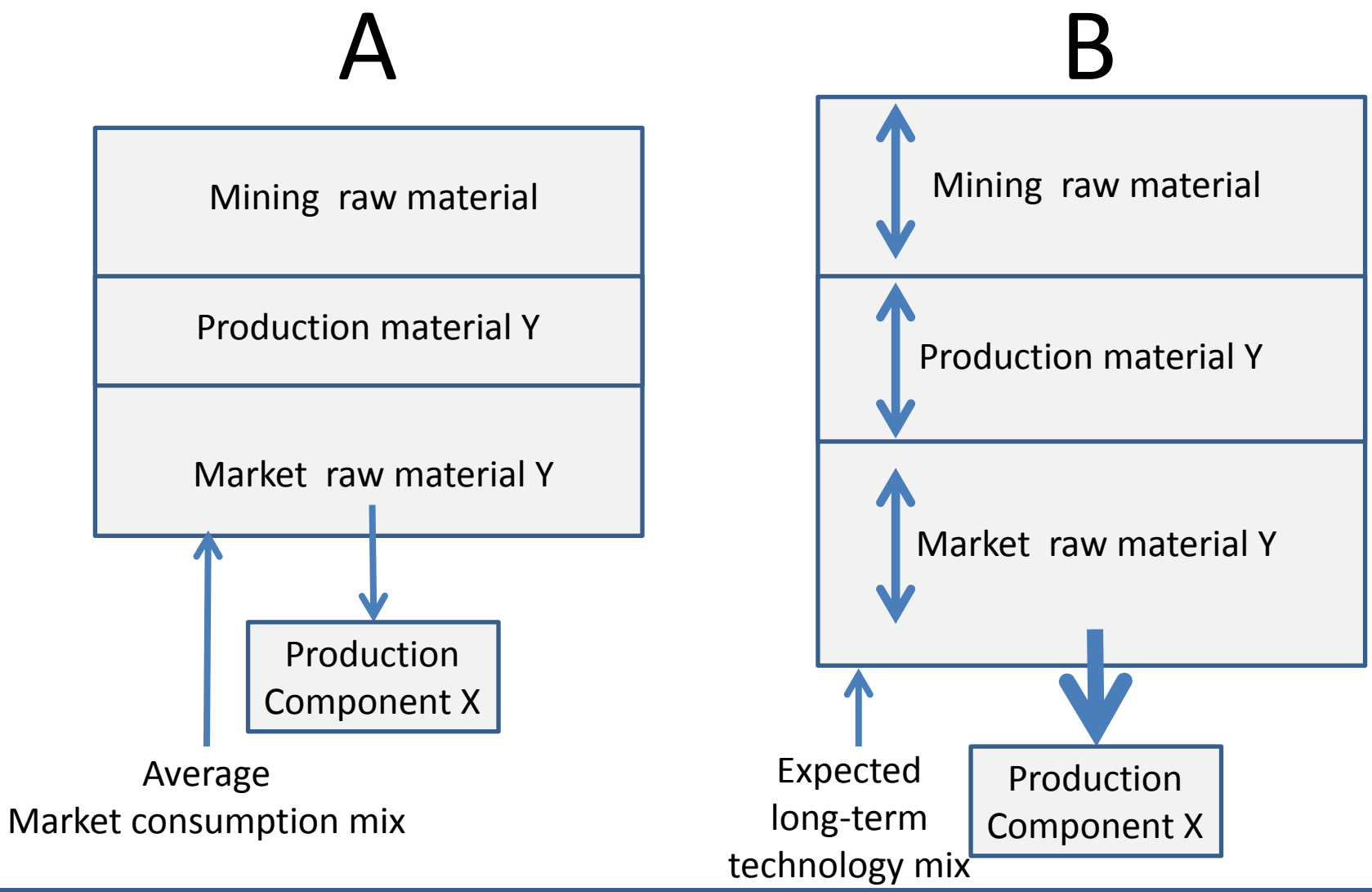
Planning data collection: primary vs. secondary data

Technology-specific primary data
from producer/ developer/ operator



Obtained from
supplier/ LCI database/ national databases:
secondary datasets

Planning data collection: background dataset type



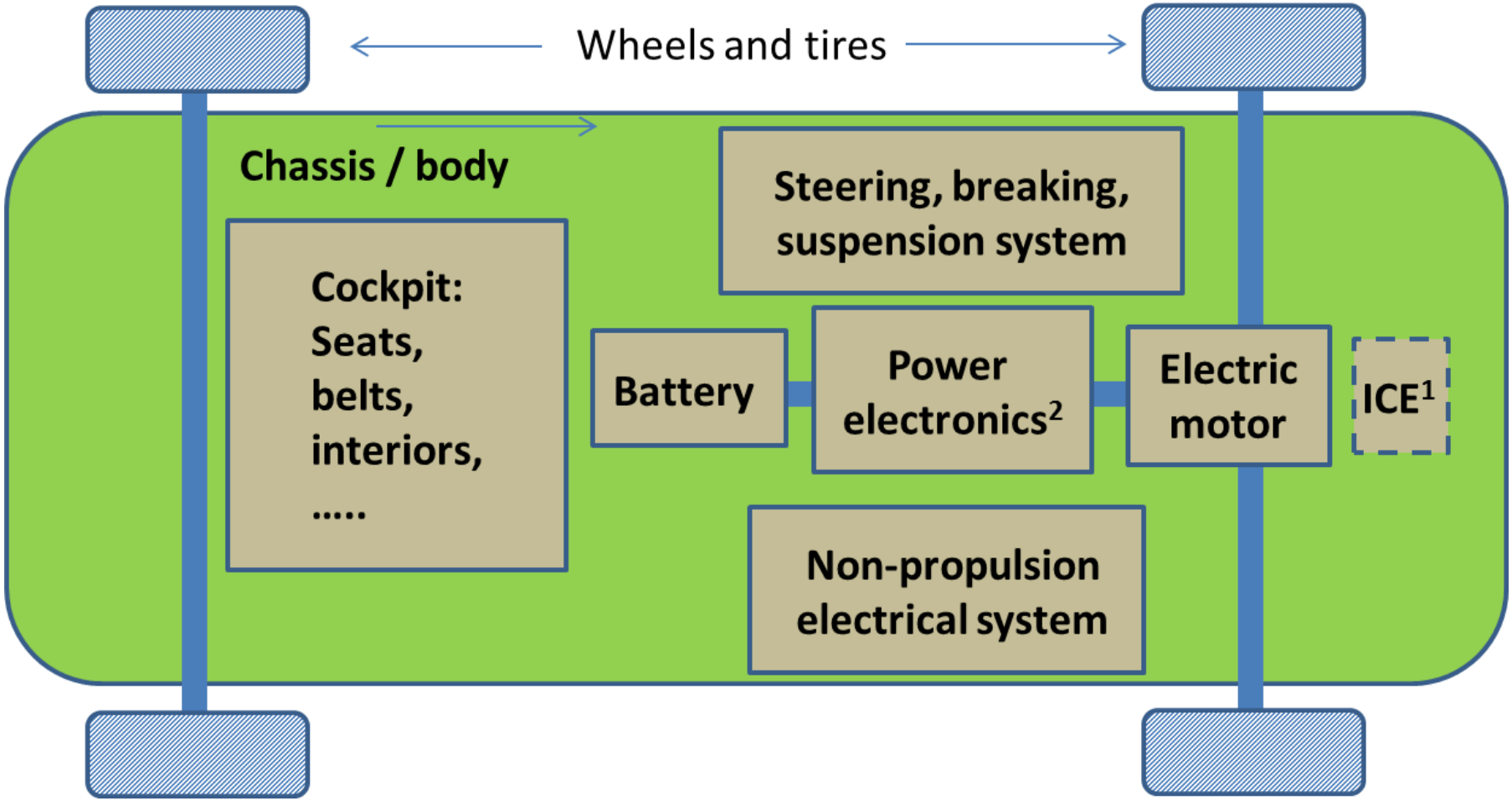
Planning data collection: consistency and selection

- Primary and secondary data: same modelling
- Secondary datasets: technological, geographical and time-related representativeness.
- Secondary datasets may be used for parts of the foreground if of better quality than primary data

Data collection

- Characterization of process
- Collection (quantitative) of all data for comprehensive technological description:
  - Types and amounts of energy carriers (e.g. kWh Electricity and specific technology mix)
  - Quantities of materials, auxiliaries, services
  - Characterization of building/ machinery infrastructure
  - Amounts of emissions/ wastes/ scraps
  - …
- Data representative of average operation conditions

Main components in the vehicle



1 for PHEV

2 Charger included in power electronics

Recommendations: battery

- Metallic electrodes: differentiation (mining, resource consumption, etc.)
- Lithium mining – future developments?
- Battery management system (electronics)

Recommendations: body, SSBS, wheels and tyres, ICE

- Large use of metals: differentiation (mining, resource consumption, etc.)
- Innovative materials (e.g. lightweight): specific production processes/efforts
- Manufacturing machinery/ efforts (heat, electricity, etc.)
- Tyres, brakes: non-exhaust emissions

Recommendations: electric motor

- Various types: permanent magnets, electromagnets
- Large use of metals: differentiation (mining, resource consumption, etc.)
- Copper in electromagnets
- Rare earths (e.g. Neodymium) in permanent magnets
- Manufacturing machinery/ efforts (heat, electricity, etc.)

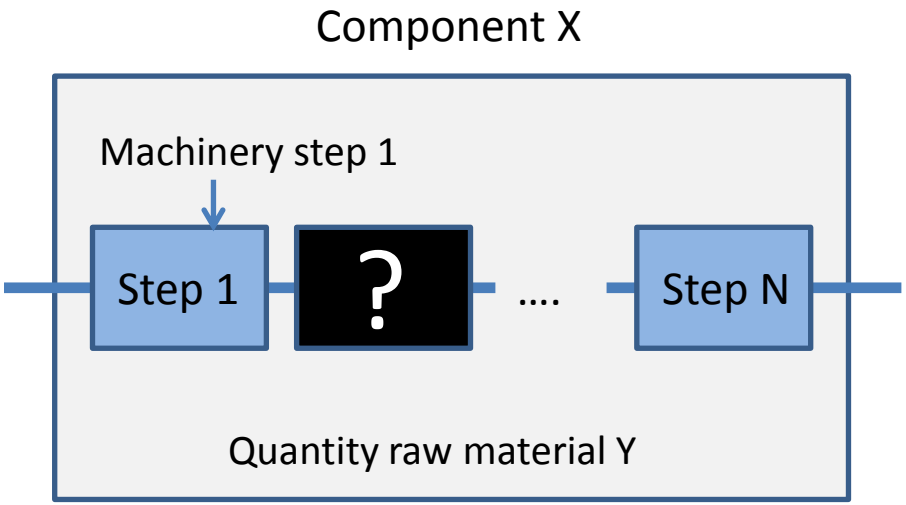
Recommendations: Electronics

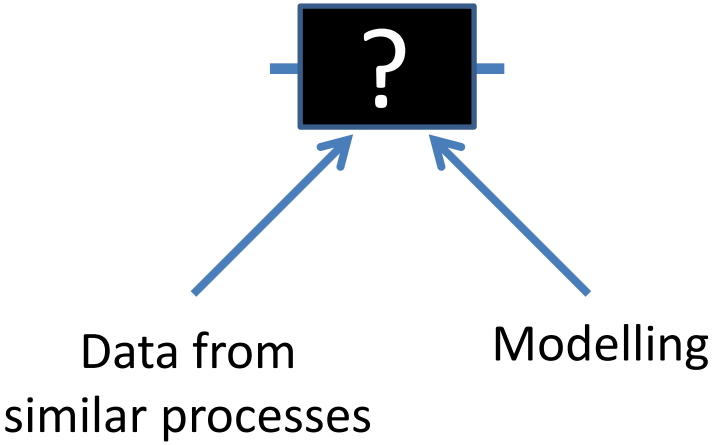
- Contains noble metals, Au, Ag, Pt, etc.: differentiation (mining, resource consumption, etc.)
- Copper in devices and cables
- Various types of manufacturing technologies (surface mount, through-hole) and corresponding devices (resistors, transistors, capacitors, printed wiring boards, etc.): differentiation (production infrastructure, efforts)
- Subdivide according to function of component.

Recommendations: Cockpit

- Large number of very different components:
  - Insulation materials
  - fabrics
  - foams
  - plastics/synthetics
- Inventory of specific materials and of their production efforts.

Filling data gaps





Future technologies

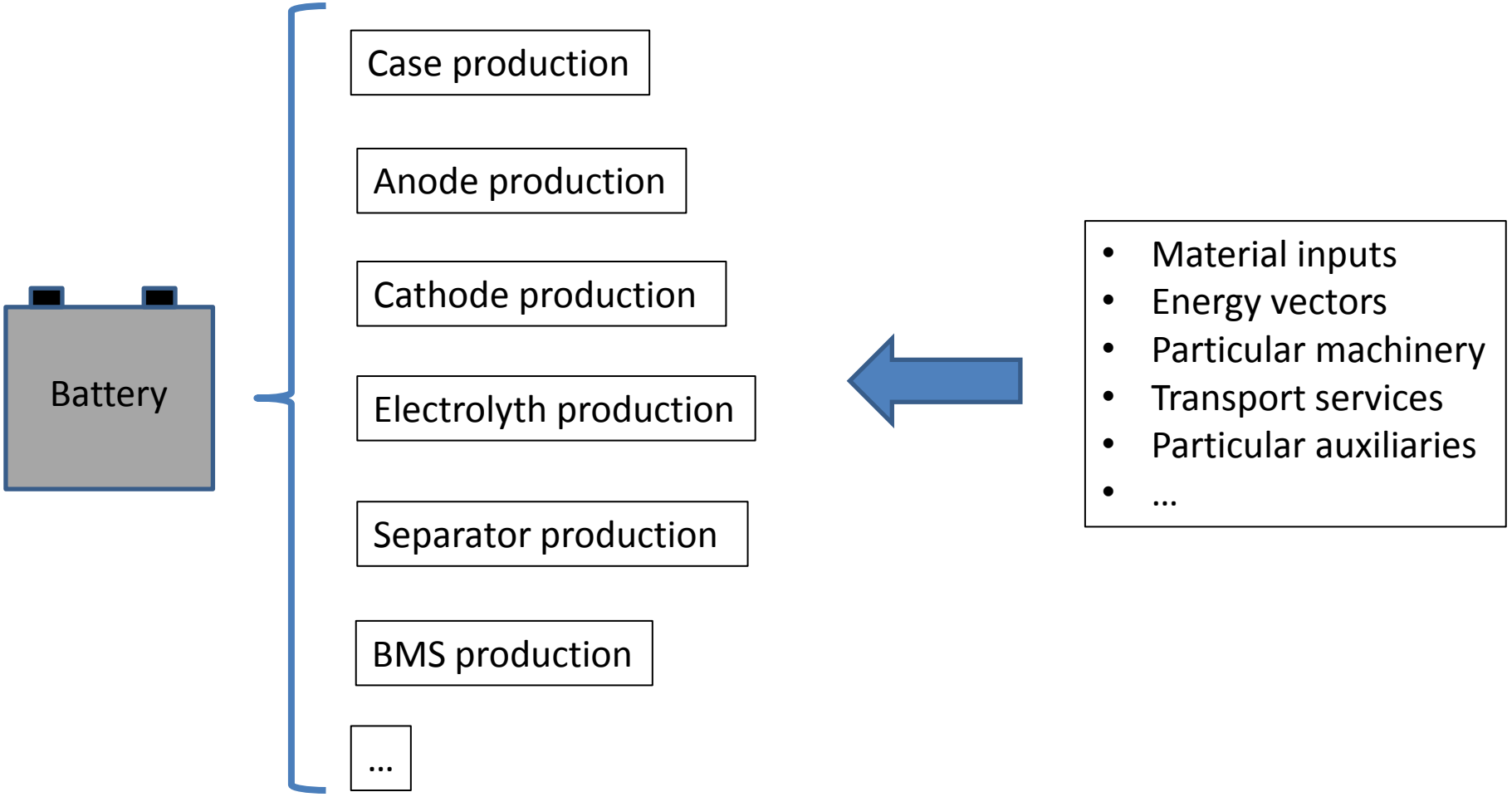
- In development, under investigation: lack of information and expertise!
- Proposed/ prototype production processes typically different to established ones: Comparison?
- Require extensive modelling for data and comparability!

Conclusions

- LCI Analysis: all relevant data for a comprehensive technological description should be collected.
- Modularity and no black-box processes.
- “Planning data collection” key for a consistent LCI
- Situation A and B have different data needs.
- Future technologies: require particular attention in modelling due to lack of data and comparability problems.

Questions?

Example: battery production 1



Example: battery production 2

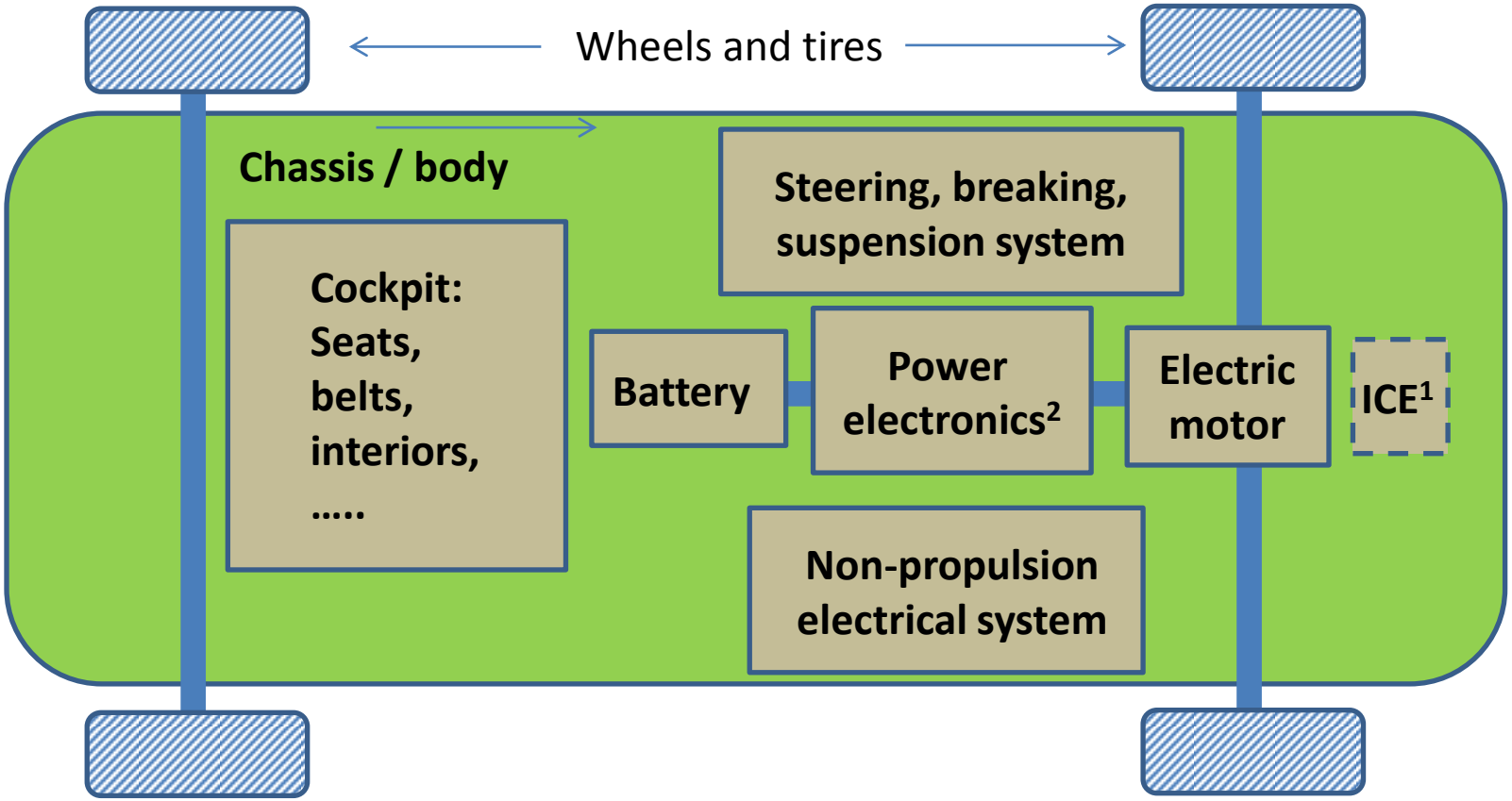
Foreground (Anode production)	Background (Anode production)
Copper	Copper, average consumption mix
Electricity	Electricity mix
Graphite	Graphite, average consumption mix
Grinding: ball mill	Ball mill dataset
…	…

Example: battery production 3

Foreground (Anode production)	Background (Anode production)
Copper X kg	X kg Copper, average consumption mix
Electricity, Y kWh, Provider …	Electricity mix, Provider …, 40% hydro,…
Graphite X kg	X kg Graphite, average consumption mix
Grinding: ball mill	Ball mill dataset
…	…

Producer/Operator/Developer

LCI Databases, national databases, suppliers



1 for PHEV

2 Charger included in power electronics

Future technologies

- In development, under investigation: lack of information and expertise!
- Proposed/ prototype production processes typically different to established ones: Comparison?
- Bottom-up approaches more appropriate
- Comparisons with established technologies need to take into account learning curves and economy of scale