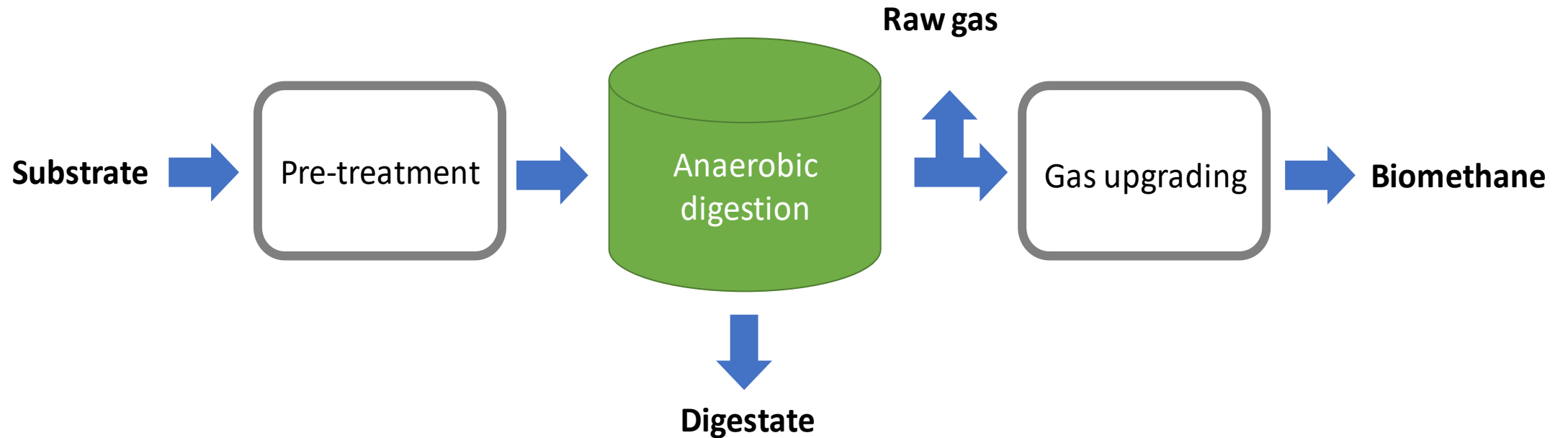


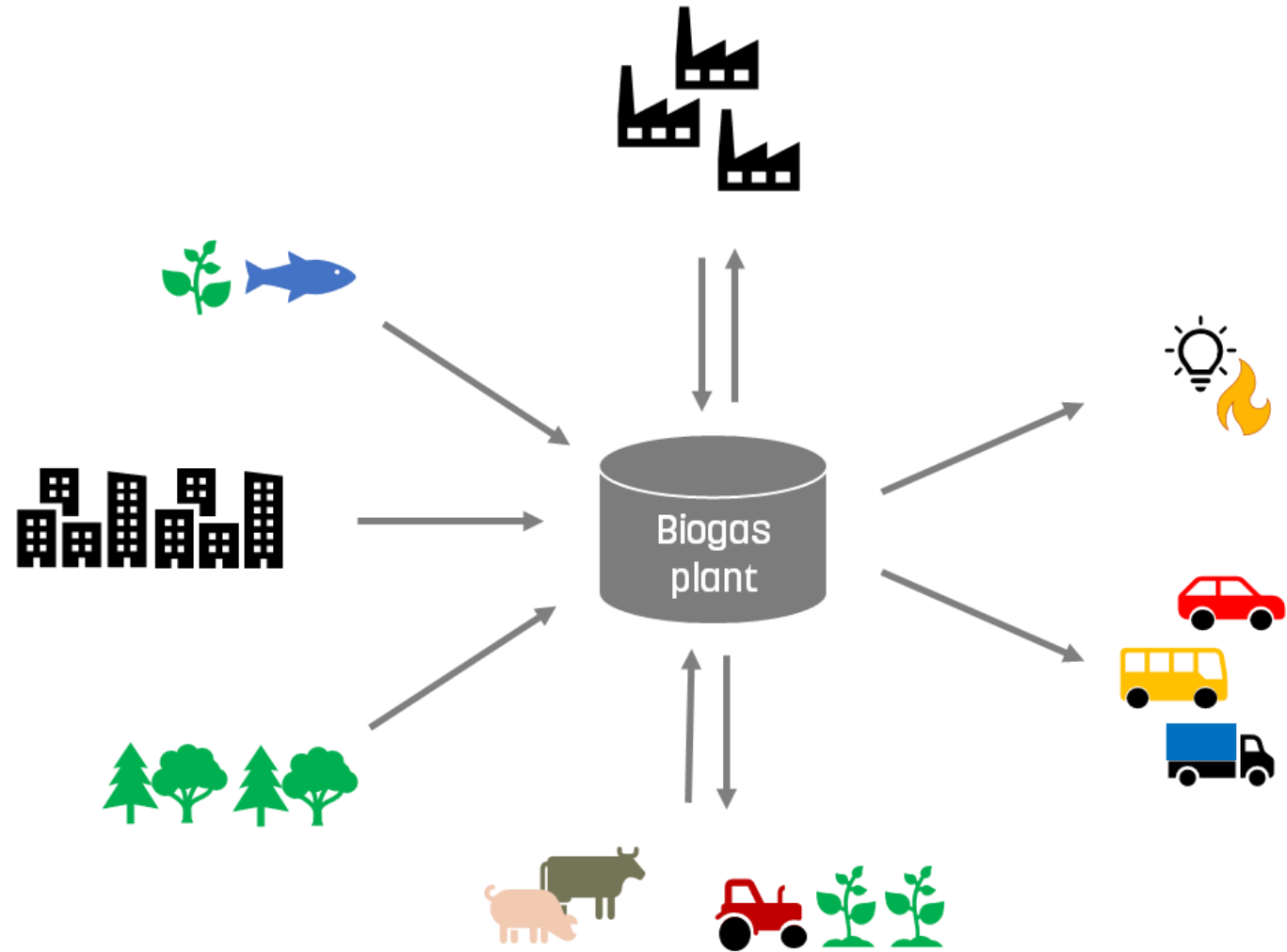
Key aspects in energy and environmental analysis of system studies

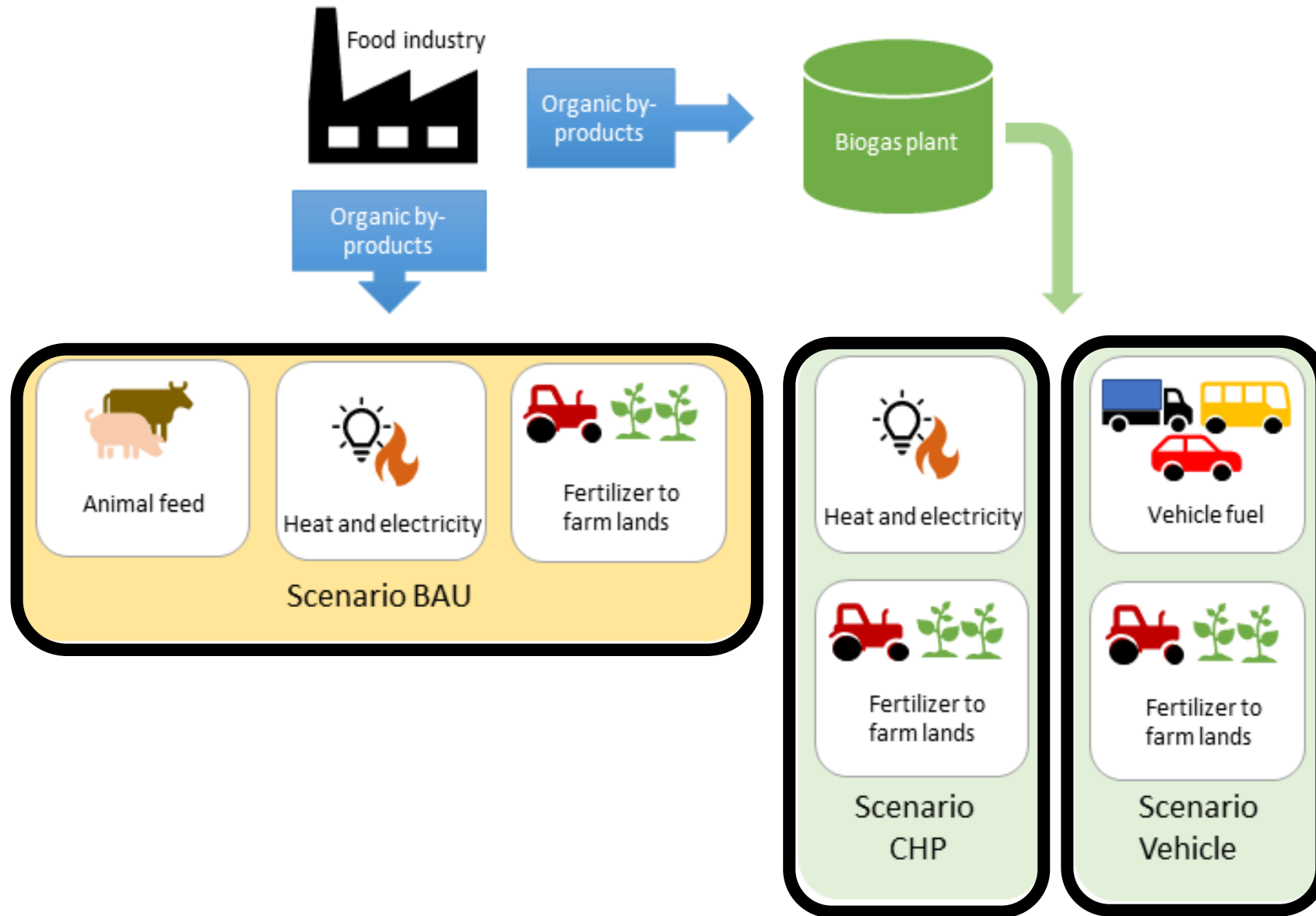
Emma Lindkvist

Biogas production

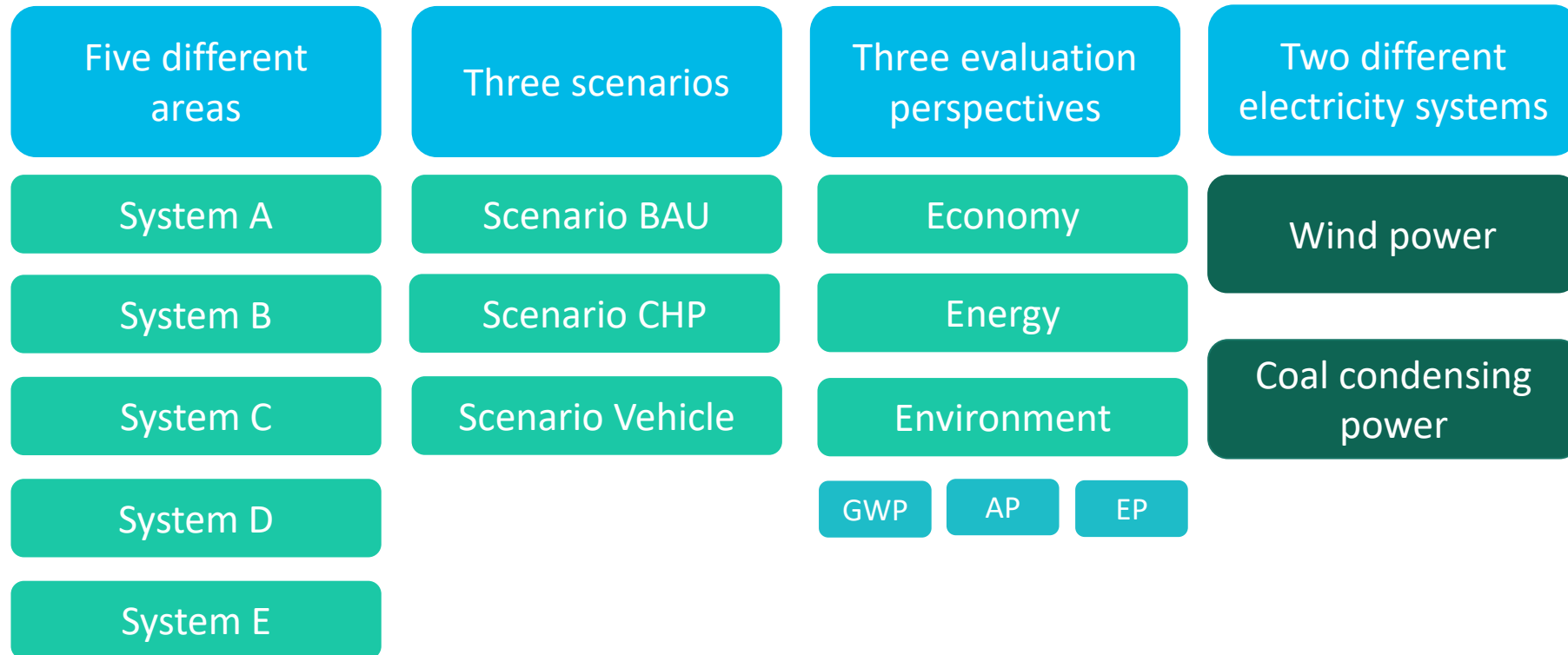


Biogas system





Key aspects



Results

| | Economy | Energy | | Environment | | | | | |
|-----------------|---------|--------|-------------|-------------|---------|------|---------|---------|---------|
| | | | | GWP | | AP | | EP | |
| | | Coal | Wind | Coal | Wind | Coal | Wind | Coal | Wind |
| System A | Vehicle | CHP | BAU | CHP | Vehicle | CHP | Vehicle | Vehicle | Vehicle |
| System B | Vehicle | CHP | BAU | CHP | Vehicle | CHP | Vehicle | Vehicle | Vehicle |
| System C | BAU | CHP | BAU | CHP | CHP | CHP | Vehicle | Vehicle | Vehicle |
| System D | Vehicle | CHP | BAU/Vehicle | CHP | Vehicle | CHP | Vehicle | Vehicle | Vehicle |
| System E | Vehicle | CHP | Vehicle | CHP | Vehicle | CHP | Vehicle | Vehicle | Vehicle |

L₄: Biogas production system plus substitution effects

L₃: Biogas production system

L₂: Extended biogas plant

L₁: Biogas plant

Anaerobic digestion and gas treatment

L_{1a}

feedstock pretreatment; hygienization, anaerobic digestion and post digestion; biogas treatment (cleaning, upgrading, liquefaction)

Digestate treatment

L_{1b}

digestate treatment (sieving, phase separation, advanced treatment)

Transports

L_{2a}

transportation of feedstock

L_{2b}

transportation of digestate and related products

L_{2c}

transportation of biogas

Provision and utilization

L_{3a}[†]

provision of feedstock (food waste source separation, sorting and collection)

L_{3b}

rejects and wastewater management

L_{3c}

utilization of digestate as biofertilizer or other soil products including storage and spreading

L_{3d}[‡]

utilization of biogas as transport fuel or for heat/power generation

System expansion

L_{4a}

substitution of mineral fertilizers or other products

L_{4b}

substitution of fossil fuels or energy carriers

(indirect) Life-cycle impacts applicable to all levels

related to provision of energy, raw materials, emissions, etc.

| No. | KPI Name | Unit | System level and sub-levels |
|------------------|---|--|--|
| KPI ₁ | Effective methane yield | Nm ³ CH ₄ (delivered) / t (food waste at source) | L ₃ excluding L _{3d} |
| KPI ₂ | Climate impact | kg CO ₂ -eq / t (food waste at source) | L ₄ |
| KPI ₃ | Energy balance | MJ (primary energy used) / MJ CH ₄ (delivered) | L ₄ excluding L _{3d} and L _{4d} |
| KPI ₄ | Nitrogen recycling potential | kg N (delivered) / kg N (food waste at source) | L ₃ (after spreading on field) |
| KPI ₅ | Phosphorus recycling potential | kg P (delivered) / kg P (food waste at source) | L ₃ (after spreading on field) |
| KPI ₆ | Enhancement of plant-available nitrogen | kg NH ₄ -N (delivered) / kg NH ₄ -N (food waste at source) | L ₃ (after spreading on field) |
| KPI ₇ | Resource cost | Euro / t (food waste at source) | L ₃ |

Conclusions

- Important to define what is included (and not included) in your system studied.
- Be transparent about your choices for others to understand your system.
- Results dependent on what is replaced in the systems studied

Thank you!

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